KENNECOTT GREENS CREEK MINING COMPANY
GENERAL PLAN OF OPERATIONS

APPENDIX 3

TAILINGS IMPOUNDMENT

Revised April 23, 2004

(Previous Version dated August 31, 2000)

TABLE OF CONTENTS

1.0 Introduction 1
1.1 Site History 1
1.2 Regulatory Background 3
1.2.1 Forest Service 3
1.2.2 Waste Management Permit 4
1.2.3 Interagency Review of Project 5
1.3 Permits and Lease 9
1.3.1 U.S. Forest Service Lease 9
1.3.2 Alaska Department of Environmental Conservation Waste Management Permit 9
1.3.3 Army Corps of Engineers 404 Permit 9
1.4 Site Characterization 10
1.4.1 Historic Geochemical Studies 10
1.4.2 Followup Geochemical Studies 11
1.4.3 Seepage Issues 13
1.4.4 Geotechnical Issues 16
1.4.5 Conceptual Model of Tailings 17
2.0 TAILINGS FACILITY OPERATION 18
2.1 Tailings Facility and Dam Structure 18
2.1.1 Introduction 18
2.1.2 Operations 18
2.1.3 Loading and Hauling 19
2.1.4 Tailings Pile Operations and Maintenance 20
2.1.5 Reclamation 22
2.2 Tailings Development 23
2.2.1 Old Pile Area 23
2.2.2 South Area 23
2.2.3 West Buttress 23
2.2.4 East Expansion 24

2.2.5 Wide Corner or Southeast Expansion 25
2.2.6 Stage 2 Expansion 25

3.0 INSPECTIONS AND MONITORING 26

3.1 Routine Inspection 26
3.1.1 Waste Management Inspections 27
3.1.2 Tails Pile Inspections 27

3.2 Compaction Testing 27
3.2.1 Tailings Facility Maintenance 28
3.2.2 Reporting Schedule 28

3.3 Emergency Action Plan 29

4.0 Tailings Internal Environmental Monitoring Program (TIEMP) 30

4.1 Purpose 30
4.1.1 Geochemistry of Tailings and Production Rock 31
4.1.2 Pore Water Chemistry 32
4.1.3 Water Flux and Cover Performance 34
4.1.4 Development and Calibration of a Water Balance/Mass Load Model 35

5.0 REFERENCES 36

Attachment A (Inspection Form)

1.0 INTRODUCTION

Kennecott Greens Creek Mining Company (KGCMC) applied for an expansion of the existing tailings impoundment in January, 2001 (Klohn 2001a). The United States Forest Service (USFS) issued a Record of Decision ("2003 ROD") on Oct 24, 2003 approving the expansion of the existing tailings impoundment area using Alternative "C" in the Greens Creek Tailings Disposal - Final Environmental Impact Statement ("2003 FEIS")(USFS 2003). With approval of the expansion based on a thorough National Environmental Policy Act (NEPA) review, KGCMC has updated the General Plan of Operation – Appendix 3 Tailings Impoundment (GPO App 3), to include references affecting the tailings facility. The previous GPO App 3 format (August 31, 2000) was utilized for this update to promote consistency with the document as we continue forward with the operation.

1.1 Site History

Tailings produced by the flotation process at the Greens Creek mill are dewatered in a filter press. Some of the tailings are placed underground as backfill. The remainder of the tailings are placed on surface in a dry tailings pile. The tailings, consisting of between 66% and 86% by weight passing the No. 200 sieve, are delivered to the tailings facility by truck. The tailings moisture content when delivered are just below the optimum standard Proctor moisture content (approximately 15%). The tailings are placed into cells, spread and compacted (Klohn-Crippen 1999a).

Construction of the Kennecott Greens Creek Mine (KGCMC) tailings facility commenced in 1988 with construction of the main and saddle dams of Containment Pond No. 6, the surface water collection system, and the finger drains. Previous to the Year 2000, the tailings were deposited in four areas, referred to as the Old Tailings Pile, the South Tailings Pile, the West Buttress and the East Expansion. Since the August 31, 2000 version of the General Plan of Operations, Appendix 3, KGCMC has added tailings capacity on the Southeast side of the tailings pile with a lined containment structure over a previously used quarry area in Year 2002. A summary of tailings pile development follows:

- Tailings placement began in early 1989 starting in the northwest corner of the Old Tailings Pile progressing south and east. In 1993, tailings placement ceased with the suspension of mining operations for a period of approximately three years. A total of approximately 735,000 yd^3 of tailings were placed in the Old Tailings Pile between 1989 and 1993.

- During the period of shutdown approximately 75,000 yd^3 of development rock was placed over the Old Tailings Pile to limit erosion during the inactive period. In August 1995, a temporary geomembrane was placed over the Old Tailings Pile at the North end of pile.

- The mine re-opened and tailings placement resumed in July 1996. Tailings placement started north of revised stormwater pond system (Containment Pond No. 6 Berm) located south of the Old Tailings Pile. The dry tailings placement area was expanded during this time in conjunction with changes to the water treatment system in the south impoundment area. Removal of the temporary geomembrane cover proceeded with renewed tailings placement in the northern section of the pile in 1997.

- Construction of a stabilizing berm (West Buttress) for the Old Tailings Pile commenced in late 1998. The West Buttress is being raised on a prepared foundation and continues to be an active placement area

- The construction of an East Expansion (May 2000) was completed and was the primary placement location to late 2002. This site added approximately 4 acres to the pile footprint. A construction summary was submitted to the USFS for this area (Klohn 2000a)

- The construction of an HDPE-lined area in 2002 was the latest area to be constructed to maintain tailings placement capacity. The liner was placed over an old quarry area to limit infiltration of contact water down into the fractured quarry floor. A design report and a construction summary were submitted to the USFS (Klohn 2001b, Klohn 2002a).

- With the expansion approval, KGCMC plans to develop the site to minimize the overall footprint needed to maintain operational capacity to continue operations, by increasing the height of the pile. KGCMC site development and tailings placement methods will remain unchanged as water diversions and contact water controls, along with cell placement and compaction methods will continue on, as is the current practice. KGCMC plans several phases of construction over the next few years to increase the tailings placement capacity to match the current mine plan reserves. By constructing in this manner, KGCMC continues the historic development philosophy of not overbuilding the facility, to minimize disturbances. The phases of construction are planned to initiate in 2004 with quarry work, infrastructure changes (truck wash relocation) and construction of additional tailings placement area in the Southeast corner of the pile.

- Additionally, KGCMC is required to investigate the biological sulfate reduction processes to determine if application of an additional available carbon source could enhance the water quality of contact water from the pile as explained in the “2003 FEIS”.

1.2 Regulatory Background

1.2.1 Forest Service

The Final Environmental Impact Statement (“83 FEIS”) for the Greens Creek Project (Figure 1) was completed in 1983. Eight alternatives were identified in the “83 FEIS” with number six being selected as the preferred alternative. Under the preferred alternative, tailings generated by the milling process would be transported and disposed as slurry into a settling pond within a 150 acre tailings basin.

In 1988, two major changes were introduced by Kennecott Greens Creek Mining Company (KGCMC) regarding development and operation of the mine. The proposed changes were addressed in the 1988 Environmental Assessment for Proposed Changes to the General Plan of Operation for the Development and Operation of the Greens Creek Mine (EA). Under the EA proposed action alternative, tailings generated by the milling process would be dewatered at the mill site and transported by truck to a smaller dry tailings basin. Wastewater from the mill site would be transported through an eight inch, single-walled, high-density, polyethylene (HDPE) pipeline to a 3.5 acre settling pond within the tailings basin. The Greens Creek Mine Tailings Impoundment was constructed according to guidelines consistent with the 1988 EA Decision Notice. In 2003, the USFS approved an expansion of the tailings impoundment area from the previously permitted tailings footprint area of 29 acres to approximately 62 acres (Figure 2). Standard development and placement methodologies at the existing tailings area (Figure 3) have been established and will be continued for the construction of the expanded tailings pile.

The tailings facility design and operation has been reviewed by Klohn-Crippen Engineering acting as consultants to KGCMC in 1998, 1999, 2000, 2001, 2002 and 2003 (Klohn-Crippen 1998, 1999a, 1999b, 2000a, 2001a, 2002a and 2003a). All design modifications and other pertinent findings of the Klohn-Crippen studies have been incorporated into this plan.

1.2.2 Waste Management Permit

Mining wastes are categorically exempt from regulation under the Alaska waste management program unless they pose a potential "welfare threat or environmental problem associated with the management of the waste". The state of Alaska made the determination that tailings placed in the dry tailings stack is subject to the chapter 60 solid waste requirements, which include the need to acquire a permit. Mining waste is regulated under the monofill standards 18 Alaska Administrative Code (AAC) section 60.455 which allows the department discretion to incorporate applicable provisions of 18 AAC 60 into a waste management permit. A waste that is not specifically addressed in Article 4 (i.e. tailings) will be classified by the ADEC and assigned the most applicable waste category.

The waste management permit contains applicable provisions of Article 1 and 2 (60.010 to 60.265) that have to do with general standards, limitations, prohibitions and administrative procedures to be followed by every disposal facility regulated under the chapter. Additionally, the waste management permit will apply relevant locational, operational, and design related requirements from the monofill standards in Article 4 (18 AAC 60.400 to 60.495.) The monofill requirements also include closure and post-closure care deed notations, notifications, monitoring and reporting.

Furthermore, the Greens Creek facilities are subject to Article 6 (18 AAC 60.700 to 60.730) which have to do with user fees and Article 7 monitoring and corrective action requirements (18 AAC 60.800 to 60.865). In Article 7, monitoring requirements specify visual, surface water and groundwater requirements. Detection monitoring is also required under Article 7. If a significant statistical difference exists between upgradient and downgradient or if the water quality standards are exceeded in detection monitoring, then assessment monitoring will be triggered. Assessment monitoring will require the plume be identified and the owner/operator identify and implement remedial corrective measures according to 40 Code of Federal Regulations (CFR) 258.55 to 258.58. Lastly, the facilities at Greens Creek are open to waivers to any provision of the chapter under 18 AAC 60.900 upon adequate demonstration and ADEC discretion.

1.2.3 Interagency Review of Project

In 1999 and 2000 State and Federal Agencies with jurisdiction over the mine in association with KGCMC arranged a third-party assessment of the risk of acid drainage and metal release, and a review of the freshwater monitoring plan (SMI 2000). As part of their review, the third-party consultant reviewed and revised the appendices to the General Plan of Operations relating to tailings, production rock, reclamation, and the freshwater monitoring plan in August 2000. In 2001, KGCMC applied for a tailings impoundment expansion, which was evaluated through the NEPA process. The development of the “2003 FEIS” by the Inter-Disciplinary Team consisting of Federal, State and Local Agencies utilizing a third party contractor resulted in a thorough examination of all aspects of tailings disposal at KGCMC. The USFS released the “2003 ROD” supporting Alternative “C” in the “2003 FEIS”. To proceed with expansion construction, the GPO App 3 is updated for continued operation.

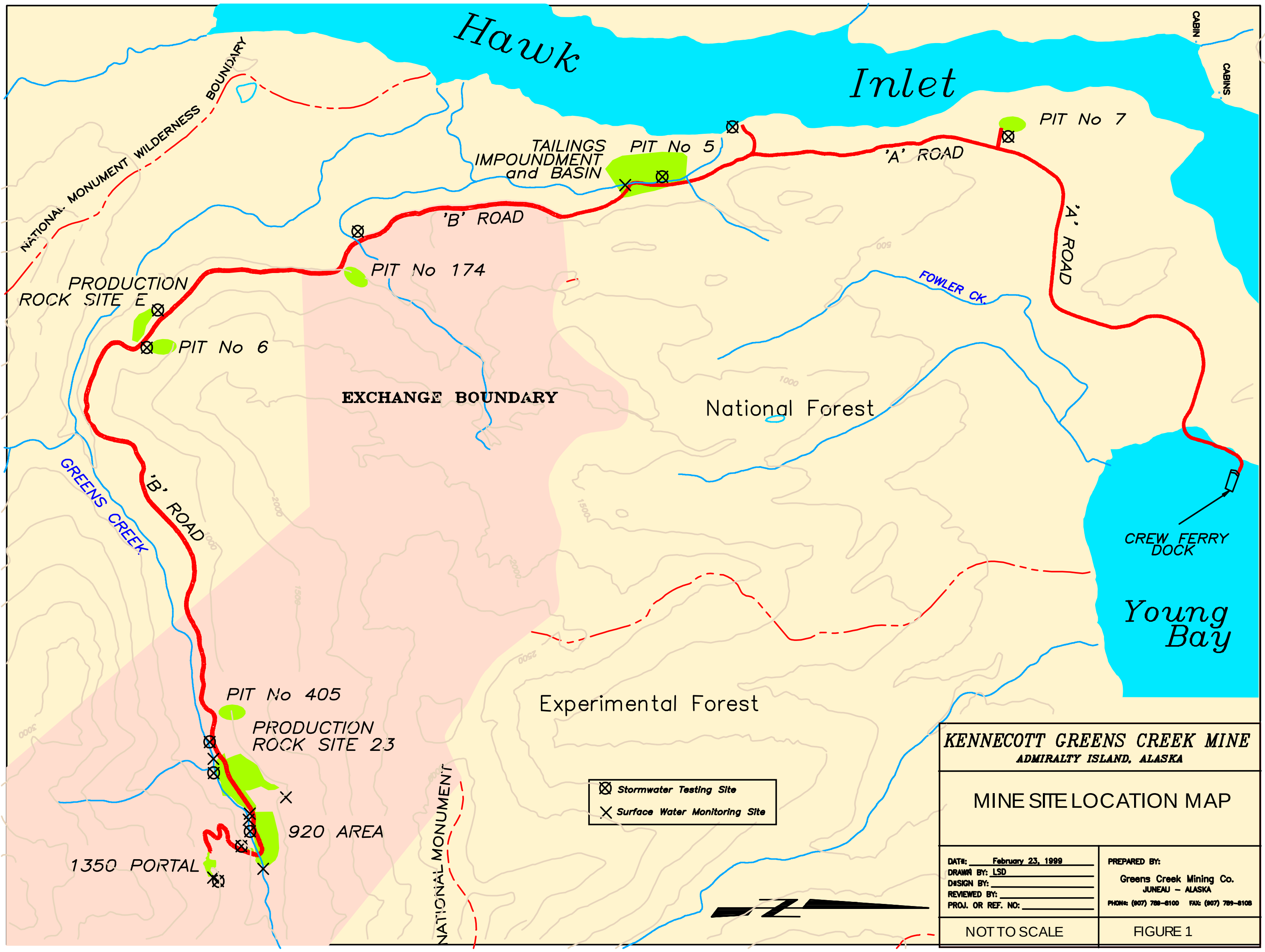

Figure 1. Location of the Kennecott Greens Creek Mine on Admiralty Island, Alaska

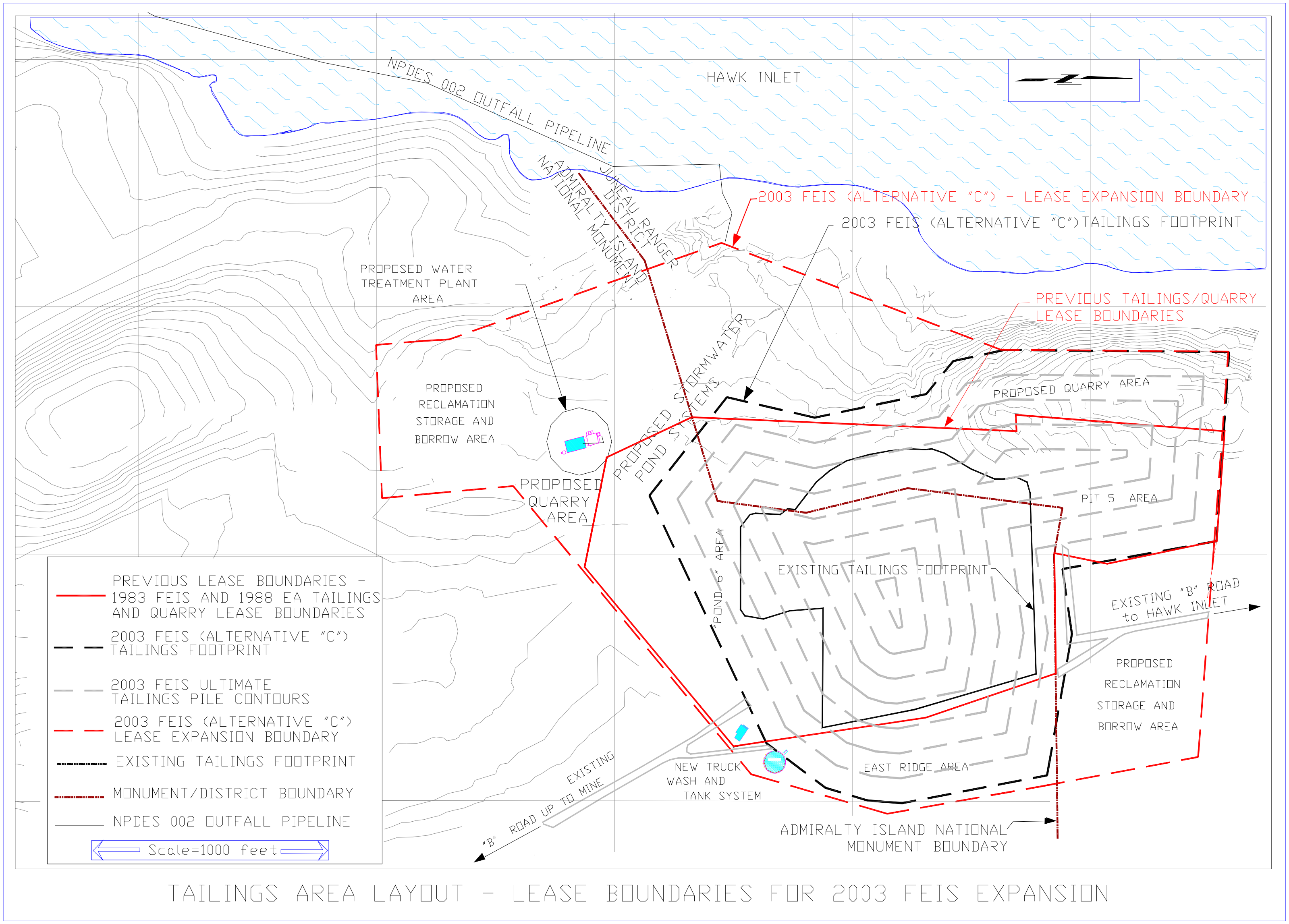

Figure 2. Tailings Facility Layout at the Kennecott Greens Creek Mine

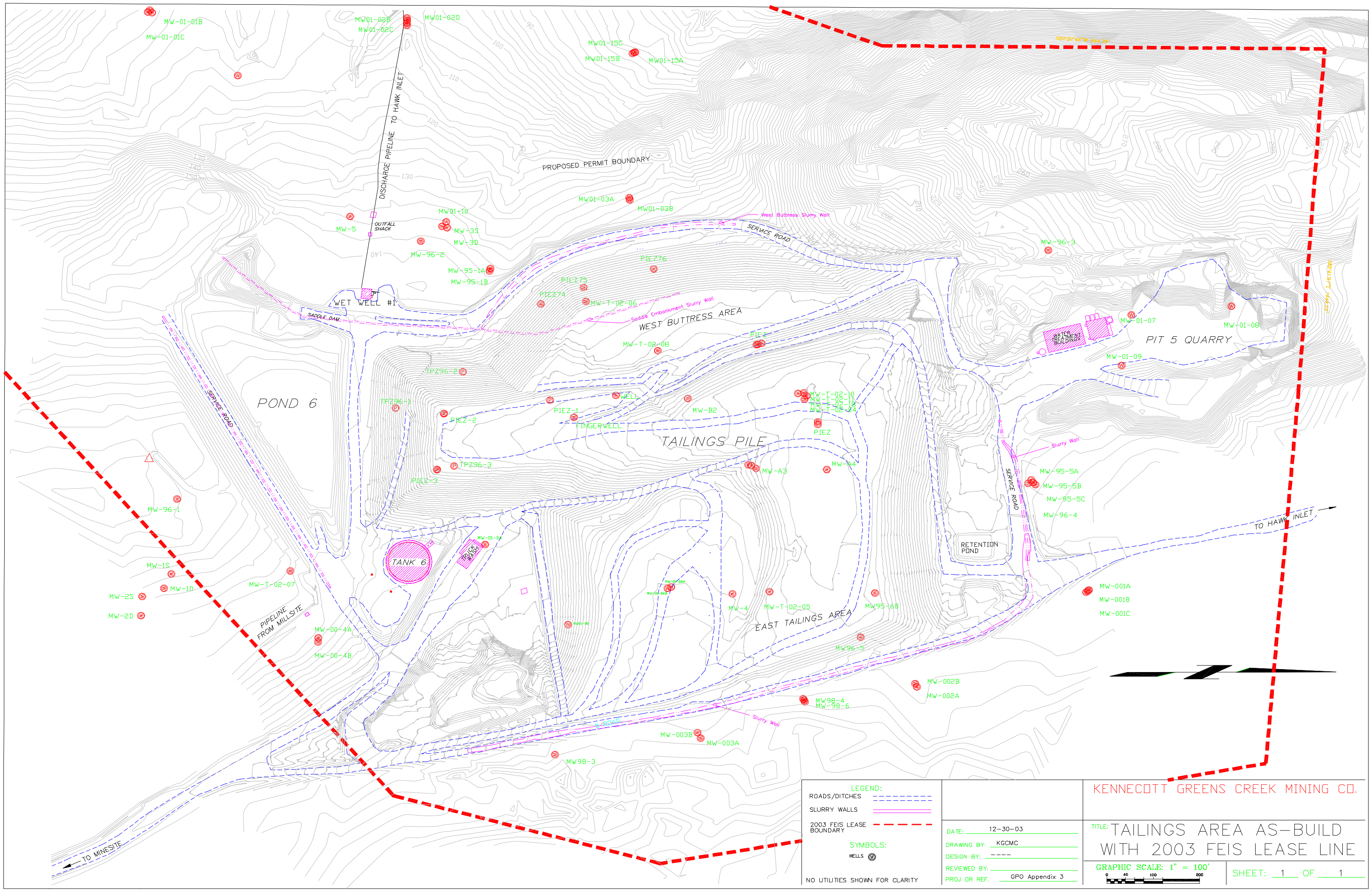

Figure 3. Tailings Area As-build with 2003 FEIS Lease boundary

1.3 Permits and Lease

1.3.1 U.S. Forest Service Lease

In September of 1988 the U.S. Forest Service issued lease number 4050-10 to Greens Creek Mining Company. This lease covered 39.89 acres for the purpose of constructing, operating and maintaining wastewater and tailings disposal systems for the Greens Creek Mine. In April of 2004 the U.S. Forest Service issued an amendment (#1) to the above lease. The newly amended lease for the tailings impoundment covers approximately 123 acres with 68 acres within the Admiralty National Monument (ANM) and 55 acres outside the ANM. Disposal of sewage sludge and residue from incinerated solid waste is approved within the tailings area consistent with State authorization and Forest Service approval of such plans.

1.3.2 Alaska Department of Environmental Conservation Waste Management Permit

In November of 2003, the Alaska Department of Environmental Conservation (ADEC) issued Waste Management Permit # 0211-BA001 to KGCMC. This permit replaces the previous Solid Waste Permit #0111-BA001 received in August 2002. The new permit was issued in parallel to the Federal NEPA review and addresses the tailings expansion as well as the other designated waste management sites at KGCMC. See Section 1.2.2 for a general description of the permit purpose. This permit allows the placement of 5.3 Million Cubic Yards (9.6 Million tons) of material in the expanded tailings facility which at full build out will have a tailings footprint area of 62.2 acres.

1.3.3 Army Corps of Engineers 404 Permit

In June of 1988, the original permit for the construction of the tailings containment dams, on land leased by KGCMC from the Forest Service, was granted by the United States Army Corps of Engineers (USACE) permit #4-880269. In December of 2003, the USACE issued permit #N-1988-0269 [Hawk Inlet 1] authorizing the tailings expansion project work. In conjunction with the USACE permit, ADEC issued a Certificate of Reasonable Assurance and the Alaska Department of

Natural Resources issued a Final Consistency Determination in regards to the project expansion. Under the Corps permit, regular dam inspection schedules are to be maintained, with the Alaska Department of Natural Resources providing regulatory oversight. Dam inspections are further discussed in Section 3.

1.4 Site Characterization

The geochemical characteristics of tailings are an important factor that affects the design, monitoring and environmental performance of the dry tailings. The Greens Creek deposit is a high-grade sulfide-hosted poly-metallic mine. Silver, zinc, lead and gold are recovered from processed Greens Creek ores. Consequently, pyritic sulfur levels are elevated in the flotation tailings. Geochemical studies have been conducted throughout the life of the mine to better understand the nature of tailings material at Greens Creek.

1.4.1 Historic Geochemical Studies

The Environmental Assessment (1988) outlined the test work required to characterize the mill tailings and evaluate its potential to produce acid, and create an acid drainage. Two tests were developed, a monthly pH check of the main finger drains to determine pH changes inside the pile, and a formal leach test characterizing the acid-producing potential of the tailings.

From July 1989 to February 1991, the pH of the drains generally ranged from 6-7. The finger drains were covered in February 1991 by the construction of additional pond capacity at the tailings facility. Efforts to uncover the drains were successful in 1994. The finger drains were redirected to Wet Well #2 which is monitored on a monthly basis. Static tests and kinetic leach tests of tailings were initiated in 1989. Results are contained in reports by BCRC (1990) and ASCI (1991). A series of laboratory static tests showed that the tailings had a potential to become acidic after weathering. Subsequent kinetic tests instead showed that the tailings had only a slight potential to form acid because of their slow reaction rate. The tailings sample had 12.1% pyritic S yielding an acid generating potential (AGP) of 379 t/1,000 t as $CaCO_3$. The sample had an acid neutralizing potential (ANP) of 244.8 for an overall Net Neutralization Potential (NNP) of –135 t/1,000 t as $CaCO_3$. Static test results such as these would normally be indicative of an acid generating sample.

In addition to the kinetic tests that indicated little ARD risk, BC confirmation tests (BC AMD Task Force 1989) showed the sample to have an acid-generating risk estimated to be none to weak. Both humidity cells and column tests showed an initial release of stored metals and acidity but solutions subsequently became neutral in pH and decreased in metals. These test results together indicated a low acid generating risk in the tailings. Dr. Adrian Smith (ASCI 1991) reviewed the tests results reported by BCRC (1990) and agreed with the conclusion that tailings would likely maintain an alkaline pH in the field and presented only a slight long-term potential for acid generation. The column and humidity cell tests indicated that elevated levels of zinc could be released, especially during the early stages of leaching when accumulated products of oxidation were mobilized.

1.4.2 Followup Geochemical Studies

Followup geochemical testing of production rock, ore and tailings from the Greens Creek deposit in 1994 (KGCMC 1994) indicate that many of the materials have the potential to become acidic. However, owing to the abundance of calcium carbonate or dolomite in the samples (generally ranging from 10 to 60%), a very long period of weathering, estimated at more than 10 years in lab tests, would have to occur prior to development of acidic conditions. Before mining, the lag period was estimated to be more than 10.8 years. Work by Condon on production rock from Greens Creek (1999) suggests the lag time is variable and that 15 years may be typical. These estimates of lag period were based on modeling results of laboratory observations of pyrite oxidation. Actual oxidation rates are likely to be much less under field conditions due to passivation of reactive surfaces, reduced oxygen supply and lower temperature. Consequently, the average lag period (before generation of acidic pH levels in the majority of potentially acid generating rocks) is probably in the range of at least 20 to 50 years. The lag period will probably be longer in tailings than in production rock because of the accumulation of oxidation products in tailings and the diminished capacity for oxygen transport. It is also possible that oxidation reactions in either the production rock or tailings facility will slow to the point that acidification never occurs. The reclamation and closure methods being developed for the mine are designed to increase this likelihood.

Even under the neutral pH conditions that are expected to prevail for tens of years in Greens Creek tailings, significant concentrations of soluble metals, especially zinc, may be released in a soluble form into water contacting the tailings. Consequently, water leaching through tailings may contain elevated zinc, and to a lesser degree other metals, such as cadmium, nickel and lead and metalloids such as selenium and arsenic.

Static test (Figure 4) and paste pH results for 1999 grab samples (Figure 5) were consistent with the findings of the 1994 sampling effort. Tailings samples have an abundance of sulfide S (generally greater than 10%) but also have a high acid neutralizing capacity. The elevated ANP indicates that acidic conditions should not form during operation of the facility, allowing closure practices to provide long-term prevention of ARD. All measured paste pH values were above 6.5, and the majority ranged from 7.5 to 8.5. The results of ongoing characterization and monitoring are summarized in annual reports (KGCMC 2002, 2003). These data support the opinion developed during baseline studies that lag period would provide sufficient time to operate and close the facility without producing acid rock drainage.

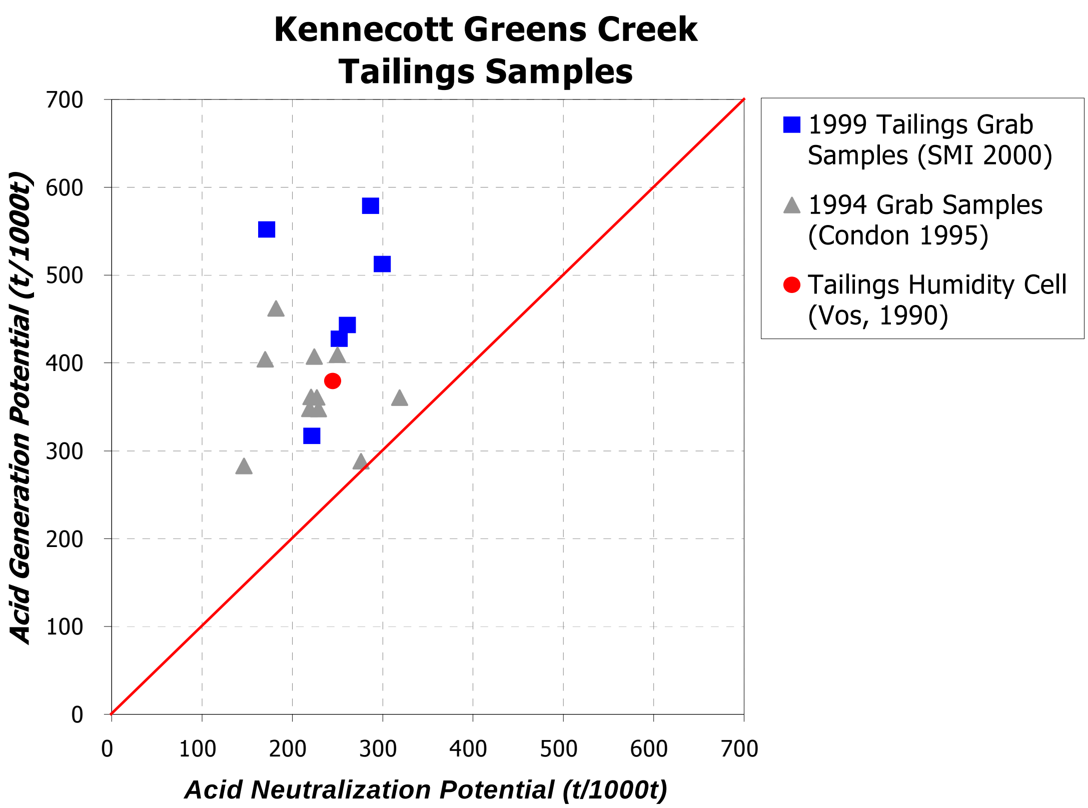

Figure 4. Net neutralization potential of various 1999 grab samples collected from the Greens Creek Mine facilities compared to analysis of 1994 grab samples from KGCMC 1995.

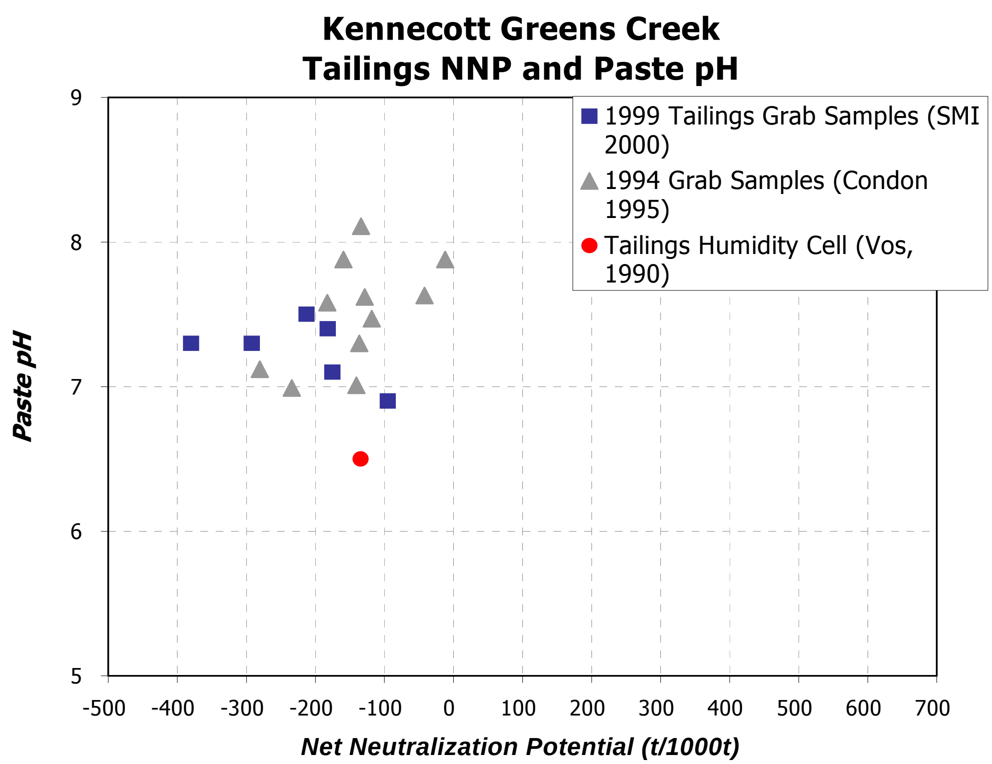

Figure 5. Paste pH and net neutralization potential of various 1999 grab samples collected from the Greens Creek Mine facilities.

The conclusion of the ARD and metal leaching evaluation by SMI (2000) was that there are three principal issues that affect ARD and metal leaching from the Greens Creek tailings facility including the siting and design of the individual facility, the operation of the facility, and reclamation and closure. Aspects of the facility design, operation and closure that serve to minimize ARD and metal leaching risk are described in this Appendix. Refer to the Reclamation Plan, Appendix 14 of the General Plan of Operations, for discussion of mine closure.

1.4.3 Seepage Issues

Prior disposal practices in the original tailings pile allowed development of saturated zones within the tailings pile. During a temporary closure of the mine (1993-1995) a PVC cover was placed over portions of the tailings to reduce infiltration. Subsequently, water levels decreased within the pile. When the cover was removed from portions of the pile in 1995, water levels subsequently increased indicating that water levels are responding to vertical infiltration of meteoric water.

A detailed conceptual flow model was developed for the tailings site (EDE, 1997, 1999, 2002a). The models incorporated generalized lithologies, including the tailings, underlying discontinuous peat, sand and till layers and bedrock. Included also in the models were the other hydrologic features such as natural drainage's, and the various man-made features that form parts of the functional facility, (e.g. drains, ponds, and slurry walls).

Water quality data were available on the chemistry of the east and west tailings drains from 1995 (Figure 6). Although the east drain was higher in zinc than the west drain, the water quality for each drain was consistent with the chemistry of contact water predicted in earlier studies by Vos (1990), having neutral pH and zinc in the range of 1 to 80 mg/L, with most samples near the lower end of this range. Pore water samples collected from the tailings in 1999 at a depth of about 4 feet also had neutral pH and somewhat lower zinc (2 to 3.5 mg/L) than measured in drains in 1995. More recent data presented in annual reports are consistent with previous results.

These data indicate that drains in the tailings facility collect a combination of groundwater underflow and water infiltrating through tailings. Additionally, the quality of water is consistent with the geochemical predictions developed during mine permitting, water is near-neutral and contains elevated levels of zinc and to a lesser degree other metals. These data indicate that oxidation is occurring in the tailings, and that carbonate dissolution maintains the pH near neutral.

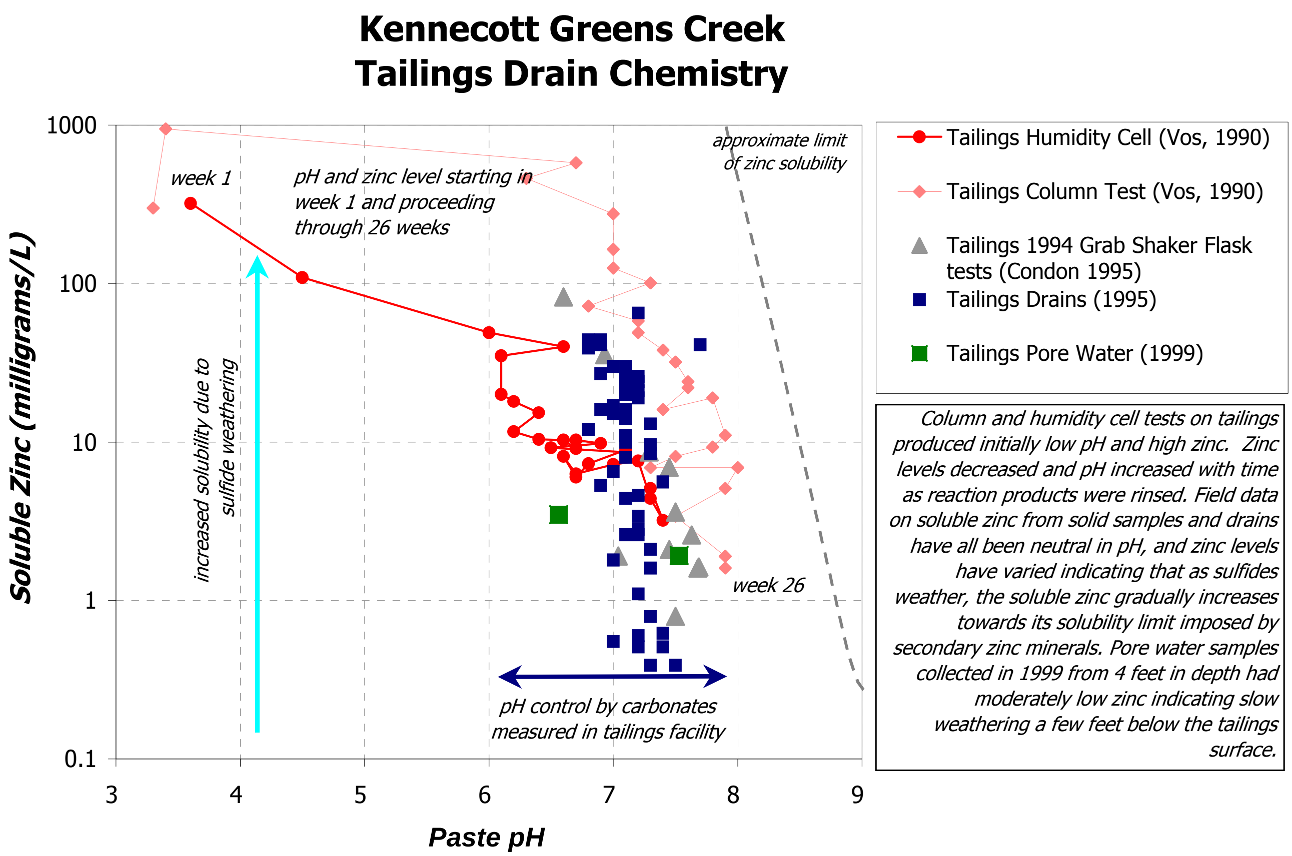

Figure 6. Chemistry of water in drains, seeps and pore water collected at Greens Creek in 1999.

1.4.4 Geotechnical Issues

Extensive in situ investigations of the tailings pile have been conducted since establishment of the pile (Klohn-Crippen, 1999, 2001c, 2003a). Work has included cone penetrometer testing (CPT) and standard penetration testing (SPT), in addition to test trenching, within the tailings and into the shallow foundation materials beneath the tailings.

Klohn Crippen completed stability analyses from this investigatory work to evaluate the current stability and projected long-term stability of the pile expansion to Elevation 330' or 160' above native ground. The analyses employed shear strength parameters based on correlations using the information derived from the CPT and SPT work. Assessments included static and pseudostatic conditions, and liquefaction potential. Seismic events considered included both the design basis and maximum credible events. Results of the static stability analysis found an adequate factor of safety with the tailings as designed. The dynamic stability analysis indicated that there was a low but quantifiable risk of modest displacement of the tailings mass (up to 12 feet) with the occurrence of the design basis earthquake.

As a result of the evaluations, modifications in the tailings placement methods have improved the operational placement methods. The modifications are a part of the continuous improvement programs that have optimized compaction and minimized development of saturated conditions in the active placement areas. Construction of the vehicle access causeway, and the cellular methodology employed, appear to be the key aspects of the plan that contribute to its success. The construction of the west buttress will improve slope stability based on the analyses (Klohn-Crippen 1998). The lateral extent of access roads is minimized to limit the formation of localized saturated zones caused by infiltration into the more permeable road rock.

Design of the tailings expansion as described in the "2003 FEIS" was evaluated based on maintaining the stability criteria set forth in all approved design reports by Klohn-Crippen (1998, 1999a, 1999b, 2001a, 2001b) and KGCMC utilizes industry standard construction practices to construct the facility expansions with third party construction engineering firms used to confirm construction practices (Klohn-Crippen 2000a, 2002a). KGCMC will continue this practice to maintain well designed facilities in the future expansions.

1.4.5 Conceptual Model of Tailings

Following dewatering in the mill, tailings are placed in the permanent disposal facility in a manner similar to an aboveground landfill. Approximately 50 percent of the tailings are used for underground backfill and the remainder is placed in the surface tailings facility. Design and operational management of the tailings facility is meant to keep the tailings geotechnically stable and water control systems are designed for diversion around the impoundment or collection within the impoundment. Contact of the tailings mass with groundwater is minimized by the slurry wall installed upgradient of the facility and a network of finger and blanket drains installed beneath the tailings. Additionally, the fine texture, compaction, and unsaturated nature of the tailings also reduces ARD potential by minimizing flow and limiting diffusion of oxygen. This is to be achieved by compacting the tailings and grading the surface to promote runoff. At closure, a composite soil cover (as explained in the “2003 FEIS”, Section 2.2.5 (USFS 2003) and also in the ADEC Waste Management Permit, Section 2.4.9.1) that reduces infiltration of meteoric water and oxygen is to be placed over the facility then followed by revegetation to stabilize the site and to prevent long-term ARD by minimizing seepage and oxidation processes.

The planned expansion of the tailings pile and facilities will continue to utilize the successful stability measures, placement methods and water control systems as in prior tailings development. The overall height of the pile will be increased to minimize the pile footprint and new stormwater systems will replace the existing systems as the pile expands. Some infrastructure changes will occur as a result of the expansion of the pile footprint, which may expand to an ultimate area of 62 acres.

In the “2003 FEIS” and the “2003 ROD”, the USFS is requiring that KGCMC undertake a sulfate reduction monitoring program to generate an analysis to address the usage of supplemental carbon additions to the pile. The “2003 FEIS” thoroughly explains the purpose of this requirement for implementation at the tailings pile.

2.0 TAILINGS FACILITY OPERATION

2.1 Tailings Facility and Dam Structure

2.1.1 Introduction

The purpose of this section is to identify specific operations and maintenance requirements for the safe operation of the tailings impoundment.

The purpose of the tailings structure is twofold:

- Collection from containment area's of storm and process water prior to treatment and subsequent seawater discharge under the NPDES permit, and
- Receipt and placement of dry tailings. Procedures for tailings disposal are included in Section 2.1.4.

This section meets the requirement for a low hazard Class D structure. The dam classification is contained in the U.S. Forest Service Special Use Lease 4050-10 approved September 1, 1988. The section also complies with ADNR Certificate of Approval for Dam Safety No. 88-4 approved May 6, 1988; and Certificate No. 89-7. Any new planned installations for expanded stormwater impoundments will be designed and approved by these appropriate agencies prior to construction. Structures anticipated to be constructed include the containment structures for the stormwater ponds, additional infrastructure and tailings placement area.

2.1.2 Operations

The current facility is operated by the KGCMC Operations Group and is maintained within the guidelines of the GPO App 3. The overall tailings facility includes water collection, storage and treatment systems, which receive collected water from overall mine containment systems. The facility also is the depository for tailings, production rock and other materials as per the permits and leases described in Section 1.3.

The current impoundment is operated to receive overflow from Tank 6 that will generally be comprised of storm and wastewater from the 920 mill site, Site 23/D, the Hawk Inlet facilities and the dry tailings placement area. All water from the upper 920 mill site and Site 23/D is transported in a set of two pipelines along the "B" Road to the tailings area. A single pipeline transports all collected waters from the Hawk Inlet facilities to the tailings water treatment systems. KGCMC will be increasing the size of the capture area in the tailings area as the pile expands and all expanded facilities will be included as extensions of the current systems. Third party reviews (EDE 2002a, USFS 2003a) have updated flow handling estimates for storm water systems in association with the expansion and closure of the tailings area. In the ADEC Waste Management Permit, it is required that KGCMC upgrade current storm event capture design from 10 year/24 hour to 25 year/24 hour capacities and this change will be incorporated into the designs.

In addition to tailings solids from ore processing, the tailings facility is permitted for placement of non-hazardous wastes from the site including production rock, sediments removed from de-gritting basins and settling ponds, ditch sediments, dewatered sewage sludge, sediment from the wastewater treatment plant, incinerator ash, and residue from combustion of wood waste and camp wastes.

At current mill capacity, the Greens Creek Concentrator generates approximately 1,800 dry tons of filter-pressed tailings a day. Approximately 50 percent are mixed with cement and trucked underground for placement in the backfilling process. The remainder of the tailings (planned at approximately 50 percent) are trucked to the tailings impoundment area for disposal. Tailings being transported are dewatered to approximately 15% moisture content by dry weight (Klohn-Crippen, 1999, 2003a), which is slightly below the optimum moisture content. Regular precipitation events thus increase the moisture content of these materials roughly equal to the optimum compaction moisture content.

2.1.3 Loading and Hauling

The tailings are loaded at the concentrator loadout area into lidded-trucks utilizing a front-end loader. The loadout area is part of the 920 mill site containment area. Runoff from the tailings loading area is routed to a containment/collection system and is not allowed directly into Greens Creek or any other water body. When loading tailings, operators' exercise care to minimize tailings spillage, thus reducing tailings accumulation and potential runoff.

Currently, KGCMC transports the mill tailings in 45-ton capacity covered maxhaul tractor/trailers. These units comply with the U-80 design loading specified for the bridges on the road. Each truck is inspected daily for mechanical and safety items to assure the tailgate is functional to prevent spillage, the rubber seal around the tailgate is in good condition, and trailer covers are in place and in good working order. All conditions must be in proper working order or the trailer will not be used. Other options for haulage is the use of a smaller size truck with covers during the maintenance of the larger trucks or to supplement the daily haulage. Operators are thoroughly trained on truck operations prior to driving alone and a safety zone is maintained along the road via radio communications for trucks to pass by each other.

Truck loading to 45 tons requires 20 round trips per day and will vary based on the daily underground tailings placement. The road surface is kept in good driveable condition for either option (see, GPO Appendix 8 Road Operation and Maintenance Plan). During thaw periods, it may be necessary to restrict operations temporarily, or reduce payload to prevent road degradation and dust control will be performed as necessary. If tailings are spilled along the roadway, they will be immediately recovered and placed in the tailings facility.

If operations are curtailed (i.e., transporting tailings), the tailings will be stored at the load-out site. The load out site is covered and has a storage capacity for approximately 24 hours of production. If that time limit is exceeded, moving tailings underground will receive priority until the road can accommodate normal traffic, or the tailings impoundment can accept additional tailings material.

2.1.4 Tailings Pile Operations and Maintenance

The surface group incorporates industry standards for equipment operation and maintenance through training and coordinating activities through job plans, work orders and prioritization. Engineering and environmental monitoring are coordinated with the operations group to ensure compliance to design and water quality issues.

Water drainage and collection systems are operated at low storage volumes to maintain stormwater capacity in the pond systems. This water operational philosophy will not change with the expansion of the facilities. Operations will maintain preparedness for storm events and capacity of storm water capacities to the most extent.

Daily area observations are made by personnel working in the tailings area. No formal daily inspection sheet is utilized by the operations group, but daily operator coverage and observations by the operators ensure the tailings perimeter is safe for tailings placement and/or spreading. Two operating groups are in the area daily and perform normal rounds of the major components of the facility. The Surface Operations Group places and maintains the facility, while the Water Operations group operates the water treatment systems. The shift supervisor is contacted prior to tailings placement if abnormal conditions are noted. During severe conditions, tailings placement will stop until suitable conditions occur. Also, the Environmental Department performs a monthly inspection and records the inspection using a standard inspection form (Attachment A).

Tailings placement procedures were adjusted in 1999 as a result of the review by Klohn-Crippen (1999a) and the recommendations of Klohn-Crippen adopted by KGCMC follow:

The current placement method was developed and implemented by KGCMC and will remain as the primary method of placement for the remaining years of the pile construction. The method involves placing the tailings in a cellular format. In this method, tailings are placed in discreet cells, which allow better control over compaction, drainage control and pore pressure dissipation. The key to the success of this method is the management of the surface water, especially during the periods of high rainfall. A summary follows:

An access road is constructed and the pile is divided into a number of cells. Prior to placing the tailings, any saturated tailings on the placement surface are cleaned off. The tailings are placed in a small area and loads are recorded by cell. The tailings are spread into a sloped one-foot lift and compacted by several passes with a bulldozer followed by at least two overlapping passes of the vibratory roller. If the delivered tailings cannot be placed and compacted upon arrival at the tailings pile, the tailings are stockpiled to minimize any additional moisture absorption (or drying during warm periods) to occur. This will help ensure that the tailings remain at the optimum moisture content prior to placement and compaction. During placement, the top surface of the cells are graded, to allow surface water to run off, and sealed as best as possible to minimize ruts or indentations, so that infiltration into the placed tailings is minimized. Due to the limited placement area, lifts can be adjusted to maximize cell placement and slope consistency. Placement then progresses to another area. This allows for any construction pore pressures that build up in the originally placed tailings to dissipate.

Crossroad construction is dictated by tailings compaction. Successful compaction will support haul truck traffic making it practical to remove some or all of the planned crossroads from the design unless excess moisture is present.

Maintaining drainage is an on-going activity and is based on the pile configuration and active placement area. Protection of tailings from erosion is a main operational concern that KGCMC addresses as needed by directing runoff to armored/rocked areas, road ditches and outside slopes, and cleaning ditches as sediment accumulates. As the pile expands, KGCMC will continue to incorporate applicable sediment control measures to limit tailings erosion.

2.1.5 Reclamation

The dry tailings facility is built in thin lifts and will attain a maximum thickness of 160 feet under the "2003 FEIS". Consequently, the opportunity to concurrently reclaim portions of the facility is limited to completed sideslope areas where the toe of the tailings have reached the permit limit, and where access is no longer required. The area of disturbed and reclaimed acreage within the facility shall be reported to the USFS in their annual report. Interim reclamation methodology, as described in GPO Appendix 14, Section 1.6.1 – Reclamation Plan, for operational periods includes temporary soil and rock armoring, hydroseeding and best management practices employed by KGCMC at the tailings facility.

For final reclamation, production rock or other materials will be utilized to initially layer over the final tailings pile configuration at a thickness of 12" minimally. Materials or rock used for this final layer cover of the tailings should have an NNP value of greater than 100t/1,000t $CACO_3$, unless determined otherwise from best technology development. After the initial material is placed, placement of an engineered cover and revegetation will begin (see GPO Appendix 14). Final overall grade of the dry tailings pile will be 3H:1V for closure purposes. During the operational periods, slopes will be maintained to industrial standards to ensure the safety of workers and geotechnical stability of the slopes. KGCMC submitted a slope evaluation to the regulatory agencies addressing the operational period at the tailings pile (Klohn-Crippen 2003b), in particular along the south slope of the existing pile, which is at 2.75:1 slope, but is covered with a temporary soil cover, is vegetated and is adjacent to the northern pond berm.

2.2 Tailings Development

The Tailings pile has incrementally progressed to meet the mine plan needs for surface tailings disposal since 1989. Thorough descriptions of the site are contained in the “2003 FEIS” and the annual reports submitted to the USFS and AEDC. A brief overview follows:

2.2.1 Old Pile Area

Located in the north central portion of the existing tailings pile, tailings were placed here during the Years 1989 – 1993. It was constructed within the guidelines of the 1988 EA and included underdrains, drainage ditches and a pond system. A water filtration plant was constructed in the early 1990’s and in 1993, the operation temporarily ceased placing tailings at the site. In 1995, the pile had a production rock cover added to it and a temporary geomembrane was placed on the pile to minimize water infiltration.

2.2.2 South Area

In 1996, KGCMC re-commissioned the operation and added a water treatment facility to eliminate the passive water treatment system. KGCMC also extended the underdrain systems to support a southern extension of the tailings pile, which also included additional slurry walls and water diversions. Tailings placement initiated in 1996 in this area.

2.2.3 West Buttress

The West Buttress was constructed west of the Old Tailings area and has a slurry wall along the western perimeter that extends from shallow bedrock in the north to the saddle embankment slurry wall at Pond 6. This area continues to be an active tailings placement area. The key components of the West Buttress development were:

- Extension of the existing French Drain to the north.
- Relocation of the surface water interception ditch on the existing pile.
- Installation of a temporary wet well at the south end of the French Drain.
- Removal of peat and loose gravelly sand to expose till or bedrock foundation materials.
- Placement of drainage blanket and finger drains.
- Installation of filter cloth over drains.
- Relocation of services.

Tailings are placed in the West Buttress in the same manner as in the Active Tailings Pile. Details on the construction of the West Buttress are contained in Klohn-Crippen (1998).

2.2.4 East Expansion

Construction of the East Expansion Area, described by Klohn-Crippen (1999b), was initiated in 2000. Maximum slopes on the outside perimeter of the East Expansion will not exceed 3H:1V. The components of the East Expansion include:

- Construct surface water diversions to collect and divert non-contact water around the facility.
- Place a slurry wall interception and collection system to divert non-contact groundwater around the facility.
- Create a collection system to convey contact water to the water treatment plant.
- Develop a drain system to prevent contact with groundwater, maintain low phreatic levels and to collect seepage.
- Relocate a short stretch of the B-Road and all utilities.

Tailings will be placed in the East Expansion in the same manner as in the Active Tailings Pile. Details on the construction of the East Expansion are contained in Klohn-Crippen (1998).

2.2.5 Wide Corner or Southeast Expansion

Construction of the Southeast Expansion Area, described by Klohn-Crippen (2001b, 2002a), was initiated in 2002. The components of this expansion include:

- Installation of a HDPE liner and sub-drain over an old quarry area to reduce the contact water infiltration into the quarries fractured bedrock surface.

- Drainage and collection systems to collect seepage water.

- Construct surface water diversions to collect and divert non-contact water around the facility.

2.2.6 Stage 2 Expansion

In January of 2001, KGCMC submitted an expansion proposal to the USFS resulting in the “2003 FEIS” and the “2003 ROD”. KGCMC plans to continue the incremental expansion of the tailings pile to support continued operations. The development plan will reflect and follow the established standards that have successfully enabled KGCMC to continue operations (see Section 1.4.5). The expanded tailings footprint will be constructed to coincide with the direct mine plan needs to limit over building the site and the height increase for the pile will minimize the overall footprint.

KGCMC will supply annual detail construction design updates to the regulatory agencies and construction schedule updates in the annual reports. Standard construction methodologies have previously been implemented at the tailings facility and will continue to be applied to the expansion phases. KGCMC submitted specific design criteria to the agencies as part of the expansion proposal (Klohn 2001a) and will maintain standards criteria with all future designs.

In 2004, four (4) phases of construction are planned: quarry work, infrastructure changes ((i)truck wash relocation and (ii) utility relocation), and construction of additional tailings placement area in the Southeast corner of the pile.

3.0 INSPECTIONS AND MONITORING

3.1 Routine Inspection

The following observations and visual inspections are required by the U.S. Forest Service lease, the Alaska Department of Environmental Conservation who administers the waste management program, and the ADNR Dam Safety Certificate, and are an integral part of the overall operations and maintenance of the tailings impoundment. Additional construction quality assurance and water quality monitoring requirements are described in more detail in subsequent sections.

USFS

- Inspection by a qualified engineer every two years for the life of the structure;
- Inspections following earthquakes, major storms, or over flow (other than spillway); and

ADEC

- Daily recording of the volumes and types of waste placed in the facility;
- Monthly inspection of seepage from the pile and of leachate collection and surface water diversion systems.

ADNR

- After initial inspection - every five years by qualified engineer. An inspection is due by the end of 2004.

Daily observations in conjunction with monthly, and special inspections will be used to check for cracks, bulging, and settling. These or other abnormal conditions may trigger additional technical safety inspection(s) or initiate the development of alternative inspection protocols.

Inspections will be recorded on the attached form (see Attachment A) derived from the ADNR Division of Land and Water Management, Visual Inspection Checklist, Alaska Dam Safety Program. Records of visual inspections will be kept in the Greens Creek Environmental

Department files. Certified Engineer inspections will also be kept on file and a copy submitted to the USFS and ADNR.

3.1.1 Waste Management Inspections

The Alaska Department of Environmental Conservation Waste Management Permit #0211-BA001-contains all associated inspection and reporting requirements in Section 6 of the permit.

All records of visual monitoring inspections and corrective actions taken are maintained by the KGCMC Environmental Department, and are available on request. Refer to the General Plan of Operations Appendix 7 for the waste management permit conditions and stipulations.

3.1.2 Tails Pile Inspections

Daily observations are conducted by tailings pile operators as previously stated in this section and Section 2. Records of abnormal conditions are maintained on employee time cards. As-built drawings of the tailings basin, which show standardized cross-sections, will be provided to the Forest Service and ADEC within the annual reports.

3.2 Compaction Testing

Klohn-Crippen (1999a) developed the following testing program for the dry tailings.

A minimum of six (6) readings from the nuclear densitometer is required for each test site. Due to the fine-grained nature of the tailings, the nuclear densitometer cannot correctly measure water content. Consequently, if an incorrect water content value is used, then dry density of the tailings will also be calculated incorrectly at that location. To correct this, the measured water content of tailings samples were compared to the densitometer readings to derive a correction factor. This corrected water content is then used in conjunction with the wet density from the nuclear densitometer, to determine the correct dry density of the tailings.

The level of compaction achieved is based on the ratio of measured to maximum dry density. To determine this ratio, the calculated dry density is compared to the maximum achievable dry density, commonly known as the standard Proctor maximum dry density. Prior to a 1999 Klohn-Crippen site, visit an average standard Proctor value of 132 pounds per cubic foot (pcf) was used to compare against the measured dry densities, even though standard Proctor values ranged from 123 pcf to 136 pcf for the tailings. To ascertain the correct standard Proctor value for the tailings at a particular site, samples were taken and a series of one point standard Proctor test were completed in the KGCMC laboratory. This one point value was used in conjunction with the family of standard Proctor curves, obtained from testing of many samples of the tailings, to determine what value best represents the standard Proctor for the material. Subsequently, standard Proctor tests are completed on tailings samples at regular intervals to form a larger database of curves. KGCMC will continue to evaluate compaction measurement methodology and supply information in the annual reports.

Records to be collected and retained by KGCMC staff include:

- Standard count sheet for the nuclear densitometer to track any problems occurring with the unit;
- Field placement and density summary sheets to track location and density of tailings in the facility;
- Weather data to help achieve a better understanding of tailings placement performance, as related to compaction; and
- A summary report, which summarizes the location of, placed tailings, volume of placed tailings, test results, and any discussion of incidents related to the tailings facility. The summary report is submitted periodically to a qualified geotechnical engineer for review and comments.

3.2.1 Tailings Facility Maintenance

If problems are noted during any inspection, KGCMC will have a qualified engineer inspect the component of the system that fails to meet operating standards, and provide recommendations for correction.

3.2.2 Reporting Schedule

Monitoring data described in chapter 3 and 4 of this appendix will be summarized and submitted to the USFS and ADEC in Annual Reports. Each report will contain results for the prior calendar year and will be submitted by April 15, unless an extension is granted by the Agencies. Monitoring records will be maintained at the site in a fashion that allows on-site inspection.

3.3 Emergency Action Plan

The following actions will be taken in the event of an emergency:

- Unsafe conditions/impending failure - stop water inflow from all managed sources.
- Notification of Forest Service Personnel, Monument Manager 586-8800.
- Notification of the State of Alaska ADNR Dam Safety Officer (Charlie Cobb) at (907) 269-8636
- Persons to be notified downstream - not applicable.
- Map delineating area of inundation.
- Person responsible for carrying out this Plan is the KGCMC Environmental Manager, phone (907) 789-8170.

4.0 TAILINGS INTERNAL ENVIRONMENTAL MONITORING PROGRAM (TIEMP)

4.1 Purpose

The Freshwater Monitoring Plan (GPO Appendix 1) was established to monitor the environmental performance of the Greens Creek facilities as well as other disturbed areas during operation. Monitoring sites have been established to periodically measure surface and groundwater quality outside the perimeter of the tailings facility. Measurement and evaluation of hydrologic and geochemical processes that occur within the tailings facility is conducive to better understanding the behavior of the tailings and their potential interaction with the environment. Consequently, a Tailings Internal Environmental Monitoring Program (TIEMP) has been developed for this purpose. It is important to remember that water quality data collected as part of the internal monitoring program represent “mine water”, or “contact water” that is contained, collected and treated prior to discharge under the KGCMC NPDES permit. As a result, data are not to be compared to compliance levels established for ambient surface and groundwater peripheral to the site. However, measurement of the changes in the quality and volume of seepage over time during operation and after capping will aid in evaluating the need for long-term treatment. Additionally the data will help in the design of post-closure water management and treatment systems, should these be required.

Hydrologic and geochemical processes are important factors that define the success of the management of the tailings facility. Operational techniques and closure approaches were designed to prevent acidification, minimize infiltration of oxygen and water, and to reduce metal loading from the facility. Short-term control of metal loading relies on minimizing ARD and metal release and on the collection and treatment of contact water. Long-term control measures will emphasize the minimization of acidification, oxidation, and infiltration of meteoric water. As a result, the TIEMP will provide information about the following:

- geochemical behavior of tailings and production rock placed in the tailings facility; and

- collection of data that will allow periodic update of a mass load model for the tailings that describes the movement of meteoric water through the pile, and the chemistry of pore fluids contained in the tailings.

4.1.1 Geochemistry of Tailings and Production Rock

The net neutralization potential (NNP) and the paste pH of materials within the tailings facility will be measured on samples that are collected from representative locations within the facility. The sampling and testing requirements are outlined below.

Each calendar year that the mine is active, a minimum of 16 samples of fresh tailings will be collected for analysis of NNP. Samples should be collected from a recent placement cell and should consist of a composite sample taken from the top 6-inch depth. At least 4 samples will be collected each quarter. The date collected and the approximate location within the pile will be recorded for each sample. Static tests will be determined using the modified Sobek Method used for analysis of prior samples (1994 and 1999 grab samples). The NNP will be calculated on the basis of the Sobek acid neutralization potential in tons per 1,000 tons as calcium carbonate minus the non-sulfate sulfur (pyritic sulfur found by summing the nitric acid extractable and the residual S fraction) times 31.25. Alternatively, if barite is found to comprise the majority of the residual sulfur, then the pyritic sulfur will be assumed to equal the nitric fraction only.

Each calendar year until final closure of the tailings, a minimum of 20 samples but not less than 1 sample per 2 acres covered by tailings, will be collected for analysis of paste pH. Samples should be aerially distributed across the facility with samples collected from portions of the facility that vary in age. The samples should be collected as composites from the top 6-inch depth. The cell designation of each sample will be recorded. One of every 5 paste pH samples will be randomly selected to be analyzed for NNP value. Additionally, each sample with a paste pH of less than 6 will also be analyzed for NNP values.

All results will be provided in an annual monitoring report submitted to the USFS, and ADEC. Data will be graphed in a manner similar to Figure 4 and Figure 5. If a significant reduction in average NNP value is observed (of more than 50 t/1,000 t), if the acid neutralization potential (ANP) of more than 25% of the samples is below 50 tons/1,000 tons, or if more than 10% of the paste pH values are below 5, then an expert in ARD will be asked to review the information, and if necessary, to develop a suitable management plan. Additionally, the USFS and the ADEC will be informed of the results and the management plan will be submitted for their review and approval prior to its implementation.

4.1.2 Pore Water Chemistry

Management of Contact Water

Water that contacts tailings is collected and treated during operation of the tailings facility. After closure, surface water will no longer contact tailings as occurs now. Consequently, only interstitial water within the pile will contact tailings. After closure, the "draindown" of water from the dry tailings stack, if any, and the long-term net infiltration through the engineered cover will determine the quantity of contact water that may exit the site. The chemistry of contact water is therefore important in determining long-term mass loads of metals that may be released.

The chemistry of contact water will be sampled in three ways: surface water, groundwater beneath the facility and interstitial water.

Surface water and groundwater that may have contacted tailings will be collected from the internal stations, identified in the subsequent section. Additionally, interstitial water will be collected using suction lysimeters installed at nested depths at representative locations in the tailings facility.

Data Quality Objectives

Data quality objectives (DQO's) define the amount, kind, and quality of data that are required to make relevant decisions. In the context of the TIEMP, data on the chemistry, and, if applicable, flow rate of contact water are required to maintain the mass balance model. Additionally, water chemistry data will be used to identify significant trends in the chemistry of contact water. Such trends could reflect changes in the geochemical nature of the tailings by processes such as acidification.

Constituents to be analyzed consist of a series of "indicator parameters" (Table 1). Based on review of existing data from KGCMC collected through the Freshwater Monitoring Plan, some or all of these constituents will always be found in contact waters, therefore, changes in their concentrations will identify changes in the amount or chemical nature of contact water that is detected at a monitoring station. In addition to the indicator parameters (suite H from the FWMP), common ions will also be analyzed.

Table 1. Analyte Suites

Suite H		
Conductivity	Dissolved Arsenic	Dissolved Mercury
pH, Temperature[1] & Hardness	Dissolved Cadmium	Dissolved Zinc
Sulfate	Dissolved Copper	
Total Alkalinity	Dissolved Lead	
Common ions		
Dissolved Calcium	Dissolved Magnesium	Dissolved Sodium
Dissolved Potassium	Nitrate plus nitrite	Bicarbonate
Silica	Chloride	

Samples will be collected from each station quarterly for surface water stations, for groundwater stations and lysimeters.

Samples from surface water stations will be collected quarterly for groundwater/interstitial waters. Samples will be analyzed for the constituents in Table 1. All analyses will be in a dissolved form. Sampling sites will include all listed in Table 2.

Water quality data will be summarized in annual Tailings and Production Rock Site Report to the USFS, ADEC, and ADNR. There are no specific compliance levels for these data, but information should be presented on graphs of concentration vs. time to graphically illustrate trends in the data, if any.

Table 2. Internal Sampling Locations

Station	Measurements	Frequency	Comments
PZAT-00-01	water level and chemistry	quarterly	Located in old tailings area
MW-T-02-06 MW-T-02-05 MW-T-02-08	water level and chemistry	quarterly	Located in active tailings
Wet well 2	flow and chemistry	monthly	
Wet well 3	flow and chemistry	monthly	
SL-T-02-04 SL-T-02-05 SL-T-02-06 SL-T-02-07	chemistry	quarterly	At depth
Lysimeter nest 2 (consists of 4 lysimeters at 2 feet, 4 feet, mid pile, pile base)	chemistry	quarterly	Constructed in 2004, sampled if suction is maintained
Lysimeter nest 3 (consists of 4 lysimeters at 2 feet, 4 feet, mid pile, pile base)	chemistry	quarterly	Constructed in 2007, sampled if suction is maintained

See Figure 3 - Tailings Area Layout for sample locations.

4.1.3 Water Flux and Cover Performance

As yet, no significant area of tailings has been constructed to final grade. Consequently, engineered covers have not yet been placed over any portion of the tailings. When cover is initially placed on the tailings, a monitoring plan that measures the performance of the cover shall be undertaken within 1 year of cover deployment. At a minimum, the monitoring plan should allow calculation of the flux of meteoric water and oxygen through the base of the cover into the tailings. The monitoring plan will be submitted to the USFS, and ADEC, for review and approval prior to its implementation.

4.1.4 Development and Calibration of a Water Balance/Mass Load Model

After a minimum of 2 years of cover performance monitoring data has been collected, the facility water balance and mass load model in the “2003 FEIS”, applicable to post-closure conditions will be updated. The model report describes the conceptual hydrogeochemical model that includes groundwater flow paths for the hydrologic basin within which the tailings are situated. Also, the mass flux of water and metals out of the reclaimed tailings, the fate of constituents along the flow path, and the resultant seasonal concentration of critical constituents in receiving water are predicted. The updates of the mass load model will be submitted to the USFS, ADEC, and ADNR.

5.0 REFERENCES

ASCI. 1991. Review of Acid Generation Potential Testing of Greens Creek Tailings. Memorandum from Adrian Smith to KGCMC.

British Columbia Acid Mine Drainage Task Force. 1989. Draft Acid Rock Drainage Technical Guide. BiTech Publishers, Richmond, BC.British Columbia Research Corporation,, Division of Extractive Metallurgy. March 1985. Column Leach Testings of Greens Creek Tailings.

British Columbia Research Corporation, 1990. Potential for Acid Drainage from Greens Creek Tailings, B.C. Research, Inc.1990.

British Columbia Research Corporation,., Vancouver, B.C., June 1990. Final Report on the Potential for Acid Mine Drainage from Greens Creek Mine Tailing.

Condon, P. D. 1999. Characterization and prevention of acid rock drainage processes at the Greens Creek Mine, Admiralty Island, Alaska. University of Oregon. Ph.D. dissertation. Eugene, OR.

EDE, 1997. Kennecott Greens Creek Mine Tailings Repository Groundwater Flow Model, Environmental Design Engineering, February 1997.

EDE, 1999. Kennecott Greens Creek Mining Co. Tailings Disposal Area Groundwater Flow Model 1999 Update, Environmental Design Engineering, December 12, 1999.

EDE, 2002a. Kennecott Greens Creek Mining Co., Stage 2 Tailings Expansion Hydrologic Analysis, Environmental Design Engineering, February 2002.

EDE, 2002b. Kennecott Greens Creek Mining Co., Stage 2 Tailings Expansion Geochemistry Report, Environmental Design Engineering, February 2002.

KGCMC, 1994. Production Rock Characterization Study, General Information Regarding Borehole Summaries, 1994 Surface Drilling Program. 1994.

KGCMC, 2002. Tailings and Production Rock Report – 2001 Annual report. April 2002

KGCMC, 2003. Tailings and Production Rock Report – 2002 Annual Report. June 2003

Klohn-Crippen, 1998. Kennecott Greens Creek Mine – Design of Tailings Pile West Buttress, Final Report, October 1998.

Klohn-Crippen, 1999a. Kennecott Greens Creek Mine – Evaluation of Tailings Pile, Final Report, July 1999.

Klohn-Crippen. 1999b. Preliminary Design of East Expansion to Tailings Pile. Final Report, December, 1999.

Klohn-Crippen. 2000a. Kennecott Greens Creek Mine East Expansion to Tailings Pile Construction Summary . November 2000.

Klohn-Crippen. 2001a. Tailings Project – NEPA application. January 8, 2001.

Klohn-Crippen. 2001b. Wide Corner Quarry Liner Design- Final Report. November 13, 2001

Klohn-Crippen. 2001c. Kennecott greens Creek Mining Company 2001 Geotechnical Investigation, Field Report – Final. May 2001

Klohn-Crippen. 2002a. Southeast Expansion Construction Summary – Final Report. November 14, 2002.

Klohn-Crippen. 2003a. 2002 Geotechnical Investigation – Field Report. April 3, 2003.

Klohn-Crippen, 2003b. South Slope Stability Assessment. July 11, 2003.

Shepherd Miller, Inc. 2000. Technical Review – ARD Metals Leaching and Freshwater Monitoring Plan. Report to Kennecott Greens Creek Mining Co.

U.S. Army Corps of Engineers, Regulatory Branch, Permit Processing Section, June 1988. Permit Number 4-880269.

U.S.D.A. Forest Service, 1988. Lease for Mining Purposes (39.89 acres) (Tailings Impoundment & Pipeline Leases).

U.S.D.A. Forest Service, Chatam Area, Tongass National Forest, March 1988. Environmental Assessment for Proposed Changes to the General Plan of Operation for the Development and Operation of the Greens Creek Mine, Admiralty Island National Monument, Alaska.

U.S.D.A. Forest Service, Tongass National Forest R10-MB-482a, November 2003. Greens Creek Tailings Disposal – Final Environmental Impact Statement, Volumes I and II.

KENNECOTT GREENS CREEK MINING COMPANY
GENERAL PLAN OF OPERATONS

APPENDIX 3
ATTACHMENT A
FORMS

Kennecott Minerals

VISUAL DAM INSPECTION CHECKLIST

NAME OF DAM: Upper Cannery Tailings Dam (AK00203)
(aka Containment Pond No. 6)

DATE: ____________________ **PRIOR MONTHLY INSPECTION DATE:**_______
POOL ELEVATION: __________ Staff Gauge (ft) Avg. temperature since prior inspection:_________Deg C.
CURRENT WEATHER:________________________ Total precipititaion since prior inspection:________inches
INSPECTOR:____________________________ **Signature** ____________________________

		ITEM	YES	NO	REMARKS
1a	**Crest**	(Main embankment)			
	A	Settlement			
	B	Cracking			
	C	Surface seepage			
1b	**Crest**	(Saddle embankment)			
	A	Settlement			
	B	Cracking			
	C	Surface seepage			
2	**Upstream Slope**				
	A	Adequate slope protection			
	B	Any erosion			
	C	Trees growing on slope			
	D	Deteriorating slope protection			
	E	Visual settlements			
	F	Any sink holes			
3	**Downstream slope**				
	A	Adequate slope protection			
	B	Any erosion			
	C	Trees growing on slope			
	D	Animals burrows			
	E	Any sink holes			
	F	Visual settlements			
	G	Surface seepage			
	H	Slides or slumps			
4	**Abutment Contacts**				
	A	Any erosion			
	B	Seepage present			
5	**Spillway**				
	A	Weir clear			
	B	Approach clear			
6	**Outfall Structure**	(Wet Well)			
	A	Blockage in Pipes			
	B	Valves Open			

SPECIAL REMARKS