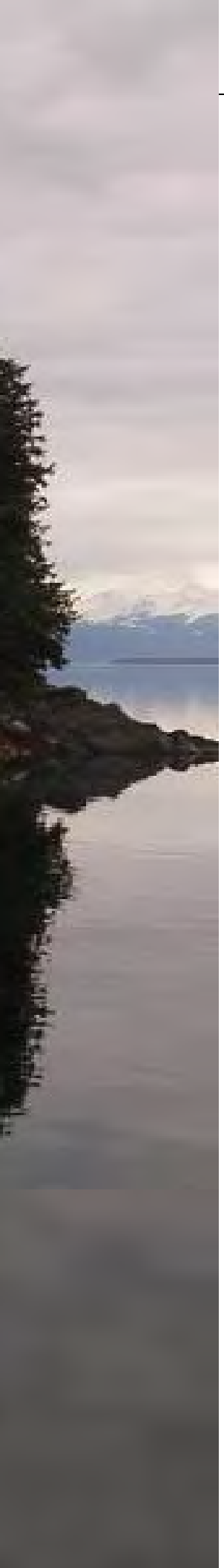

Environmental Audit Of the Greens Creek Mine

FINAL REPORT

Report Submitted to

State of Alaska Department of Environmental Conservation

State of Alaska Department of Natural Resources

The United States Department of Agriculture Forest Service

Hecla Greens Creek Mining Company

Report Prepared by

SRK Consulting
Engineers and Scientists

March 2009

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FINAL REPORT

State of Alaska Department of Environmental Conservation

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Hecla Greens Creek Mining Company

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SRK Project 1UK005.001

March 2009

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Executive Summary

SRK Consulting (SRK) was retained by Hecla Greens Creek Mining Company (HGCMC) to conduct an environmental audit of the Greens Creek Mine. The audit was directed by the Alaska Department of Environmental Conservation (ADEC), in coordination with the Alaska Department of Natural Resources (ADNR) and the United States Department of Agriculture Forest Service (USFS).

Facility environmental audits are required by HGCMC's Waste Management Permit 0211-BA001, dated November 7, 2003, and the Memorandum of Understanding between the USFS, ADEC, ADNR and HGCMC, dated May 23, 2007. The Waste Management Permit specifies that the audits be conducted every five years, prior to the renewal of the permit, and at the expense of HGCMC.

The audit was conducted in two separate visits. The geotechnical portion of the audit occurred at the Mine site from April 28 to April 30, 2008, with the remainder of the audit conducted at the Mine site and in the offices of ADEC and USFS from May 5 to May 9, 2008.

In general, the Greens Creek Mine was found to be well managed with respect to oversight by HGCMC personnel and the agencies and in compliance with the majority of the applicable permits, plans, approvals and regulations. Most of the major findings were issues that both HGCMC and the agencies were aware of as areas of concern prior to the audit, and in many cases, were already actively addressing.

It should be noted that the findings shown in this report are those found at the time the audit was conducted. The audit findings were ranked based on the criteria shown in Table A-1, with each finding assigned a Significance Level between 1 and 3.

Table A-1: Significance Levels for Ranking of Findings

Significance Level	Environmental Systems		Management and Permits		Cost to Operation
1	Currently causing an environmental effect	**OR**	Management systems fail to protect environment and reputations of mine and agencies	**OR**	Items exceeding $5 million
2	Has potential to cause an environmental effect or result in non-compliance or is non-compliant with permit requirements, policies or standards	**OR**	Contradictory or ambiguous management and permit requirements	**OR**	Items between $1 million and $5 million
3	In compliance but opportunities to improve practices	**OR**	Management improvements at mine or agency oversight	**OR**	Items less than $1 million

Findings that were assigned Significance Levels 1 and 2 are summarized in Table A-2, which includes the report section number where the detailed discussion associated with each finding can be found. Significance Level 3 findings are included in Section 4, "Audit Findings".

Table A-2: Summary of Major Findings

Level	Finding	Report Section
Tailings Disposal Facility		
1	It is not clear if fugitive dust is causing an impact to surrounding soils, water, vegetation and biota. This should be evaluated.	4.2.1.7
2	The tailings are potentially acid generating, leading to a potential for acidification of surface runoff at some point in the future. Placement of covers will mitigate this issue.	4.2.1.5
2	Water chemistry predictions in the EIS indicated that water treatment may not be required following mine closure. However, the full benefit of treatment with organic matter and the effect of soil covers have not been evaluated.	4.2.1.5
Production Rock Site 23/D		
1	Seepage from D Pond Berm contains some constituents above ADEC Water Quality Standards and is discharging directly into Greens Creek.	4.2.2.5
2	Site D material is potentially liquefiable and, consistent with current plans, Site D material needs to be removed prior to or during closure.	4.2.2.2
2	During relocation of Site D production rock, mobilization of oxidation products can be expected by meteoric water. The potential for water quality to exceed standards needs to be evaluated and managed accordingly.	4.2.2.5
2	It is not known if native soils beneath Site D contain products of production rock weathering. Reclamation of native materials should consider measures to limit leaching of these weathering products when they are exposed.	4.2.2.5
Inactive Production Rock Sites and Quarries		
2	During relocation of rock fill, mobilization of oxidation products can be expected by meteoric water. It is not known if water quality could exceed standards and result in a need to manage runoff accordingly.	4.2.3.1
2	It is not known if native soils beneath the rock fill contain products of production rock weathering and if there is a need to reclaim native materials to limit leaching of these weathering products when they are exposed.	4.2.3.1
2	Rock fill in 920 and 960 areas has not yet acidified to the expected extent. The potential for acidification to result in greater contaminant loads reaching Greens Creek in the future needs to be evaluated.	4.2.3.2 4.2.4.1
2	The potential for mill backslope instability needs to be addressed due to its potential to affect the operation of the mill.	4.2.3.3
Underground Mine		
2	Drainage points from the mine during flooding at closure are unknown.	4.2.5
2	Water quality trends at closure are unknown, leading to uncertainties about the need for water treatment and the decommissioning of the site access.	4.2.5

Level	Finding	Report Section
Storm Water Management and Effects		
1	The 920 Portal, mill, tailings load-out, Site 23, waste dump haul road, mine access road, and Tailings Disposal Facility have increased potential for contamination of storm water due to high concentrations from mine production rock or quarry materials used in construction of roads, dikes, and drainage structures and tracking of material on transport vehicles.	4.2.6
Bond Review		
2	Equipment ownership, insurance, maintenance labor, overhead and profit need to be checked in some cases and equipment types need to be defined.	4.2.7.2
2	Overtime labor costs should be added.	4.2.7.2
2	Contractor profit and freight components relating to materials need to be checked.	4.2.7.2
2	Requirements for a one-year “Holding Period” need to be better defined and costed. Long-term treatment costs need to consider possible changes in influent chemistry. Additional supervision of foreman during Years 1 and 2 should be included.	4.2.7.3
2	Efficiency and correction factors need to be documented for production rock sites. A constant fleet needs to be assumed rather than an optimal fleet for each task. Costs for keeping the underground mine open while backfilling Class 3 or 4 rock should be considered.	4.2.7.3
2	A wastage factor should be included in the cover construction for the Tailings Disposal Facility to allow for covers that do not meet specifications and need to be re-built.	4.2.7.3
2	A contingency of 20% is more usual for costs that are not based on detailed design.	4.2.7.4
2	Post-closure costs should be discounted using a net present value method.	4.2.7.4
Closure and Reclamation		
2	The need for long-term water treatment represents the greatest uncertainty in the Reclamation Plan and cost estimate. The site should continue to collect the data needed for assessing long-term water quality, treatment requirements and treatment options.	4.2.8.2.4
Fresh Water Monitoring Plan		
2	Evidence of compliance with subsections 2.6.5 and 7.1.2 of the Waste Management Permit was not evident during the audit (reporting to ADEC of an exceedance of a water quality standard during surface or groundwater monitoring at points of compliance or a statistically significant change in water quality).	4.2.9.5
Spills and Releases		
2	The HGCMC Spill Reporting Procedure flow sheet and Small Spill Report appear to apply requirements for spills of oil to spills of chemicals, which have more stringent reporting requirements.	4.2.10.1.2
2	HGCMC was not able to produce documentation from ADEC supporting current procedure for managing underground mine as secondary containment.	4.2.10.1.3
2	Approximately 40 to 50% of lined ditch immediately below equipment wash area at mill was blocked by gravel/sediments, significantly reducing the flow capacity (Photo 23 and Photo 24).	4.2.10.5

Level	Finding	Report Section
2	The area of construction for a temporary fresh water intake line (near the potable water treatment plant) poses the potential to impact the quality of Greens Creek due to flushing of fines directly into the creek upstream of the weir (Photo 25).	4.2.10.5
2	The secondary containment on the transformer located behind the old water treatment plant at the Tailings Disposal Facility was found to be full of water, eliminating the containment capacity. Inspections of secondary containment of transformer areas could not be verified during the audit (Photo 3).	4.2.10.5
2	The tailings thickener containment would direct any unanticipated discharge into the road area west of thickener. There is a risk for puncture of the thickener based on indications on side of wall of tank (Photo 26 and Photo 27).	4.2.10.5
2	The various pipelines crossing Greens Creek between the underground mine and the mill area do not have appropriate secondary containment to contain material and prevent it from entering the creek in the event of a rupture or other type of failure (Photo 28).	4.2.10.5
2	HGCMC cannot substantiate that sufficient storage to contain and control the 24-hour, 25-year storm event is provided at all locations requiring such containment, as required Section 3.4.3 of the Waste Management Permit.	4.1.11 4.1.13.3 4.2.10.5
Audit of the Agencies		
1	The large number of permits and authorizations (>50) imposes significant administrative burden, which has the potential of distracting from the efficient and effective management of environmental risks.	4.2.11.4.2
2	There is no evidence of any regulatory agency conducting independent compliance sampling.	4.2.11.3.1
2	Agency follow-up on ensuring that required reporting is submitted, reviewed and responded to in a timely manner requires improvement.	4.2.11.3.1
2	Inconsistencies between requirements specified within the Waste Management Permit and the General Plan of Operations were identified.	4.2.11.3.1 4.1.13.3 4.2.9.5
2	A significant lag time was noted between the date of ADEC inspections and the delivery of the inspection report to the Greens Creek operation.	4.2.11.3.2
2	A significant imbalance between the frequency of USFS and ADEC site compliance inspections exists. Representatives of ADEC should increase the frequency of compliance inspections and the USFS should consider reducing the frequency of inspections.	4.2.11.3.2
General Compliance		
2	Waivers from sampling Synthetic Organic Contaminants (SOC) and other organic contaminants (OOC) for PWS 119205 and PWS 113560 expired on December 31, 2007 and require extension.	4.1.10
2	Temporary Water Use Authorization #J2000-10 expired and ADNR needs complete adjudication of the application to approve a Water Appropriation.	4.1.12
2	The tree blow-down study required by subsection 2.4.8 of the Waste Management Permit has not been submitted.	4.1.13.3
2	A number of monthly inspections required by the Waste Management Permit were not on record.	4.1.13.3
2	Tailings and production rock have not been analyzed for paste pH since 2005, which is required by the Waste Management Permit and General Plan of Operations (GPO) Appendices 3 and 11.	4.1.13.3

Level	Finding	Report Section
2	Hazardous waste storage areas were being inspected monthly rather than weekly as required in 40 CFR 265 Subpart I.	4.1.13.4
2	A container of hazardous waste at the 920 Area was not labeled as required in 262.34.	4.1.13.4

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Acronyms

ABA	Acid-Base Accounting
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish & Game
ADNR	Alaska Department of Natural Resources
ANILCA	Alaska National Interest Land Conservation Act
AP	Acid Potential
ARD	Acid Rock Drainage
ARDF	Alaska Resource Data Files
AWQS	Alaska Water Quality Standards
BMP	Best Management Practices
$CaCO_3$	Calcium Carbonate
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DOT	Department of Transportation
EA	Environmental Assessment
EDE	Environmental Design Engineering
EIS	Environmental Impact Statement
EMS	Environmental Management Systems
EPA	Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FWMP	Fresh Water Monitoring Program
GPO	General Plan of Operations
HDPE	High-Density Polyethylene
HGCMC	Hecla Greens Creek Mining Company
ISO	International Organization for Standardization
JRG	Joint Regulatory Group
KCB	Klohn Crippen Berger
KGCMC	Kennecott Greens Creek Mining Company
MAGs	Management Information Goals
MEND	Mine Environment Neutral Drainage (program)
MIGs	Monitoring Information Goals
ML/ARD	Metal Leaching/Acid Rock Drainage
MOU	Memorandum of Understanding

MPH, REHS	Master of Public Health, Registered Environmental Health Specialist
NEPA	National Environmental Policy Act
NNP	Net Neutralization Potential
NP	Neutralization Potential
NPDES	National Pollutant Discharge Elimination System
NPV	Net Present Value
NRC	National Response Center
OH&S	Occupational Health & Safety
OOC	Other Organic Contaminants
OSU	Oregon State University
P.E.	Professional Engineer
P.Eng.	Professional Engineer
P.Geo.	Professional Geologist
PAG	Potentially Acid Generating
PERP	Prevention and Emergency Response Program
PWS	Public Water System
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFP	Request for Proposal
ROD	Record of Decision
SAG	Semi-autogenous
SOC	Synthetic Organic Contaminants
SOP	Standard Operating Procedure
SPAR	Spill Prevention and Response
SPCC	Spill Prevention Control and Countermeasure
SRMP	Sulfate Reduction Monitoring Program
TDF	Tailings Disposal Facility
TKN	Total Kjeldahl Nitrogen
TLRMP	Tongass National Forest Land and Resource Management
TPH	Total Petroleum Hydrocarbons
TSDF	Treatment, Storage and Disposal Facility
TWUP	Temporary Water Use Permit
USFS	United States Department of Agriculture Forest Service
USFWS	United States Fish and Wildlife Service

USGS	United States Geological Survey
VMS	Volcanogenic massive sulfide
WMP	Waste Management Plan
WTP	Water Treatment Plant

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1 Introduction

1.1 Background

SRK Consulting (SRK) was retained by Kennecott Greens Creek Mining Company (KGCMC)[1] to perform an environmental audit of the Greens Creek Mine located on northern Admiralty Island in Alaska (Figure 1). The request for proposal for this audit was issued by KGCMC in December 2007, in coordination with the State of Alaska Department of Environmental Conservation (ADEC), State of Alaska Department of Natural Resources (ADNR), and United States Department of Agriculture Forest Service (USFS), referred to subsequently as "the agencies".

The work associated with this audit was directed by ADEC, in conjunction with ADNR and USFS. HGCMC was responsible for all financial obligations associated with the audit, in addition to soliciting proposals, hosting site visits, providing reports, answering technical questions, and participating with the agencies in the audit.

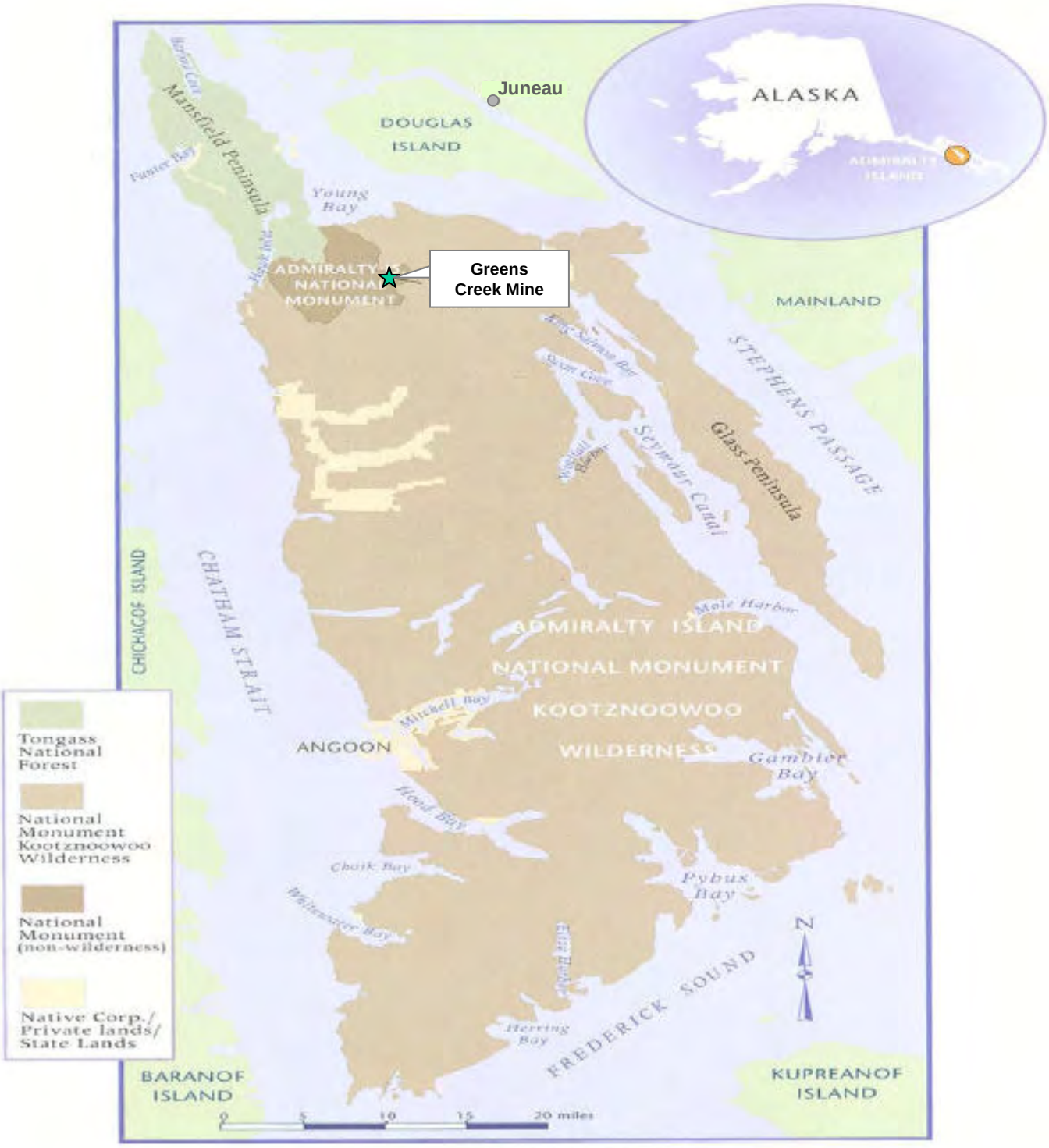
The geotechnical portion of the audit was conducted at the Greens Creek Mine site from April 28 to April 30, 2008, with the remainder of the audit conducted at the Mine site and in the offices of ADEC and USFS from May 5 to May 9, 2008. This document presents the findings of the audit.

1.2 Limitations

The scope of work provided by the agencies participating in this audit was comprehensive and included areas outside the scope of compliance. To evaluate compliance with permits, plans, approvals and regulations, a sample of documents and procedures was examined, as is the normal practice for an audit in which the timing of the audit is pre-defined (for example, ISO 2002) . As a result, SRK does not guarantee the compliance status of all requirements of a given permit, plan or approval.

The findings and recommendations in this report are based on the best professional judgment, expertise and experience of the auditors. HGCMC and/or the participating agencies may develop alternative responses to the audit findings that are equally acceptable.

[1] In April, 2008, Hecla Mining Company completed the acquisition of the Rio Tinto subsidiaries that held a 70.27% interest in the Kennecott Greens Creek Mining Company (KGCMC) joint venture, forming Hecla Greens Creek Mining Company (HGCMC). SRK was retained by KGCMC, but the financial obligations of the project contract were assumed by HGCMC. All regulatory obligations of KGCMC were also taken on by HGCMC. This report subsequently refers to HGCMC regardless of chronology.



SRK Consulting Engineers and Scientists	Hecla	Environmental Audit		
		Site Location Map		
Job No: 1UK005.001 Filename: Figure 2_LocationMap_20080807.ppt	**Greens Creek Mine**	Date: Aug. 2008	Approved:	Figure: **1**

1.3 Regulatory Purpose of the Audit

Facility audits are required as specified under HGCMC's Waste Management Permit 0211-BA001, dated November 7, 2003, Section 8.1, and the Memorandum of Understanding between the agencies and HGCMC, dated May 23, 2007, Section 1.(b). The Waste Management Permit specifies that the audits be conducted every five years, prior to the renewal of the permit, and at the expense of HGCMC. Details of the requirements of the audit are provided in the above referenced documents and abstracted in Appendix A.

The purpose of the audit, summarized in the Request for Proposal, is "*to determine whether KGCMC has taken, or proposes to take appropriate actions sufficient to protect the environment and to be in compliance with applicable regulations or requirements. The audit contractor will also determine the adequacy of the agency oversight of the facility. The contractor shall also provide recommendations for changes or improvements to existing or proposed practices.*" The results of the audit are to be used to determine compliance with permits and approvals, assess the need for updates to policies, plans, procedures and financial assurance, and to assist in updating, renewing or issuing approvals and/or permits.

1.4 Scope of the Audit

The detailed scope of the audit was mutually agreed upon by ADEC, ADNR and the USFS and was included in Section 12 of the Request for Proposal issued by HGCMC in December 2007 and summarized in the Audit Matrix provided in Appendix B. The main focus of the audit relates to facilities permitted under Waste Management Permit 0211-BA001.

General areas of interest within the detailed scope of the audit include:

- Geotechnical stability;
- Seepage and run-off from facilities;
- Long-term water treatment;
- Reclamation and closure plans;
- Bonding;
- Conflicts and inconsistencies in the Waste Management Permit and General Plan of Operations (GPO);
- Monitoring;
- Spills and releases;
- Storm water and sediment control; and
- Agency oversight.

The geographical scope of work included the following areas (see Figure 2):

- Mine/mill site, including rock fills and facilities;
- Tailings Disposal Facility;
- Inactive production rock sites and quarries associated with the mine and access roads; and
- Hawk Inlet.

The scope of work allowed for some prioritization of facilities. SRK considered the highest priorities to be the mine area and tailings facilities, however all locations of the site were visited, with the exception of the upper areas (960 and 1350), which remained covered by snow at the time of the visits.

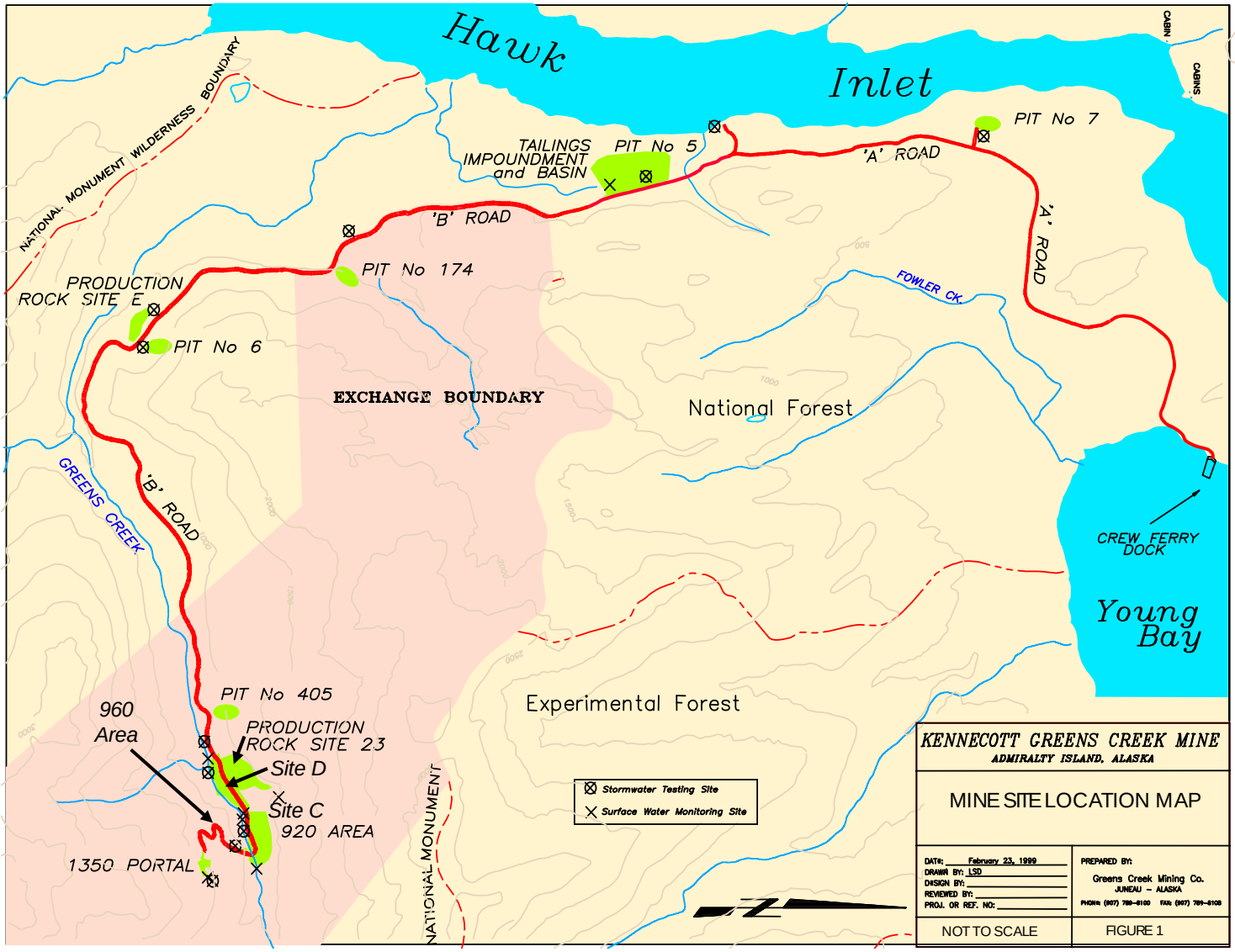
1.5 Structure of this Report

The report is structured in the following major sections:

- Chapter 1 provides background on the motivation, requirements and scope of the audit;
- Chapter 2 describes the audit methods;
- Chapter 3 summarizes the audit team's understanding of the main site features obtained from a review of documents and visits to the site. Further description of the sites are provided in Chapter 4 as needed to provide context to the audit;
- Chapter 4 provides detailed findings of the audit and recommendations. The chapter is structured according to the Audit Matrix in Appendix B;
- Chapter 5 summarizes major findings and recommendations arising from the audit.

1.6 Acknowledgements

SRK acknowledges HGCMC and the agencies for their accommodations, time, assistance and cooperation in conducting this audit. The success of an audit hinges on the cooperation of all participants, which was granted to the SRK team at all times during the audit.



SRK Consulting Engineers and Scientists	Hecla	Environmental Audit
Job No: 1UK005.001	Greens Creek Mine	**Facilities Included in the Audit**
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2 Audit Methods

2.1 Overview

As described in SRK's proposal dated January 2008, the following three guidelines formed the framework of the audit:

- Apply the procedures and discipline of a formal audit process to ensure that all of the specifically identified issues are assessed;
- Use individuals with the experience needed to see beyond the specifically identified issues, in order to identify underlying conditions, strengths or weaknesses of the facilities, their management, and their oversight;
- Do all of the above in a manner that is sufficiently transparent and replicable to withstand the scrutiny of parties with very different points of view on some of the issues.

A detailed scope for the audit was included in the Request for Proposal issued by HGCMC. Although the auditors attempted to respond to all the items in the detailed scope of work, they also used their professional judgment and experience to guide them in assessing the areas that required attention. Due to time constraints, there were instances where an element of the scope of work was not completed in order to allow the auditors to spend sufficient time to asses an area of priority. In addition, there were tasks where the scope of work called for the auditors to make specific recommendations. SRK believes that to conduct a truly objective audit, recommendations should be a result of the findings and assessment of the auditors, where the auditors feel a recommendation is necessary to achieve the desired goal of the audit.

Furthermore, it is important to note that an audit of this scope takes "samples" of the areas of interest. For example, a sample of inspection records or reports was checked for compliance for a particular permit or regulatory requirement, rather than looking at every inspection record over a period of years. When examining a sample of documents, the most recent records were chosen to reflect current conditions.

2.2 Audit Methodology

The audit broadly followed standard methodology as described in guidelines such as the ISO standards (2002). In general, the major activities of an audit are:

- Initiating the audit;
- Conducting document review;
- Preparing for on-site auditing activities;
- Conducting on-site audit activities;
- Preparing, approving and distributing the audit report;
- Completing the audit;
- Conducting audit follow-up.

2.3 Audit Team

The audit was performed by a team of six engineers and scientists, all of whom have spent most of their careers working on mining-related waste and environmental management projects. Members of the team were selected to cover all of the required areas of expertise as described below:

- Stephen Day, P.Geo., Geochemist – Project Principal/Team Leader, geochemical monitoring, long-term water treatment;
- Kathleen Willman, P.Eng., Regulatory Specialist – Project Manager, spills and releases;
- Daryl Hockley, P.Eng., P.E., Geo-Environmental Engineer – bonding, reclamation and closure;
- Cam Scott, P.Eng., Geotechnical Engineer – geotechnical issues;
- Don Hovdebo, Environmental Geologist – spills and releases, agency audit;
- Bill Jeffress, Fisheries Biologist/Regulatory Specialist[2] – storm water, fresh water monitoring, general assessment of monitoring program.

The key HGCMC and agency representatives participating in the audit included:

- Ed Emswiler, MPH, REHS, Environmental Program Specialist, ADEC, Solid Waste Program, Juneau – Audit Coordinator;
- Kenwyn George, P.E., Environmental Engineer, ADEC, Wastewater Program, Juneau;
- Charlie Cobb, P.E., Dam Safety Engineer, ADNR, Dam Safety Unit, Anchorage;
- Steve McGroarty, P.E., Geologist, ADNR, Mining, Land & Water, Fairbanks;
- Jeff DeFreest, Tongass Minerals Program Manager, USFS, Juneau;
- Sarah Shoemaker, Minerals Administrator, USFS, Juneau;
- Pete Condon, PhD, Senior Environmental Engineer, HGCMC;
- William Oelklaus, Principal Advisor, Environment, HGCMC;
- Jennifer Saran, Environmental Affairs Manager, HGCMC.

2.4 Site Visit Preparation

Preparations for the site visit included a project initiation conference call and document review. The conference call was held on February 25, 2008 and included representatives from SRK, the agencies and HGCMC.

Ed Emswiler of ADEC provided SRK with a set of electronic documents on DVDs, along with a written outline of the documents contained in the DVDs subsequent to the initial conference call (Appendix C). The documents were comprehensive and organized systematically according to the audit matrix in Appendix B. The auditors reviewed the available documentation prior to the site visit. The objective was for each of the auditors to be as familiar as possible with the background of

[2] Bill Jeffress was not included in the SRK proposal dated January 2008, but was added to the team when he joined SRK due to his extensive experience in the Alaskan mining industry.

particular issues before the site visit. Each auditor reviewed the material in their area of responsibility.

2.5 Site Activities

To accommodate the schedules of the team members, and agency and HGCMC representatives, the audit was performed as two site visits. For both visits, the audit team was based in Juneau and traveled to the site each day by the HGCMC ferry to Young Bay (Photo 1).

Cam Scott audited geotechnical issues at the site on April 28 to April 30, 2008. On the first day of the audit, he was accompanied by Charlie Cobb and Pete Condon. The remainder of Scott's site visit consisted of a detailed document review and tour of the facilities with Pete Condon. A debriefing was undertaken at the environmental offices at Hawk Inlet, in the presence of Pete Condon and Jennifer Saran.

The other auditors visited the site the week of May 5, 2008. On the first day of the audit (May 5), the SRK team and representatives from the agencies and HGCMC met initially for:

- a safety orientation;
- a presentation on the history and layout of Greens Creek Mine (provided by HGCMC); and
- a review of the objectives and methods of the audit.

Following the meeting, a tour of the major facilities at the site was provided by Pete Condon of HGCMC.

The initial meeting and site tour were attended by the following individuals:

- SRK Audit Team:
  - Stephen Day
  - Daryl Hockley
  - Don Hovdebo
  - Bill Jeffress
  - Kathleen Willman
- Agency Representatives:
  - Jeff DeFreest
  - Ed Emswiler
  - Kenwyn George
  - Steve McGroarty
  - Sarah Shoemaker
- HGCMC Representatives
  - William Oelklaus
  - Jennifer Saran

After the site tour, the auditors started the site visit component of the audit by reviewing documentation, interviewing HGCMC employees and further inspecting the site. The audit matrix

in Appendix B acted as a checklist for the audit. The auditors maintained individual notes and field records in various formats and these are compiled in the SRK project file for future reference.

Stephen Day, Bill Jeffress and Kathleen Willman visited the site daily from May 5 to 8. Daryl Hockley visited the site from May 5 to 7. Don Hovdebo audited the regulatory agencies on May 6 to 7 in Juneau. Mr. Hovdebo returned to the site on May 8 to conduct a site inspection.

Employees of HGCMC were kept informed of preliminary results of the audit and assessments by the auditors during the site visit as the information became available.

Numerous photographs were taken during the visit. Photographs to illustrate specific aspects of the audit are provided in Appendix E.

The goal of the audit visit was to complete nearly all of the review while on site and with the agencies and HGCMC available for consultation. This left the major post-audit activities as the close-out meeting and reporting.

2.6 Close-Out Meeting

The close-out meeting was held in Juneau on Friday, May 9, 2008 at the offices of ADEC to brief the agencies and HGCMC on the major findings of the audit.

The auditors (with the exception of Cam Scott) and representatives from the agencies and HGCMC participated. Daryl Hockley and representatives from ADNR participated by telephone and viewed presentation materials on-line.

2.7 Reporting

The deliverables for this work are a draft report, issued electronically to ADEC on August 8, 2008, and a final report submitted to HGCMC, ADEC, ADNR and USFS.

The reports shall include a comprehensive written record of the audit findings, along with any conclusions and recommendations of the auditors. Each team member was assigned sections based on their areas of responsibility, with the report compiled by the Project Manager.

3 Site Description

3.1 Site Location

The Greens Creek Mine is located near Hawk Inlet on northern Admiralty Island, in the Tongass National Forest, approximately 18 miles southwest of Juneau, Alaska (Figure 1). The Mine site is situated partly within the Admiralty Island National Monument and completely within the municipal boundaries of the City and Borough of Juneau.

The Forest Service has issued special use permits/leases for various aspects of the operations. In addition, HGCMC holds approximately 7,300 acres of patented mining and mill site claims in the area. This land will be conveyed to the United States at the end of mine life or in 2095 at the latest.

3.2 Geology

3.2.1 Hardrock

Geological background information was provided at the opening meeting. This information was supplemented by the description of the deposit from USGS Alaska Resource Data Files (ARDF) (http://ardf.wr.usgs.gov/quadmap.html). The following features of the deposit are noted:

- Greens Creek is a Triassic age volcanogenic massive sulfide (VMS) deposit. The USGS classifies the deposit as “Kuroko”-type, but mine personnel prefer “hybrid” because some of the features of the Kuroko-type model are not represented.
- The deposit occurs at the contact between black graphitic meta-argillite (structural footwall, geological hangingwall) and thinly laminated quartz-mica-carbonate phyllite (structural hangingwall, geological footwall).
- Both argillite and phyllite are mineralized with pyrite to varying degrees, but the phyllite is more mineralized.
- There are three main ore types present: massive, black and white. Massive ore is most common and is composed of pyrite, sphalerite and galena in a matrix of barite-bearing silica-carbonate rock. Chalcopyrite and arsenic, antimony and silver sulfosalts are present but less common. The black ore is similar but contains graphite. The white ore is pyrite poor and the gangue mineralogy is variable (barite, silicates or carbonates).

The 13 mile access road (Figure 2) from the ferry dock to the Tailings Disposal Facility and mine site intersects bedrock in several places. Rock types are similar to those found at the mine area and include variably pyritic argillites and phyllites.

3.2.2 Surficial

The following summary of the geomorphology and local soils is based largely on information provided in reports by Terrasat (1991), SRK (1989) and Blunden (1988).

Glaciers of up to 3,000 feet in thickness scoured the area during the Pleistocene, leading to the characteristic U-shape of Greens Creek Valley and the rounded ridges that occur in the upland areas, such as at the Tailings Disposal Facility. Retreating and advancing glaciers have left a thick complex of basal tills and outwash deposits (glaciofluvial and glaciolacustrine) overlain by colluvium and peat. Post-glacial isostatic rebound and tectonic activity have resulted in an emergent coastal landscape, which is marked by raised beaches and rejuvenated streams.

The soils in the vicinity of the 920 mill site facilities (Figure 2) consist typically of glaciofluvial silty sands and gravels, overlying a thick deposit of glaciolacustrine clayey silt. The silt is relatively stiff (or overconsolidated according to the terminology used in geotechnical engineering), likely due to the loading associated with a subsequent phase of glaciation. At Site 23, slightly west of the mill site, there are deposits of landslide debris and colluvium. The retreat of the glaciers in this area may have contributed to extensional creep within the glaciolacustrine deposit and the development of the landslide deposits at Site 23.

Down-gradient between Site 23 and an elevation of approximately 600 feet, the soils in the Greens Creek Valley typically consist of silty sands and gravelly outwash deposits directly overlying bedrock. Below an elevation of about 600 feet, deposits of glacial outwash, ablation tills and basal (lodgement) tills are common. These deposits are often comprised of compact clayey silt with some pebbles and cobbles.

The marine mollusks evident at the Zinc Creek Bridge area (elevation of approximately 250 to 300 feet) indicate the Greens Creek Valley was previously a marine fjord. However, the non-marine silt and clay deposits found at the base of terrace remnants between elevations of 500 and 600 feet indicate that a glacial lake occupied at least a portion of the valley.

In the vicinity of the Tailings Disposal Facility, the deposits typically consist of one or more of the following: peat, glaciofluvial sands and gravels, and overconsolidated marine clayey silt and a basal till made up of dense silty sand.

3.3 Mining Methods

The mine, located on the south side of Greens Creek, has a main access portal at an elevation of 920 feet. Personnel and supplies are brought into the mine at the 920 portal and distributed throughout the mine with rubber-tired vehicles. Ore and production rock[3] are removed from the

[3] For the purpose of this audit, the word “production rock” is equivalent to the term “waste rock” as defined in Title 18, Chapter 60 of the Alaska Administrative Code (18 AAC 60.990).

920 portal with rubber-tired vehicles, and all other levels are interconnected with ore and production rock passes accessed with these same rubber-tired vehicles. Ventilation intake occurs through the 920 portal, and exhaust is either directed out of the 1350 adit or from two nearby vertical ventilation shafts. A second small portal is located adjacent to the main 920 portal and serves as a secondary emergency escape way from the underground workings.

Underground mining methods incorporate rubber-tired diesel-powered equipment. Drift and fill is the primary mining method used to extract the ore. Long-hole stoping is also utilized in select ore zones conducive to this bulk mining method. Cemented tailings and production rock generated by the mining operations are used as backfill in mined out areas to support vehicles and equipment and to provide structural ground support, allowing subsequent mining of adjacent ore. Excess water from the mining operations is collected and piped to Pond 'A', located on the north side of Greens Creek.

3.4 Milling Methods

The mill site is located on the north side of Greens Creek approximately 800 feet from the mine. Access to the mine site from the mill site is via a bridge that crosses Greens Creek. The mill site consists of the mill buildings, fuel storage tanks, an office/shop complex, a coarse ore stockpile and production rock pile, water supply pumphouse, switch gear building, and a warehouse and storage area. A minimum of two weeks worth of supplies, including reagents, are typically stored at the mine/mill site.

A selective flotation milling process is used to concentrate valuable minerals from the raw ore following grinding. The flotation process consists of size reduction, mineral concentration, and moisture reduction of the concentrate. Size reduction involves grinding the ore in semi-autogenous (SAG) and ball mills. Ore enters the SAG mill at a size of 15 inches or smaller and leaves in the 0.05-inch (minus 16 mesh) size range. The ore then enters the ball mill to be further reduced in size to 80 percent at minus 74 microns (minus 200 mesh). This material is then slurried. Further size reduction of select flotation material in tower mills assists with the concentration of target metals.

The slurry is transported in pipes to flotation cells, where carbonaceous wastes, then valuable minerals, are separated from gangue materials in a series of froth flotation processes. The ore minerals in this case are sulfides of lead, zinc, copper, silver, and free gold. Waste includes various silicate, carbonate, and sulfide minerals. The valuable minerals adhere to air bubbles that rise to the surface of the tank and are removed. To make the process work, air and various reagents are selectively added to the flotation cells. This allows the bubbling or frothing action to float different minerals selectively so that differing metal concentrates can be produced. The concentrator recovers various valuable minerals into one of three concentrates for sale: zinc, lead, and bulk. No reduction of sulfides to base metals, or other changes in the chemical composition of ore minerals, takes place in the concentrator or at the project site. Small quantities of metallic gold and silver are also recovered on site using a gravity process and melted to form impure doré bars for shipment to off-site refineries.

Following separation of ore minerals from tailings, the concentrate slurries are piped to separate thickener tanks, where the water content is reduced. The thickened slurries are then compression-filtered to remove most of the remaining water. Concentrate products are reduced to some 8% by weight moisture. Tailings material is reduced to some 12% moisture, the optimum moisture level to achieve maximum compaction when placed as mine backfill or at the surface Tailings Disposal Facility.

During normal production, HGCMC mines an average of some 2,000 tons of ore each day. A comparable milling rate is processed daily, producing approximately 700 tons per day (tpd) of concentrate and 1,300 tpd of tailings.

3.5 Waste Management

3.5.1 Tailings

The filter-pressed tailings, which have 66% to 86% solids by weight passing the No. 200 sieve and are just below the optimum standard Proctor moisture content (approximately 15%), are split into two 'streams': a portion reports to the underground mine as backfill and the remainder is stacked in a pile at the Tailings Disposal Facility (TDF) situated near Hawk Inlet. In general, tailings are preferentially placed back into the mine as structural backfill, with the remaining material placed at the TDF. Tailings reporting to the TDF are loaded at the concentrator load-out area into covered maxhaul tractor/trailers, each with a 45-ton capacity, and hauled down the B Road to the TDF (Figure 2). Approximately 20 round-trips per day are required, but this varies depending on the daily underground tailings backfill requirements.

The current surface placement method involves depositing the tailings in discrete cells in the TDF, which allows better control over compaction, drainage and pore pressure dissipation. An access road is constructed and the pile is divided into a number of cells. Prior to placing the tailings, any saturated tailings or snow accumulations 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 in a sloped, one-foot lift and compacted by several passes with a bulldozer followed by at least two overlapping passes of a vibratory roller. If the delivered tailings cannot be placed and compacted upon arrival, the tailings are stockpiled to minimize the potential for additional moisture infiltration (or drying during warm periods). During this placement, the grading and compaction-sealing of the surface allows surface water to run off, and, as best as possible, minimizes 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 provides time for the dissipation of any construction pore pressures that may have built up in the originally placed tailings.

The construction of access roads on the surface of the tailings pile is dictated by tailings compaction. Successful compaction supports haul truck traffic, making it practical to remove some or all of the planned access roads from the design unless excess moisture is present.

Maintaining drainage is an on-going activity and changes as a function of the pile configuration and active placement area. In order to protect tailings from erosion, runoff is directed to armored/rocked areas, road ditches and outside slopes. Ditches are cleaned on a schedule that depends on the rate at which sediment accumulates.

3.5.2 Production Rock

Due to its variable geochemical properties (and acid generation potential), production rock is managed on the basis of the following classification system. The classification is done by a geologist at the underground blast face or muck pile based on visual characteristics.

- Class 1: This material has a Net Neutralization Potential (NNP) > 100 tons Calcium carbonate ($CaCO_3$)/1000 tons. No special handling is required.
- Class 2: This material has a NNP value between 100 and -100 tons $CaCO_3$/1000.
- Class 3: This material has a NNP value between -100 and -300 tons $CaCO_3$/1000 tons.
- Class 4: This material has a NNP value less than -300 tons $CaCO_3$/1000 tons and is kept underground as fill.

A letter from ADEC dated May 13, 2004 approved the following proposal by HGCMC for production rock handling. The GPO Appendix 11 will be revised to reflect these changes:

- Allow mixing of Class 2 and Class 3 to avoid physical discontinuities in the pile;
- Discontinue placement of Class 1 at the base of the pile to allow more beneficial use at Site 23 and the tailings pile as an outer slope encapsulating layer, for erosion protection and for road construction;
- Decrease the outer Class 1 layer from 5 feet two 2 feet to meet demand for Class 1 at the Tailings Disposal Facility.

Production rock of Classes 1 through 3 hauled from the underground mine is placed at Site 23, west of the mill site. Site 23 is the only active production rock disposal facility. The site is being developed with outer slopes acceptable for final closure (3H:1V) using the ascending ("bottom up") construction method. In order to increase the stability and capacity of Site 23, parts of the backslope are excavated prior to the placement of the production rock. In addition, designated placement zones linked to the three classes of rock are marked on the active lift area prior to placement of production rock.

3.5.3 Non-Mining Wastes

Solid wastes at the site are managed under Waste Management Permit 0211-BA001, according to Title 18, Chapter 60 of the Alaska Administrative Code (18 AAC 60), and Subtitle D of the Resource Conservation and Recovery Act (RCRA). A large number of materials are sent offsite for recycling, significantly reducing the quantities of waste to be managed onsite. HGCMC should be commended for their efforts to reuse and recycle materials. The majority of non-hazardous incidental waste that cannot be recycled is incinerated or shipped offsite for disposal. In addition, some quantities of non-hazardous wastes are placed in permitted facilities (up to 5% of waste in the

TDF, Site 23 and underground may include some non-mining waste under provisions of Waste Management Permit 0211-BA001).

The Greens Creek Mine site is a Small Quantity Generator under RCRA and ships limited quantities of hazardous wastes offsite to a permitted treatment, storage and disposal facility (TSDF).

3.6 Water Management

An updated report describing the site water balance was prepared by Environmental Design Engineering (EDE) in 2003. However, significant improvements to the water management and water treatment systems at the site have been implemented since that time, in part because of a regulatory requirement that the storm water design criteria be increased from the 24-hour, 10-year event to the 24-hour, 25-year event. A general overview of the current water management systems is provided below.

The cycle of water management begins with the collection of fresh water for mine, mill, and potable uses. Fresh water intake diversions are located at Greens Creek near the mill site and at Cannery Creek near the Hawk Inlet camp and shipping dock facilities. These fresh water sources provide water for milling operations, domestic use, equipment wash-down, and fire suppression. Fresh water storage is provided at two locations: the 1160 storage tank above the mill site and office facilities, and in three head tanks near the camp facilities at Hawk Inlet.

Wastewater sources include mill process water, wastewater from the mine, domestic wastewater, and facilities storm water. Although the mill site water treatment plants (WTP) and sewage treatment plant provide treatment at the mine/mill facilities area, all wastewater is ultimately routed to the Tailings Disposal Facility containment, treatment and discharge facilities. This “composite” wastewater comes primarily from the following locations:

- Domestic wastewater and storm water from the upper and lower facilities pads at the Hawk Inlet operations area collected at de-gritting basin 04 (DB–04);
- Surface tailings contact water and storm water from tailings area facilities, plus seepage which is captured from these facilities;
- Site 23/Site D storm water, plus seepage which is captured below Site 23/Site D; and
- Mill site area storm water, mill site domestic wastewater and mill WTP discharges (which result from the preliminary treatment of water from the mill site area and Site 23/Site D).

The central wastewater treatment facility is located adjacent to the TDF. The WTP facility at Pit 5 was decommissioned when the new WTP facility adjacent to Pond 7 was commissioned in June 2008. The WTP at Pond 7, which was under construction at the time of the SRK site visits, will have the capacity to treat much larger volumes of water than possible with the previous system. Treated water is routed to Tank 7 adjacent to Pond 7 and discharged via gravity flow through a pipeline and submerged diffuser within Hawk Inlet (NPDES discharge Outfall 002).

3.7 Monitoring

Monitoring activities conducted at the Greens Creek Mine include, but are not limited to, the following:

- Air quality as specified in Air Quality Operating Permit No. 302TVP02, including US Environmental Protection Agency (EPA) 9 Visible Emissions Observations from equipment exhausts and source testing on liquid-fired turbines to determine the concentration of particulate matter in exhausts;
- Water quality of groundwater and surface water as specified in Waste Management Permit 0211-BA001 and Fresh Water Monitoring Program (FWMP, Appendix 1 of GPO);
- Quality of water discharged under the National Pollutant Discharge Elimination System (NPDES) Permit – AK004320-6, as well as semi-annual marine organism and sediment monitoring under provisions of this permit;
- Storm water monitoring according the Best Management Practices and NPDES Permit – AK004320-6;
- Leachate from the tailings disposal and production rock facilities according to the Tailings Internal Environmental Monitoring Program (Appendix 3 of GPO) and Production Rock Internal Environmental Monitoring Program (Appendix 11 of GPO) on a quarterly basis;
- Freshwater aquatic life according to the FWMP in July each year;
- Visual inspections of the facility daily, weekly or monthly depending on the specific area;
- Inspections of fuel and oil containment according to the ADEC Title V Air Quality Permit AQ0302TVP02, Spill Prevention Control and Countermeasure (SPCC) Plan and Facility Response Plan's provisions;
- Dust levels and the metal constituents in the dust near the Hawk Inlet ship loading facilities;
- Hazardous waste as specified under the Resource Conservation and Recovery Act (RCRA);
- Precipitation and temperature as required by Waste Management Permit 0211-BA001;
- Geochemical monitoring of tailings and production rock according to the Tailings Internal Environmental Monitoring Program (Appendix 3 of GPO) and Production Rock Internal Environmental Monitoring Program (Appendix 11 of GPO);
- Geotechnical monitoring of the Tailings Disposal Facility and Site 23 (phreatic water level, density).

3.8 Infrastructure

Supplies, such as fuels and reagents, are transported by barge to the Hawk Inlet dock facility and unloaded at the marine terminal complex. The cargo dock is located at the same site as the old cannery dock structure. The barge dock consists of breasting dolphins and a floating dock connected by ramp to land. HGCMC receives a yearly average of 80 barges bringing goods, road rock, and fuel to these Hawk Inlet facilities. Chemicals and containers are unloaded from barges by forklift and transported to the process site by truck. HGCMC wastes and return materials shipping containers are placed back onto these barges by forklift.

Hawk Inlet infrastructure also includes 200,000 gallon and 10,000 gallon bulk diesel fuel storage tanks, associated fill piping from the fuel barge unloading dock, a fuel loading facility for vehicles and the tanker truck, an electrical generator building, and warehouse. Less than 1,000 gallons of gasoline is also stored at the fuel loading facility. Assorted lubricating oils and used oils in portable tanks, totes, and drums are temporarily stored at this site's warehouse prior to their transport to the mine/mill site. A large ore concentrate storage building (maximum 40,000 tons capacity), temporary housing facilities, and ancillary support facilities are also located at the Hawk Inlet site. Chemicals are delivered in dry and wet form in containers by barge, offloaded, and stored at the warehouse at this location.

Concentrates are transported from the mill to Hawk Inlet dock facility by covered haul truck. An enclosed telescoping boom conveyor and drop chute are used to transport concentrates from within the shore storage area directly into the holds of bulk cargo ships. Some twelve to 18 concentrate ships are loaded by HGCMC annually in Hawk Inlet.

In 2006, the installation of infrastructure to augment the mine's use of diesel-generated power with less expensive hydroelectric power was completed. Although the Snettisham hydroelectric link has the ability to provide cheaper power, the hydroelectric power has to rely on normal or above normal precipitation in order to generate sufficient power for the mine. The Greens Creek operation relies on on-site power generation when hydroelectric power is not available, which was the case after the April 16, 2008 avalanches severed Juneau's connection to the Snettisham hydroelectric project.

3.9 Regulatory Setting

The Greens Creek Mine is located within the Admiralty Island National Monument. Currently, there are 53 separate permits and approvals issued by various Federal, State and Municipal agencies covering activities at and around the Greens Creek operation. The operation of the mine and associated facilities is authorized in part under a series of leases and other land use authorizations from the USFS, and are carried out in accordance with the General Plan of Operations approved by the USFS. Certain areas of the mine's operation are also subject to other federal and state permits and approvals issued by other federal and state agencies.

USFS has issued special use permits/leases for various aspects of the operations. In addition, HGCMC holds approximately 7,100 acres classified as a Land Exchange Area for which the USFS has granted HGCMC exclusive rights to explore and mine, with specified restrictions, for 99 years, provided all stipulations have been met. This area is inclusive of the HGCMC patented mining claims and some previously leased/permitted sites from the USFS within the area. All lands owned by or leased to HGCMC by the USFS will be conveyed to the United States at the end of mine life or in 2095 at the latest.

ADEC regulates mill tailings and production rock disposal facilities at the Greens Creek Mine as well as other aspects of the operation primarily through Title 18 of the Alaska Administrative Code

(AAC), Chapters 50, 60, 70, 72 and 80. Several permits are issued by ADEC, including, but not limited to the Air Quality Operating Permit No. 302TVP02 and the Waste Management Permit 0211-BA001 (WMP), which authorizes tailings and production rock disposal and prescribes monitoring, reporting, closure, post-closure and financial responsibility requirements. ADEC also approves the discharge of wastewater by Clean Water Act Section 401 certification of the EPA NPDES permit AK-004320-6.

ADNR issues certain land and water use authorizations and dam safety certificates covering site wide operations, including some of the tailings management infrastructure. In addition, ADNR regulates the Reclamation and Closure Plan and bonding for the mine.

Oversight by the EPA includes storm water management and wastewater disposal, regulated through NPDES Permit AK004320-6, hazardous waste disposal, regulated by the Resource Conservation and Recovery Act and the management of fuel and oil under the oil pollution prevention requirements of 40 CFR 112. Other federal agencies involved in the operation of the mine include the US Coast Guard, Nuclear Regulatory Commission (nuclear sources), Bureau of Alcohol, Tobacco and Firearms (explosives), Federal Communication Commission (radio station authorization) and Federal Aviation Administration (floatplane landing facility).

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4 Audit Findings

The following sections document the findings of the auditors and include recommendations to address the findings. The sections are organized in a similar fashion to the Detailed Scope of Work provided in the Request for Proposal and summarized in the Audit Matrix (Appendix B). Sections have also been added for findings not included in the original Detailed Scope of Work.

4.1 General Areas

Many of the areas outlined in the Detailed Scope of Work are discussed in Section 4.2, *Specific Areas*. In particular, findings associated with permitted waste management facilities, such as the Tailings Disposal Facility, Production Rock Site 23/D, and the underground mine are discussed in Sections 4.2.1, 4.2.2, and 4.2.5, respectively. All discussions of reclamation and post-closure cost estimates can be found in Section 4.2.7. Conflicts and inconsistencies within the Waste Management Permit (WMP) and General Plan of Operations (GPO) are addressed in Sections 4.1.13.3 and 4.2.11.3.

4.1.1 Other Inactive Production Rock Sites and Quarries

This task is addressed in Section 4.2.3.

4.1.2 Storm Water Management and Effects

All tasks associated with storm water are discussed in Section 4.2.6.

4.1.3 Bonding for Reclamation and Post-Closure Activities

This task is addressed in Section 4.2.7.

4.1.4 Environmental Monitoring Programs

4.1.4.1 General

Environmental monitoring programs should be designed and implemented in a manner that allows for the identification of statistically significant changes in the targeted component of the ecosystem and be of sufficient rigor to allow for an informed assessment of whether an observed change is significant enough to threaten ecosystem integrity.

In order to assess the ability of the current Greens Creek Mine Site environmental monitoring program to fulfill this role, the following documents were reviewed prior to the site visit: Appendix 1, 3, and 11 of the General Plan of Operations, the *Tailings and Production Rock Site 2006 Annual Report*, the *Inactive Rock Sites and Quarries 2006 Annual Report*, the *Aquatic Biomonitoring*

Report, Greens Creek Mine 2006, and the *Fresh Water Monitoring Program Annual Report, Water Year 2006*.

This was followed by a site inspection on Monday May 4, 2008 and Thursday May 8, 2008, during which particular attention was paid to the location of sampling stations and the position of each station in relation to site activities, surface features and potential contaminant transport pathways, such as surface water flows, prevailing winds, etc. A copy of the Site Inspection Report is included in Appendix D.

As the 2007 annual reports became available subsequent to the May 2008 site inspection, these were also reviewed during the preparation of this report. That review included the *Tailings and Production Rock Site 2007 Annual Report*, the *Inactive Rock Sites and Quarries 2007 Annual Report*, the *Aquatic Biomonitoring Report, Greens Creek Mine 2007*, *Fresh Water Monitoring Program Annual Report, Water Year 2007*, a number of *NPDES Discharge Monitoring Reports (DMRs)*, and *2007 Annual BMP and Stormwater Monitoring Report.*

Based on these activities, it can generally be concluded that the current environmental monitoring program at the Greens Creek Mine Site is appropriate to allow for an informed assessment of whether or not an observed change in the environment is statistically significant. Therefore, based on the review the program, the environmental monitoring program is generally performing its role as a check on the performance of the site, with the few exceptions discussed below.

Additional monitoring is recommended as follows:

- Evaluation of the impacts of wind-blown dust dispersion from the Tailings Disposal Facility, discussed in Section 4.2.1.7;
- Assessment of potential contaminant uptake by vegetation, discussed in Section 4.2.1.8; and
- Installation of a second slope inclinometer at a location significantly downslope of the existing inclinometer at Site 23/D, discussed in Section 4.2.2.2.

Some adjustments are also recommended to the existing water monitoring regime, discussed in Section 4.2.9, and to the geochemical monitoring programs, discussed in the following section.

4.1.4.2 Geochemical Monitoring Programs

The existing geochemical monitoring programs for production rock and tailings solids are considered appropriate; however, SRK recommends improvements in record-keeping to allow results to be easily and efficiently retrieved when needed.

A method being used for neutralization potential (NP) determination at the site is not completely consistent with the standard method due to the fact that the “fizz determination” is not being completed. Fizz is determined using hydrochloric acid and results in the selection of acid strength and volume in the subsequent step in the procedure. The site currently assumes that the fizz is “strong”, which results in the highest allowable strength acid and largest volume of acid in the

procedure. This can result in over-estimation of NP if carbonate content is low. The adaptation of the method is considered reasonable for the site conditions because the rocks contain high levels of carbonate; however SRK recommends recording of the fizz determination for future analyses to provide support for the adaptation.

4.1.5 Spills and Releases

This task is addressed in Section 4.2.10.

4.1.6 Agency Oversight

This task is addressed in Section 4.2.11.

4.1.7 Modifications since Bond Review

All discussions of reclamation and post-closure cost estimates can be found in Section 4.2.7.

4.1.8 Schedule for Initiation of Reclamation of Inactive Sites

This task was not completed during the audit. Recommendations have only been provided when they resulted from an audit finding and were deemed essential to the overall goal of the audit.

4.1.9 Hawk Inlet

During the May 9, 2008 site inspection, the Hawk Inlet loading facility was inspected in detail. A copy of the site inspection is included in Appendix D. The most significant findings related to the inspection of the Hawk Inlet facilities are provided below.

4.1.9.1 Stationary Barge and Ramp

The stationary barge and ramp were inspected and found clean and well maintained. Spill response material was adequate, well maintained and easily accessible. Two used automotive/industrial batteries were noted. When questioned, site personnel indicated that during the required annual scuba inspection of the area, “legacy” batteries and other waste materials from the historic cannery facilities operated at this site are often recovered from the substrate in the HGCMC docks and stationary barge area.

Based on the visual inspection, the stationary barge ramp appears to have been constructed using creosote treated timbers and it was noted that appropriate management and disposal of this material will be required when the barge ramp is decommissioned. Prior to the disposal of this material, HGCMC should initiate discussions with ADEC and the EPA in order to ensure that any applicable legislation, regulations and policy requirements are fully addressed.

4.1.9.2 Concentrate Load-out Facility

The concentrate storage building was inspected as was the area immediately in front of the facility doors. The area in front of the building doors has concrete containment, which extends to the truck wash station and the fuel loading stations. All areas of the concrete containment slope toward strategically located floor drains, which were found to be free of debris and in good working order. Some evidence of a small amount of concentrate outside of the facility doors was identified; however it was all within the designed containment area.

General housekeeping of the concrete area in front of the concentrate load-out building must be maintained at all times in order to reduce the potential of tracking the material out of the building and potentially off the concrete apron.

DB-04 containment pond was inspected and found to be well maintained. Adequate freeboard was found within the pond at the time of the inspection.

The loading gantry was also inspected and found to be clean and well maintained. It could not be confirmed during the site inspection whether a formal inspection and maintenance schedule has been established for the load-out facility in an effort to reduce equipment failures and unanticipated spills during loading operations. If not in place, consideration should be given to establishing a detailed inspection schedule of the facility, including a mechanical inspection of the gantry and associated equipment (chutes, hook ups, etc.) and the permanent retention of a record of the inspections and maintenance conducted.

4.1.9.3 Concentrate Area Truck Wash

The concentrate load-out area truck wash was inspected and found to be in good order. Splash was retained within the building and containment and collection of the wash water appeared adequate. A bulk fuel storage tank located at the back of the facility did not have a cap (bung) on the inspection hole for the outside containment.

Two haul trucks were stationed (parked) at Hawk Inlet at the time of the inspection. A detailed inspection of two trucks which had recently been through the truck wash station was conducted. The inspection included the visible surface areas of the truck and the undercarriage of both the tractor unit and the trailer. Generally, all areas were found to be clean with little residual materials found on the majority of the truck and trailer surfaces. A small amount of residual material was found within small protected void spaces and on areas of high splash (mud flap tops, etc.). This material was located at the same height on each truck and was found to be wet to the touch and easily dislodged, indicating that it may be the result of not washing the trucks for a sufficient amount of time for all the material to be dislodged.

It was not clear during the inspection how often the truck wash is inspected or if environmental personnel at the site perform spot audits of the trucks themselves and of the truck washing facility performance. Consideration should be given to such a program if not already in place.

4.1.9.4 Bulk Fuel Unloading Dock

The bulk fuel unloading platform (steel construction) was inspected and found to be excellent. Secondary containment within the facility was excellent. A barge of more than 100,000 US gallons of diesel had been unloaded within the previous 12 hours, and there was no evidence of spillage; all surfaces were free of hydrocarbon, with only an extremely light hydrocarbon sheen on a puddle within the containment created by a recent rain.

The entire length of the fuel unloading pipeline was inspected and found well maintained. No evidence of past spillage was evident at any point along the pipeline.

The Hawk Inlet bulk fuel storage area was inspected as was the secondary containment. The secondary containment appeared to be more than adequate in size and was found in good condition with no significant cracks or holes in the HDPE liner. The area was dry with only small ponding of precipitation water. Water from this containment area is discharged to the nearby DB-04 pond by manual operation of a pump, from where it is conveyed to the water treatment facility at the TDF along with other site-wide wastewaters.

The Hawk Inlet re-fueling station area was found well maintained, with no evidence of spillage during refueling of equipment. Nozzle drip containment reports to a trough, which reports to the tank farm secondary containment area.

4.1.9.5 Used Oil Tank

There is a 10,000-gallon tank containing used oil located at the Hawk Inlet Warehouse for which no secondary containment is provided (Photo 2). SRK recommends that HGCMC consider providing secondary containment for this tank.

4.1.10 Potable Water

Potable water is treated onsite in two Class A Public Water Systems. Public Water System (PWS) 119205 pumps water from Greens Creek and is located at the 920 area. PWS 113560 pumps water from Cannery Creek and is located at Hawk Inlet. A review of the systems indicated that HGCMC complies with operations and plant operator certification requirements.

A waiver from sampling for Synthetic Organic Contaminants (SOC) and other organic contaminants (OOC) was issued for PWS 119205 and PWS 113560 for a three-year period from 2005 to 2007. The Compliance Period was granted by ADEC. Waivers expired December 31, 2007 and new waivers have not been reissued nor the old waivers administratively extended by ADEC. HGCMC will be required to sample and analyze for SOC and OOC if the waivers are not reissued.

4.1.11 Water and Load Balance

The HGCMC Site Water Balance was updated on May 6, 2003 during the NEPA process, as part of the supporting documentation for expansion of the TDF. Refinement of the site water balance is ongoing, with the planned installation of eighteen (18) surface flow measuring devices (i.e. trapezoidal weirs, Parshall flumes, staff gauges, etc.). A number of flow measuring gauging stations were installed during 2008 for testing, and the remaining stations will be installed pending test results. The addition of these flow measuring devices will further improve the existing site water balance.

Waste Management Permit #0211-BA001 subsection 3.4.3 requires that the permittee "*by January 29, 2006 provide sufficient storage to contain and control the 24-hour, 25-year storm event*". Containment and control of a 24-hour, 25-year storm event is dependent on having sufficient capacity throughout the entire water management infrastructure on site to effectively handle the anticipated flows. This includes having sufficient capacity in all components of the system, including containment ditches, piping, culverts (if present), and retention ponds and pumping capacity, to effectively manage potentially contaminated water. A recent and up-to-date site water balance, which includes accurate containment pond volumes, average flowrates at specific locations and pumping capacities, was not provided during the audit, although a site map showing flow paths was provided by site personnel on the second inspection day. During the May 8, 2008 site inspection, site personnel could not provide accurate average flows or containment volumes for a number of different lined containment ponds located throughout the facility. As a result, it was not possible to clearly ascertain whether the requirements specified in subsection 3.4.3 of the Waste Management Permit were met.

An updated site water balance is the basis for the TDF expansion design and is critical in storm water control structure design. SRK recommends that HGCMC prepare a current and detailed site water balance for the entire site and that the water balance include, at a minimum, all flows paths within the site, accurate volumes for all containment ponds, the summary of average flows at specific and strategic locations, and pumping capacities at strategic locations. It is further recommended that the updated water balance be submitted as soon as possible for review and approval by the appropriate regulatory agencies.

The water balance should be updated on a regular basis and coupled with a load balance to properly assess changes to the water flow regime and/or chemical balance of the system.

4.1.12 Water Use Authorizations

A review of the water use authorizations was conducted during the audit. In summary:

- Temporary Water Use Permits (TWUP) J2005-04, J2005-03, and J2000-10 provide the authorization for the bulk of the water required for HGCMC operations from the Fowler Creek drainage, Greens Creek drainage and Cannery Creek, respectively.

  - TWUP J2005-04 and TWUP J2005-03 expire on 05/08/2010;
  - TWUP J2000-10 expired on 10/25/05 and HGCMC's application for water appropriations was accepted by the ADNR Division of Mining, Land and Water on August 7, 2000. Due to a backlog and lack of resources at ADNR, the protracted adjudication process of LAS 23150 to replace TWU J2000-10 may continue.

- LAS 11807 and 11808 water use authorizations expired on 03/10/98 and were indefinitely extended by ADNR in a letter dated 02/25/99.
  - The enabling statute or regulations that authorize ADNR to indefinitely authorize such extensions should be verified by ADNR to justify their procedure.

- ADL 43347, State of Alaska Water Rights Certificate for Cannery Creek, is in place and continuous.

- ADNR requires annual water use reports for TWUP, LAS, and ADL authorizations. HGCMC currently submits monthly reports to USFS.
  - The rationale for the USFS requirement for HGCMC to submit monthly water use reports was not documented nor explained by staff. This seems to be an unnecessary reporting requirement when the authorizing agency (ADNR) only requires annual reporting.

4.1.13 General Compliance

Key permits, plans and supporting documentation were reviewed during the audit. In addition, a review of compliance against the RCRA regulations was conducted. The review examined a sample of supporting documents only and did not include an examination of all available records. Table 4-1, located at the end of this section, shows the documents and requirements examined and the finding in each case. Further discussion of the requirements contained in some of the supporting documentation is provided in subsequent sections.

4.1.13.1 NPDES Permit AK-004320-6

The auditors requested a sample of records required to be on file as specified in NPDES Permit AK004320-6. HGCMC was able to produce all the records requested, as shown in Table 4-1.

4.1.13.2 Air Quality Operation Permit AQ0302TVP02

A limited amount of time was spent auditing compliance with Air Quality Operating Permit No. 302TVP02 as a full compliance evaluation of the Air Quality Permit was completed by ADEC on December 31, 2007. The evaluation covered the period from April 15, 2006 through December 31, 2007. Due to the fact that HGCMC did not provide records of current M9 certification certificates at the time of the evaluation, ADEC found HGCMC to be out of compliance with Condition 54 of the permit, which states: "*Upon request, the Permittee shall furnish to the Department copies of records required to be kept by the permit*". No action was taken as it did not appear to be a recurring violation and HGCMC took action to address the violation.

4.1.13.3 Waste Management Permit 0211-BA001

Waste Management Permit #0211-BA001 was reviewed in detail during the audit. Inspection records, documents and procedures were examined to assess compliance with the Waste Management Permit, as summarized below:

- Section 1.1, Prohibited Wastes, provides a list of wastes that are not allowed to be disposed of at the permitted facilities. HGCMC has a Waste Handling Standard Operating Procedure (SOP) that employees are required to follow. Inspections should include a check for prohibited wastes at the permitted facilities;
- Section 2.1.3 states: "*Up to five percent of the waste in the tailings disposal facility or Site 23 may be non-hazardous incidental wastes which may include the following*". The auditors were not able to establish if any controls exist to ensure this stipulation is met;
- Subsection 2.4.8 of the WMP states that within two years of the issuance of the permit (i.e. by October 7, 2007), conduct a qualitative and quantitative study performed by a qualified plant or soil scientist that addresses long-term issues related to tree blow-down on the final cover system, incorporate the findings into the reclamation plan as appropriate and insure that the study shall provide reliable information on whether or not tree blow-down may cause deterioration of the integrity of the final cover system over time or change any of the design assumptions. Evidence of compliance with this section of the Waste Management Permit was not found.
- Section 2.7 provides stipulations for visual monitoring. HGCMC inspects using a checklist, as shown below. The following inspection forms were examined for the past two years:
    - Production Rock Site 23 Inspection
    - Tails Inspection
    - Tailings Dam inspection
    - 920 Water Control and Containment Inspection
- Several inspection forms were missing from the files as shown in Table 4-1.
- After a thorough review of the items on the inspection forms, the auditors were not able to verify that all the stipulations in Sections 2.7 are being met. The inspection forms do not contain the same language as the permit, which makes it difficult to check for compliance.
    - SRK recommends that HGCMC review the requirements for visual monitoring in the Waste Management permit to determine which inspections fulfill these requirements. This information should be documented. A good location to hold this information is the existing Compliance Matrix (see Section 4.1.14). Items not being inspected and recorded on a checklist should be addressed with additional inspections and/or revisions to existing inspection forms.
- Upon review of the requirements of Section 2.7, it was unclear which facilities were required to be inspected monthly using a checklist. For example, Section 2.7.1.6 includes the requirement to inspect containment or seepage structures. The auditors were not clear if

containment structures included secondary containment structures or containment structures associated with permitted waste management facilities only. This question was posed by the auditors to ADEC, but a definitive answer has not yet been received.

  - SRK recommends that ADEC provide clarification on this issue in the next permit. Alternatively, HGCMC could specify the areas to be inspected in a plan of operations, which would then be adopted by the Waste Management Permit upon approval by ADEC.

- Monitoring of groundwater, surface water and leachate under the Fresh Water Monitoring Plan are discussed under Section 4.2.9 and 4.2.11.3.1.
- As discussed in Section 4.1.11 of this report, Section 3.4.3 of the Waste Management Permit requires that the permittee "*by January 29, 2006 provide sufficient storage to contain and control the 24-hour, 25-year storm event*". It was not possible to ascertain whether this requirement has been met at all locations requiring such containment. SRK recommends HGCMC prepare a current and detailed site water balance for the entire site and submit it as soon as possible for review and verification by the appropriate regulatory agencies.
- Section 3.6.2 requires that HGCMC "*Analyze four samples of fresh tailings each quarter for the Net Neutralizing Potential and exposed tailings annually for paste pH in accordance with Appendix 3 Section 4 of the GPO*". The GPO Appendix 3 also includes requirements for analyzing tailings for paste pH. A review of the Tailings and Production Rock Site 2007 Annual Report and interviews with HGCMC revealed that the tailings have not been analyzed for paste pH since 2005;
- The GPO Appendix 3 states "*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*". The Waste Management Permit and the GPO Appendix 3 requirements are inconsistent. Greater effort is required by all parties to ensure consistency between the Waste Management Permit and GPO. One option that may be considered is to have the Permit reference the GPO rather than specifying the frequency and number of samples required. This would allow for greater flexibility to modify the requirements.
- Section 4.1.1.2 states: "*Analyze annually for the chemistry, net neutralizing potential and paste pH. The sampling schedule shall be in accordance with Appendix 11 of the GPO*". The GPO Appendix 11 also states "*a minimum of 32 samples, but not less than 1 sample per 1 acre from the uncovered sideslope of Site 23 will be collected for analysis of paste pH*". As with the tailings, analysis of paste pH on production rock has not been conducted since 2005.
- Section 6.2 requires that an annual report be submitted. The Tailings and Production Rock Site 2007 Annual Report was reviewed to check for compliance with the reporting requirements. The report is very comprehensive. However, it was difficult for the auditors to verify that all the requirements of the annual report were included. The cross references in the Executive Summary did not match the Permit sections in all cases. For example, the Executive Summary lists Section 6.2.4 of the Permit as "Location and Volume of Materials",

whereas 6.2.4 of the Permit covers updates to financial assurance. The auditors could not find any reference to financial assurance in the Table of Contents or Executive Summary (it is included in Section 2.8, Reclamation/Closure Plan).

4.1.13.4 Hazardous Waste Management

Hazardous waste management practices were reviewed broadly during the audit. HGCMC is a Small Quantity Generator under RCRA, which means they generate between 100 and 1000 kg of hazardous waste per month. As such, HGCMC is required to comply with the Resource Conservation and Recovery Act regulations in 40 CFR, including:

- 262.11 – Requirement to make a hazardous waste determination on all wastes;
- 262.12 – Requirements for obtaining an EPA identification number;
- 262 Subpart B – Requirement for manifests for shipments of hazardous waste;
- 262 Subpart C – Pre-transport requirements, including packaging, labeling, marking, placarding and accumulation time;
- 262 Subpart D – Requirements for record keeping and reporting;
- Part 266 – Standards for the management of specific hazardous wastes
- Part 268 – Land Disposal Restrictions
- Part 273 – Universal Waste standards
- Part 279 – Used Oil standards

The results of the review are summarized below:

- HGCMC has the appropriate EPA waste identification number.
- The Standard Operating Procedure for Waste Handling outlines the procedures for managing hazardous wastes at the site. There are two hazardous waste storage areas: 1) the 920 storage site, which is a storage facility for 55-gallon or less drummed material; and 2) the Hawk Inlet Warehouse, which serves as the staging area for materials being shipped offsite for disposal. In addition, there are Satellite Accumulation Areas for aerosol can perforation units.
- The auditors examined the 920 Waste Area Inspection forms. Based on the dates on the inspection forms, the inspections are done monthly. 40 CFR 262.34(1)(i) requires that containers meet the requirements of 40 CFR 265 Subpart I, which includes the requirement for inspections at least weekly. Section 265.174 states: "*The owner or operator must inspect areas where containers are stored, at least weekly, looking for leaks and for deterioration caused by corrosion or other factors*".
    - HGCMC needs to ensure that all hazardous waste storage areas, other than Satellite Accumulation areas, are inspected weekly.
- During the surface inspection on May 08, a Connex holding hazardous waste was examined at the 920 area. The Connex held a single container of hazardous waste. The container was

not labeled with the words "Hazardous Waste" or the date upon which the accumulation period began, which is required according to 262.34.

- SRK recommends that HGCMC:
  - Develop a RCRA compliance program, which includes:
    - Appropriate training for employees (e.g. annual refresher for at least one employee, DOT training for employees filling out manifests);
    - A system to calculate the total amount of hazardous waste onsite at any time and the amount of time each container of waste has been stored to ensure the accumulation time and quantity limits for Small Quantity Generators are not exceeded;
    - Documentation for all wastes supporting their waste determinations (whether by generator knowledge or analysis);
    - Standard Operating Procedures for all aspects of the management of hazardous waste onsite, including hazardous waste determinations, inspections, required training, accumulation time and quantity limits, shipping, etc.
  - Include the requirements of RCRA in the Compliance Matrix (Section 4.1.14).

4.1.13.5 Spill Prevention Control and Countermeasure (SPCC) Plan

The HGCMC SPCC Plan, GPO Appendix 6, dated September 9, 2006, is certified by a professional engineer, licensed in the State of Alaska, as required under 40 CFR 112. The SPCC Plan was reviewed in terms of its adequacy in preventing and controlling spills, the results of which are provided in Section 4.2.10.6. An assessment of compliance with a number of the requirements of the Plan was also made during the audit, which included a review of the following inspection forms:

- HGCMC Weekly Tasks, which include tasks relating to secondary containment and spill response equipment;
- Monthly SPCC Inspection of Hawk Inlet Fueling Facilities;
- Monthly SPCC Inspection of 920 Bulk Oil & Fluids Facilities;
- Monthly SPCC Inspection of 920 Bulk Fueling Facilities;
- Tank Farm Inspection Sheet;
- Declaration of Inspection Prior to Bulk Cargo Transfer;
- Transfer Checklist for Person-In-Charge;
- Pre-Fuel Transfer Checklist for Hose Watchman.

From a review of a sample of inspection records, it appears that these inspections are being carried out appropriately and regularly. A review of training documents and records was also made. HGCMC has an extensive training program for Surface Operations personnel, which is detailed on the "Surface Ops Pre-Job Checklist Form". Surface Operations personnel are trained in spill prevention and response as their job duties include transporting and transferring hazardous materials and operating the Hawk Inlet Bulk Fuel Unloading Dock. Training records were

requested during the audit. A training record for a Person-In-Charge was produced; however it was dated December 16, 2006. More recent records were not provided to the auditors.

A review of inspection records and interviews with HGCMC personnel did not reveal documented inspections for all transformer secondary containment, although personnel report that these areas are regularly inspected. During the surface inspection on May 8, secondary containment on the transformer located behind the old water treatment plant at the Tailings Disposal Facility was found to be full of water, eliminating the containment capacity (Photo 3). This demonstrates the need for documented inspections of these areas.

Table 4-1: Compliance Review Summary

Documentation/Requirement	Status
NPDES Permit AK-004320-6	
Annual video showing status of diffuser	On file
Monthly Discharge Monitoring Reports	On file
Annual reports	On file
Quality Assurance Plan	On file
Best Management Practices Plan	On file
Comprehensive Site Compliance Evaluation	On file
Air Quality Operating Permit 302TVP02	
Sulfur content of fuels consumed	On file
Visible emissions monitoring forms	On file
Records of equipment operating hours	On file
Waste Management Permit 0211-BA001	
Wastes prohibited	Waste Handling Standard Operating Procedure outlining proper waste disposal
Section 2.1.3 "*Up to five percent of the waste in the tailings disposal facility or Site 23 may be non-hazardous incidental wastes*"	Unclear how this stipulation is controlled
Subsection 2.4.8 requires a tree blow-down study for the final cover system	Evidence of this was not found
Visual monitoring/monthly inspections of facilities – *see inspection forms below:*	Requirement met by a variety of inspection forms. It is difficult to verify that all aspects required under the Waste Management Permit are being checked since the HGCMC checklists do not use the wording from the permit. The permit language is ambiguous as to what facilities must be inspected for the criteria listed in Section 2.7
• Production Rock Site 23 Inspection	*Missing from files:* June 2007, March 2008
• Tails Inspection	*Missing from files:* January, May, June, September and December 2007
• Tailings dam	*Missing from files:* August, September, December 2007

Documentation/Requirement	Status
• 920 Water Control and Containment Inspection	On file
Requirement to provide sufficient storage and contain and control the 24-hour, 25-year storm event	Could not verify that this has been met at all locations requiring such containment
Requirement to analyze samples of tailings for paste pH	This has not been done since 2005 The requirements in the permit for analyzing tailings are not consistent with the GPO Appendix 3; permit should refer to GPO for details of analyses
Requirement to analyze samples of production rock for paste pH	This has not been done since 2005
Annual Report requirement	Comprehensive report, but difficult to verify that Permit requirements are met due to structure of report
Hazardous Waste Management (RCRA)	
Aerosol can puncturing inspections	Monthly inspections are on file
920 Waste Area Inspections	Conducted monthly, rather than weekly as required by 40 CFR 265.174
Hazardous waste container at 920 Area	Improperly labeled (as required by 40 CFR 262.34)
Spill Prevention Control and Countermeasure (SPCC) Plan	
Certification by licensed engineer	On file
HGCMC Weekly Tasks	On file
Monthly SPCC Inspection of Hawk Inlet Fueling Facilities	On file
Monthly SPCC Inspection of 920 Bulk Oil & Fluids Facilities	On file
Monthly SPCC Inspection of 920 Bulk Fueling Facilities	On file
Tank Farm Inspection Sheet	On file
Declaration of Inspection Prior to Bulk Cargo Transfer	On file
Transfer Checklist for Person-In-Charge	On file
Pre-Fuel Transfer Checklist for Hose Watchman	On file
Training records	A training record from December 2006 was the most recent record produced
Secondary Containment Inspections	Documentation of inspections of transformer secondary containment not produced during audit

4.1.14 Environmental Management

The Greens Creek Mine Site is ISO 14001[4] certified. Semi-annual third-party audits under the ISO 14001 standards have been conducted since the December 2004 initial certification, and the site was re-certified in December 2007 on the regular three-year ISO 14001 required cycle. One of the tools used as part of their environmental management system is a Compliance Matrix, which lists all the applicable permits and approvals, and their associated stipulations. The matrix is an excellent tool to assist in maintaining compliance with the myriad of permits and approvals. However, the applicable regulatory requirements need to be added where they are not currently covered by an existing permit to ensure compliance with ADEC spill reporting regulations, Resource Conservation and Recovery Act, Environmental Planning and Community Right-To-Know Act, Chemical Facility Anti-Terrorism Standards, Toxic Substances Control Act, and any other applicable standards.

SRK recommends that the responsible position assigned to each requirement be added to the Compliance Matrix, along with the control document (e.g. SOP), record title and location of the record. During an audit of the Waste Management Permit, it was difficult for the auditors to ascertain compliance with the monthly inspection requirement due to the fact that there are several different inspection forms used to fulfill the inspection requirement. There was no documentation on record to indicate which specific forms substantiated compliance with this requirement.

Upon review of the printed version of the compliance matrix, it was unclear the version of the GPO's that are being referenced. Dates should be added to the matrix to ensure that those using it know which version of a particular document has been referenced and to facilitate updates as revised documents are issued.

4.2 Specific Areas

4.2.1 Tailings Disposal Facility

4.2.1.1 Description

Dewatered tailings are preferentially placed into the underground mine as structural backfill. Those which are not placed underground as backfill are placed on the surface in a "dry-stack" tailings pile at the Tailings Disposal Facility (TDF, Photo 4 through Photo 6). Development of the TDF

[4] According to the International Organization for Standardization, an Environmental Management System (EMS) that meets the requirements of the ISO 14001 standards, "is a management tool enabling an organization of any size or type to: identify and control the environmental impact of its activities, products or services; improve its environmental performance continually; and implement a systematic approach to setting environmental objectives and targets, to achieving these and to demonstrating that they have been achieved." An organization that has been certified has received written assurance from an independent external body that it has audited the EMS and verified that it conforms to the requirements of the ISO 14001 standards.

commenced in 1988 with the construction of the main and saddle embankments, the surface water collection system and finger drains. Tailings placement began in 1989 in the northwest corner of the TDF, and progressed to the south and east. Except for an operational shutdown from 1993 to 1996, tailings deposition at the TDF has occurred essentially on a continuous basis. At the time of the SRK site visit, approximately 2.7 million yd^3 of material, consisting primarily of tailings, production rock from the underground mine and other materials, such as ditch sediments, had been placed in the TDF.

Concurrent with the growth of the tailings pile, the layout and water management/treatment aspects of the TDF have changed significantly. Following the completion of an Environmental Impact Statement in November 2003 and subsequent permitting, the pile footprint has expanded to the hillside on the east side of the pile, and the long-term height of the pile has essentially doubled. Future expansion is set to occur, for example, to the northwest (former site of Pit 5), up and laterally to the east, and to the south (the site of Pond 6, which was recently approved for decommissioning). Drainage improvements have occurred with the installation of numerous wet wells, French drains, blanket drains and, in 2005, Pond 7. As a result of the construction of Pond 7, Pond 6 will be decommissioned. The water treatment plant at Pit 5 was replaced by a new, much larger water treatment plant adjacent to Pond 7, which was commissioned in June of 2008.

4.2.1.2 Physical Stability

Following a review of the various technical reports related to the physical stability of the TDF, it is apparent that the geotechnical conditions at the site have been characterized sufficiently for purposes of undertaking stability analyses, which address the range of potential failure modes and loading conditions at an appropriate technical level. The geotechnical characterizations are based on the acquisition of useful data which complements, and fits logically with, data collected during the early stages of the project.

The physical stability of the dam and tailings pile under static loading conditions meets or exceeds conventional criteria. However, the main driver regarding the physical stability of the TDF is the maximum design earthquake (MDE), which, based on the dam classification and criteria recommended by the International Commission on Large Dams (ICOLD), corresponds to 75% of the maximum credible earthquake. The determination of the MDE and the analytical methods used to assess the stability under dynamic loading conditions conform to current standards of practice. Based on these analyses, the stability of the dam and tailings pile under dynamic loading conditions meets or exceeds conventional criteria.

In order for the tailings pile to perform as predicted by these analyses, it is imperative that the in-place tailings achieve the prescribed density. This requires continuous attention to the prescribed methodologies for transporting, dumping, spreading and compacting the tailings. Density testing is completed on a regular basis at the TDF to evaluate the actual field densities that are being achieved. The field measurements, which are summarized in the Tailings and Production Rock Annual Reports, have shown that adequate density results (i.e. greater than 90% compaction)

are being achieved most of the time. Continuation of the existing system of field verification testing should provide confidence in the behavior of the tailings pile during the MDE.

4.2.1.3 Water Management

Mine personnel appear to have been quite diligent regarding water management at the TDF. With regards to the post-closure water management requirements, the closure and rehabilitation goals will require integration of the water management elements with the other closure elements, such as covers and revegetation. Some level of maintenance will be required post-closure, but the extent and duration of this maintenance will likely be determined on the basis of post-closure inspections and performance monitoring.

4.2.1.4 Chemical Stability

Mineralogical studies of the tailings have been limited. Tailings characterized as part of the Sulfate Reduction Monitoring Program (Lindsay and Blowes 2007) indicate that the dominant minerals in the tailings are quartz, dolomite and pyrite. Other sulfide minerals include sphalerite, galena, tetrahedrite, arsenopyrite and chalcopyrite. Solid phase sulfate analyses indicate that sulfate occurs in similar quantities to sulfide due to the presence of barite. Acid-base accounts are determined by the mine using iron as a surrogate for sulfide; hence Acid Potential (AP) correctly reflects pyrite, rather than the other sulfide minerals and barite. The presence of iron as a component of other minerals may result in over-estimation of AP; however, the effect appears to be limited. Pete Condon indicated that the method is checked annually.

Monthly acid-base accounting testing since 2001 indicates the tailings have Net Neutralization Potentials (NNP) ranging from near 0 to below -400 kg $CaCO_3$/t. This is a result of APs varying between 300 and nearly 700 kg $CaCO_3$/t and Neutralization Potentials (NPs) from 200 to 400 kg $CaCO_3$/t (KGCMC 2008). NNP has tended to increase slightly with time due to decreases in AP rather than increases in NP; however, NNPs remain well below 0 on average. Acid-base accounts were also determined by Lindsay et al. (2007), but their NPs were systematically about 50% lower than the lower NPs indicated by the site monitoring program. Pete Condon indicated the difference is being evaluated as part of a study at the University of Waterloo.

Solid phase element analyses indicate that tailings are highly enriched compared to crustal normal values for many elements, in addition to the commodities of economic interest. These elements include arsenic, antimony, cadmium, copper, mercury and selenium.

The acid-base accounting data indicate that tailings are classified as potentially acid generating. A number of the elements present in the tailings do not require acidic conditions to leach.

4.2.1.5 Long-Term Water Treatment

4.2.1.5.1 Water Chemistry Predictions

Water quality was predicted for the tailings in the 2003 Environmental Impact Statement (EIS), which assessed the effect of the TDF expansion. Detailed geochemical assessments and modeling were presented in Appendix A of the EIS. In summary, the following were concluded:

- Under fully oxidizing conditions (oxygen not limiting), acidification of the tailings could occur in decades;
- Due to placement of tailings in small lifts, compaction during placement and the planned placement of a compacted low permeability cover, oxygen was predicted to enter the tailings very slowly by diffusion. While final tailings at the surface could acidify in the above time frame, the progression of the acidified front into the tailings is expected to occur over time frames of centuries to millennia;
- Even if the surface tailings acidify, the large reservoir of neutralization potential will prevent widespread acidification of the tailings;
- Acidification of the surface could result in acidic runoff, however cover placement and alkaline amendments could be used to mitigate the drainage;
- Neutral pH metal leaching is acknowledged as a concern. The focus has been mainly on zinc leaching;
- Vertical geochemical zoning in the tailings was interpreted to include:
    - A very thin, near-surface acidifying layer,
    - A partially oxygenated layer in which sulfide minerals are oxidizing, but carbonate minerals remain, and metals are precipitated as carbonate and hydroxide secondary minerals; and
    - A deep non-oxidizing zone in which sulfate reduction and metal sulfide precipitation occurs, fostered by the presence of sewage solids from the Hawk Inlet facilities and residual organic process reagents.

Evidence for the latter includes elevated iron concentrations, measurable dissolved sulfide, and metal concentrations below the expected solubility of metal carbonates. Seepage discharged to a ditch near Pond 6 showed evidence of this process by the presence of iron hydroxide precipitates and a strong hydrogen sulfide odor. The conceptual geochemical model and prediction that geochemical zoning and porewater chemistry will evolve slowly over time is also reasonable.

Water chemistry was modeled for the 2003 EIS using four alternatives (no expansions, expansion, carbon addition and carbonate addition). The modeling results indicated the most promising approach to meeting water quality at proposed compliance points was carbon addition to induce sulfate reduction, which is being investigated further (see next section). The model for this method predicted that elevated sulfate concentrations could persist for centuries and that antimony would not be addressed by carbon addition.

The modeling methods were not reviewed in detail, but the conclusions are consistent with current observations at the site and the conceptual geochemical model.

HGCMC is pursuing application of cover materials to limit infiltration. This approach has not been modeled to predict the long-term implications for water treatment. Modeling approaches of the type in the EIS could be applied to the proposed reclamation action, and monitoring implemented to evaluate the model predictions. Due to the expected slow changes in water chemistry at the site, the review and update of model predictions could occur every five years of so.

4.2.1.5.2 Sulfate Reduction Monitoring Program

Based on the observation that the presence of organic matter could achieve in situ remediation of metals, the 2003 supplemental EIS required evaluation of the deliberate addition of organic matter to the tailings to enhance the existing processes. The Sulfate Reduction Monitoring Program (SRMP) study was initiated to test different types of carbon amendments, evaluate performance under unsaturated conditions, evaluate long-term performance and identify dissolved constituents with limited removal. The study, which includes both field and laboratory experiments and pore water modeling, is in progress and ongoing. Re-assessment of the extensive data obtained to date could not be completed within the scope of the environmental audit.

With respect to the objectives, the results to date are not quantitative. The ability of various organic amendments to cause sulfate reduction in the near surface tailings environment has been demonstrated, but the amendment rate required to sustain sulfate reduction in the long term is not known. The study has found that decreases in pore water concentrations of iron, zinc, lead, nickel, manganese and calcium occurred as a result of sulfate reduction due to the formation of secondary sulfide and carbonate minerals. However, reducing conditions de-stabilized existing iron oxy-hydroxides, allowing arsenic to desorb and re-enter solution. Presumably this occurred due to testing of slightly oxidized tailings and would be less important for freshly generated tailings.

The current understanding of the tailings geochemistry does not eliminate the need for long-term water treatment because the longevity of the existing organic content of the tailings and organic matter amendment is not known. The former is certainly providing a benefit while the latter is evaluated for long-term effectiveness. Unless supplemented by additional carbon (for example, degradation of surface vegetation or re-cycling of microbes), both sources of dissolved organic carbon will have a finite life, leading to a decrease in sulfate reduction in the future. It is recommended that the organic content in the current tailings and the SRMP site be evaluated with respect to the long-term sustainability of sulfate reduction. The source water quality modeling should be updated and reviewed periodically to reflect new findings from the SRMP and the effect of soil covers. It is further recommended that instruments be installed in the tailings to confirm the conceptual geochemical model in the EIS, with annual reporting of the results.

In the meantime, the most effective means of reducing chemical load requiring treatment will be to advance the design of the final soil covers. These designs are at an early stage and, as described above, the implications for long-term water treatment have not been determined.

4.2.1.5.3 Water Treatment

Water is currently treated at a facility located at the Tailings Disposal Facility for discharge through Outfall 002. The plant treats primarily process water from the mill and mine site, in addition to contact water from the tailings pile and Site 23/D, treated domestic sewage from the 920 and Hawk Inlet extended aeration plants and storm water from the mine/mill and Hawk Inlet areas. A water treatment plant has operated since 1993 when leaching of zinc first became apparent.

At the time of the visit, the Pit 5 water plant was in operation, but was being decommissioned and replaced by a new plant located near Pond 7. The process is conventional and appropriate for the types of water treated and the requirements of the NPDES permit. Under normal conditions, lime and ferric chloride are added for pH adjustment and solids precipitation using a High Density Sludge (HDS) process. During the visit, alkali was being provided by potassium rather than calcium hydroxide. Treatment sludges are de-watered for co-disposal with the tailings. Provided the tailings do not acidify due to long-term efforts to manage oxygen entry, the sludges should remain stable.

Given that water chemistry is not expected to change fundamentally during operation or closure, the water treatment technology is not expected to change unless the NPDES permit requirements change.

4.2.1.6 Placement of Production (Waste) Rock

On July 26, 2001, ADEC gave conditional approval for the disposal of 10,000 tons of Class 4 production rock in the tailings pile at the TDF due to a lack of suitable disposal locations in the underground mine (ADEC 2001). Disposal of Class 1 through 3 production rock into the tailings pile has regularly occurred to provide armoring of outside slopes, and to provide internal access roadways. Co-disposal of additional production rock from the excavation of Site E into the tailings pile is also being considered. If approved, this will be done in accordance with a plan that takes into account both geochemical and geotechnical stability issues. Geochemically, this management method is appropriate for the reasons stated in the approval. The rock material provides enhanced structural stability, and the tailings effectively provide a seal to limit oxygen availability to the production rock, thereby significantly curtailing oxidation. Further, if acidity were to be produced by oxidation of the production rock, tailings below the production rock would buffer the acidity provided the production rock is not a large source of acidity. There are no specific geochemical best management practices for disposing of production rock in tailings to address ML/ARD. The main requirement is that the production rock is below the zone of long-term oxygen penetration in the tailings so that the risk of acidification of the production rock is low.

4.2.1.7 Impacts of Wind-Blown Dust

Section 2.2.2.11 of Waste Management Permit #0211-BA001 and Section 36 of Air Quality Operating Permit No. 302TVP02 issued by ADEC require the permittee to construct, operate, close, maintain and monitor the facility to "control wind-blown airborne particulate dispersion".

The *Tailings and Production Rock Site 2007 Annual Report, Kennecott Greens Creek Mining Company, April 2008* provides a discussion of the observed lead levels in three shallow wells south (Site 27) and west (Sites 29 and 39) of the tailings pile that approach or exceed the freshwater quality standard and states that "dust from the tailings pile may contribute to the lead levels observed in these wells" (Pg. 17). The document reports that snow samples were collected in April 2007 and February 2008 in order to quantify the amount of tailings dust that had accumulated on the snow pack when conditions for dust loss were greatest (typically December through February) and presents the results of analysis of those samples. The report also states that during 2007, the following measures were undertaken to reduce dust losses from the tailings pile:

- Snow fences and concrete block wind breaks were installed on the crest of the tailings pile;
- Snow removal was limited to only active placement areas;
- Interim slopes were covered with rock; and
- Outer slopes were hydro seeded where appropriate.

According to the report, visual observations and snow sample assays suggest that these mitigation measures have helped to reduce the dispersion of dust from the tailings pile; however additional efforts are still warranted.

The 2007 Annual Report does not provide any interpretation of the significance of the measured concentration on either the shallow wells identified or provide any discussion of the potential impacts to the terrestrial or aquatic ecosystems in the immediate vicinity and down gradient of the observed dust accumulation. The 2007 Annual Report does go on to state that HGCMC is "evaluating air sampling methods that may augment the lead loading analysis".

SRK recommends that HGCMC:

- Prepare and submit for review and approval, a detailed air quality monitoring plan to quantify the extent and concentration of potential contaminants resulting from dust excursions from the tailings pile;
- Submit (within a specified time period) a report that provides the results of the air quality monitoring program and assesses the potential short- and long-term impacts to both the terrestrial and aquatic ecosystem components in the area potentially impacted by the dust excursions; and
- If warranted, conduct a screening level assessment of the ecological risk (if any) posed by the observed concentrations of the contaminants of potential concern in the dust excursions from the facility.

4.2.1.8 Assessment of Potential Contaminant Uptake by Vegetation

During the May 4 and May 8, 2008 site inspections, a number of varied species of wildlife were observed on, and in some instances, consuming, the vegetation seeded on the side slopes of the tailings pile. Deer and migratory waterfowl were observed feeding on the vegetation and two bears were observed in close proximity to the Tailings Disposal Facility.

SRK recommends that consideration be given to a one-time sampling program of the prevalent vegetation species on specific areas of the site, including, but not necessarily limited to, that growing on and immediately surrounding the tailings pile in order to assess the concentration of potential contaminants of concern. The sampling program should be conducted in the late summer in order to ensure that any potential contaminant uptake by the plant species is maximized, and should include leafy tissue, berries and woody tissue (if present) from those species that potentially serve as a food source for value ecosystem components identified for the site.

If warranted, the resulting data could then be included in the screening level ecological risk assessment discussed in the previous section in order to assess the potential impact of both contaminant uptake in the vegetation seeded on the tailings pile as well as the impacts (if any) of the dust excursions reported from the tailings pile.

4.2.2 Production Rock Site 23 and Site D

4.2.2.1 Description

Site 23 production rock site is situated on the valley sideslope, above Site D and Greens Creek (Photo 7 through Photo 11). It has received production rock from the underground mine since 1995. As of the spring of 2008, the site had received approximately 1 million tons of production rock.

The rock is placed in two-foot lifts, with placement depending on the geochemical classification of the production rock. Production rock in Classes 2 (NNP between -100 and 100 kg $CaCO_3$/t) and 3 (NNP between -300 and -100 kg $CaCO_3$/t) are placed in the interior of the pile, whereas rock in Class 1 (NNP>100 kg $CaCO_3$/t) is placed in a two-foot zone on the margin of the pile.

4.2.2.2 Physical Stability

The results of an evaluation of the physical stability of Site 23/D are summarized in a report by Klohn Crippen Berger (KCB) dated January 2005. The report concluded the stability at Site D has a 2% chance of failure in the next 10 years due to the liquefaction potential of the Site D material, and should therefore be removed. The report also addressed the stability of Site 23, assuming the material in Site D had been removed, and the analyses indicated that Site 23 is stable for an appropriate range of conditions. Given the potential buttressing effect of the Site D material, the approach to analyze the stability of Site 23 assuming Site D has been removed is appropriate.

As a consequence of the KCB (2005) findings, plans are apparently in place to remove the waste material from Site D. We understand that Site D will be removed in stages and that the observational approach will be used as a precautionary measure in conjunction with its staged removal. In addition to monitoring the physical stability of the Site 23/D area as part of the removal of Site D, the stability and functionality of the drains and water management controls at Site 23 will have to be monitored. It is conceivable that modifications or repairs will be required as a consequence of the Site D removal.

The slope performance monitoring in the vicinity of Site 23/D is based, in part, on the presence of an array of surface monitoring hubs installed over the entire site and a vertical slope inclinometer installed near the upper portion of the site. Visual observations and the data from these monitoring systems support the general conclusion that no large movements have occurred since the acquisition of data commenced. However, Independent of the KCB (2005) analyses, four sets of slope inclinometer data from Site 23 indicate that very small but distinct movement (about 1/3 of an inch) has occurred over the past two years at a depth of approximately 85 feet. This depth apparently corresponds to the contact between the overlying historic landslide material and the intact till unit. The potential for movement along this contact was not accounted for in the previous stability analyses.

Given the plans to increase the capacity of Site 23 for production rock and, in the future, to relocate the material in Site D, it would be prudent to install a second slope inclinometer at a location significantly downslope of the existing inclinometer. Assuming the movements are potentially indicative of a large scale system of movement, the primary objective of this new installation would be to provide additional information on the depth of the movement plane and the extent of the affected area. The new inclinometer would also provide redundancy with respect to the existing inclinometer. This information will be very useful in order to evaluate the current and future stability as a consequence of the ongoing development and reclamation of this site.

Assuming this instrumentation is installed in the next nine to 18 months; additional data should be collected from both slope inclinometers with a view to confirming the approximate geometry of the mass associated with this movement. With the new data in hand, the stability of the site should then be re-evaluated with a view to examining the impact of removing Site D on both short-term stability and the long-term, post-closure stability.

4.2.2.3 Water Management

As with the Tailings Disposal Facility, mine personnel appear to have been diligent regarding water management at Site 23/D. The closure and rehabilitation goals associated with post-closure water management will require integration of the water management elements with the other closure elements, such as covers and revegetation. The extent and duration of post-closure maintenance will likely be determined on the basis of post-closure inspections and performance monitoring.

4.2.2.4 Production Rock Management

Classification of production rock occurs as follows:

- Pre-production drilling provides an initial indication of waste classes ahead of mining, but plays no role in subsequent classification of the rock.
- Following blasting of a 14'x14'x14' round, the rock is sprayed down for dust suppression and visually classified.
- Follow-up samples are collected from the rib and analyzed on site for acid-base accounting. Sulfur is not determined directly, but is estimated by iron concentration (following 3:1 HNO_3:HCl digestion) as a surrogate. During annual reporting, classification by visual and chemical results is evaluated. Neutralization potential is determined by the modified (MEND 1991) rather than Sobek et al. (1978) method. However, the acid strength used is always 0.5 N (fizz rating of moderate or strong).
- Visual results are communicated through the mine dispatch to indicate locations for disposal (as described above). Rock assigned to Class 4 (NNP<-300 kg $CaCO_3$/t) is disposed underground.
- Placarded muck piles are located near the active dumping areas in Site 23.

Potential concerns with the system are as follows:

- Visual classification system – annual checks indicate that the visual approach tends to result in rock being classified as more reactive than indicated by chemical analysis. The simplification of the NP determination may over-estimate NP, but this is not a significant concern.
- The geochemical classification system – the NNP-based approach is out-of-date compared to current NP/AP-based approaches (Figure 3). In fact, the original basis for the classification system does not appear to be well established. Class 1 overlaps into NP/APs between 1 and 2, which are usually considered to represent classification uncertainty. However, since most Rock in Class 1 has AP<100 kg $CaCO_3$/t, this is not a significant concern. The system is based on ARD potential rather than metal leaching potential. However, modeling by HGCMC has considered leaching of zinc and cadmium from the production rock (see Section 4.2.2.6).
- Dispatch system – the possibility for classification errors exist. This is mitigated by the visual association of Class 1 with the argillites which are darker than the phyllites. During the audit, the piles were visibly distinctive.

In summary, the classification system has limitations; however these do not fundamentally affect the assessment of the geochemical stability of the production rock dump.

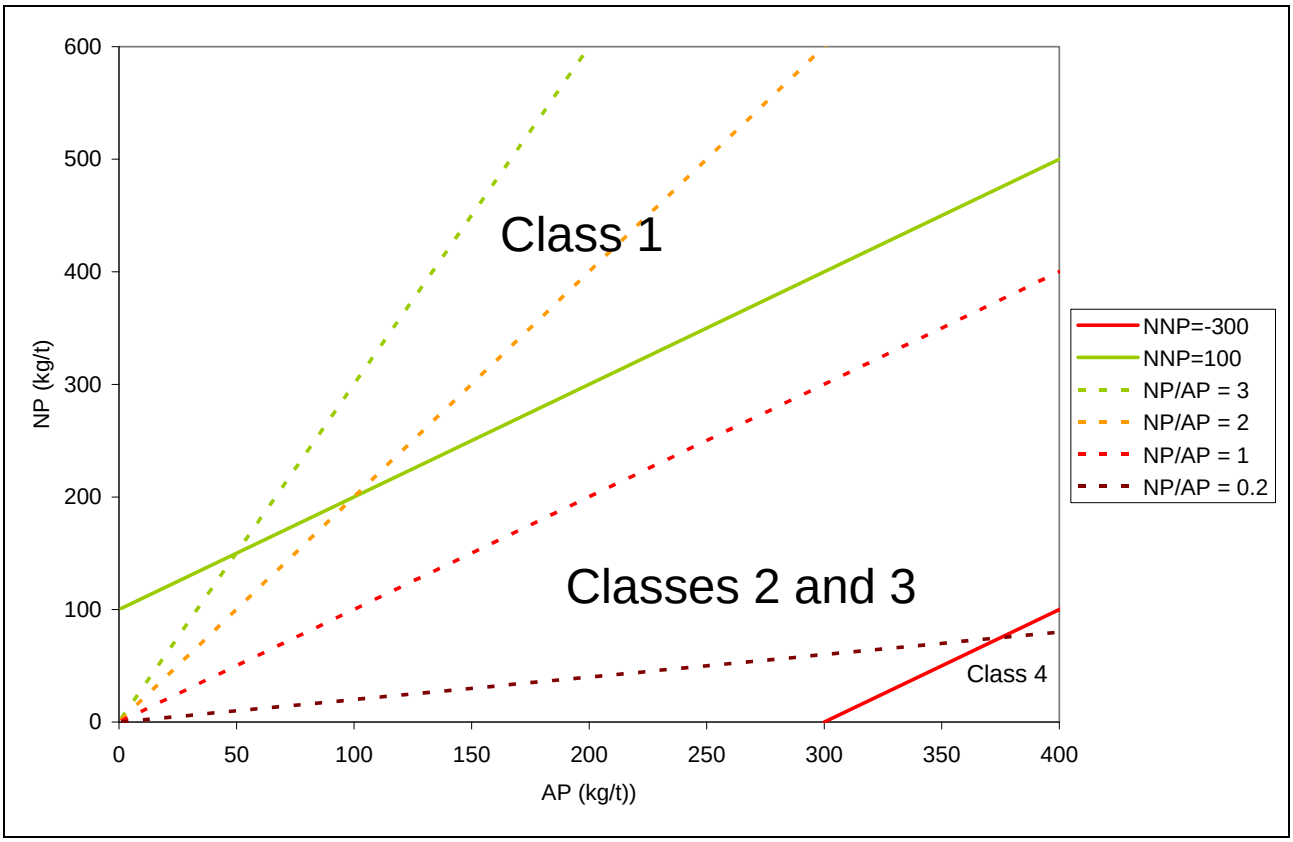

Figure 3: Production Rock Classification System – Comparison of NNP and NP/AP Criteria

4.2.2.5 Chemical Stability

Current monitoring data indicate that the production rock is oxidizing and leaching, thus producing elevated sulfate, zinc and cadmium concentrations. However, the ABA monitoring data indicate Site 23 is a potentially acid generating production rock dump as it is composed primarily of Classes 2 and 3. Mitigation of the ARD potential is occurring through measures designed to limit oxygen (as an oxidizing agent) and water (as a transport agent). These measures include placement in small lifts and compaction, placement of Class 1 rock on the exterior of the production rock dump, and research and commitment to a soil cover. These measures are considered appropriate and reasonable for the facility.

At the time of the site visit, the mineralized rock in the Pond D berm was observed to be leaching directly into ponds adjacent to Greens Creek. HGCMC is aware this water does not meet Alaska water quality standards for surface water discharge and has plans to remove the rock and re-construct the berm in addition to continuing the capture/pump-back of ponded waters. As indicated in Section 4.2.2.2, Site D production rock will be re-located to address stability concerns. Re-location plans need to consider:

- Management of meteoric water that comes into contact with the oxidized waste during removal to prevent runoff containing constituents above ADEC Water Quality Standards from discharging to surface water;
- Reclamation of exposed native materials that can be expected to contain leached oxidation products accumulated since placement of the production rock.

4.2.2.6 Long-Term Water Treatment

Water quality modeling has included conceptual evaluation of oxygen penetration into the production rock, and mass balance modeling to account for observations of downgradient groundwater chemistry. The evaluation of oxygen penetration (SMI 2000) concluded that with placement of a suitable soil cover, oxygen penetration into the production rock would be very slow, spanning centuries for the oxidation front to penetrate the production rock after placement of the soil. Conceptually, the conclusion is reasonable because the production rock is being compacted, rock contains elevated buffering capacity, and a non-PAG oxygen-consuming outer layer is placed on the outside.

The spreadsheet-based mass balance model performed by site personnel indicated reasonable internal reconciliation of observed water chemistry with source waters. A potential concern with cadmium leaching was identified by all closure scenarios considered by the calibrated model. The modeling methodology was generally appropriate but it was noted that:

- Oxygen penetration through the upslope dump sides was not considered.
- The modeling did not consider the effect of localized on-set of ARD.

In general, the prevention of significant future degradation of water quality at Site 23 depends on the ability to construct a cover that restricts oxygen entry and infiltration. Further review of the cover design is provided in Section 4.2.8.2.1. Nonetheless, HGCMC has determined, based on their modeling, that cadmium leaching may trigger a need for ongoing water treatment regardless of the closure measure selected.

Ongoing refinement of the water quality model is recommended as the cover designs develop to predict the long-term needs for water treatment, which are currently unknown and represent an uncertainty with regards to the costing of post-closure management of the site and the potential for impacts to Greens Creek. It is recommended that this modeling consider:

- The performance of the cover in terms of water infiltration and oxygen entry;
- Oxygen and water penetration into the production rock from upslope and through the foundation;
- Leaching of the inventory of oxidation products accumulated prior to final cover placement and construction, and draindown of stored pore waters; and
- Monitoring methods to verify water chemistry predictions.

It is also recommended that the modeling be periodically reviewed. Since changes in water quality are expected to occur slowly and the water treatment may be required for the long term (i.e. at least decades), reviews could occur infrequently (e.g. every five years).

4.2.2.7 Soil Cover

The discussion of the soil cover can be found in Section 4.2.8.2.1.

4.2.3 Inactive Production Rock Sites and Quarries

4.2.3.1 Description

Inactive sites include five locations where production rock (i.e. underground mine production rock) was placed prior to the development of Site 23/D for production rock management, and five quarries opened to provide rock for infrastructure construction in the late 1970s to late 1990s. Table 4-2 was compiled based on information provided by Pete Condon during the audit and HGCMC annual reports, with the former representing more up-to-date information.

HGCMC indicated that rock geochemical data have been collected for these sites, but it was not readily available for the audit. Furthermore, the loading contribution to Greens Creek from these sites is not known and therefore the current and future significance of these sites could not be assessed. A compilation in a database of the available geochemical information (solids and waters) for each location is recommended. This information could then be included in annual reports. It is also recommended that an overall water and load balance for Greens Creek be prepared. The water and load balance could be used to evaluate the current and future significance of these sources and to compare the relative benefits of moving rock with the potential effects associated with removal, such as short-term water quality effects due to flushing and the management of impacted foundation materials.

Based on observations of the types of rock characterization and water quality information typically collected by HGCMC staff, the geochemical and physical data needed to assess the loading significance of these sites to Greens Creek already exists and should proceed for all locations to determine the specific actions needed to address ML/ARD potential.

HGCMC has indicated plans are in place to re-locate potentially acid generation (PAG) rock to allow management of drainage. Re-location activities need to consider leaching by meteoric water and exposure of native materials as indicated for Site D in Section 4.2.2.5.

Table 4-2: Inactive Production Rock Sites and Quarries

Site	Type of Material	Years Developed	Production Rock Volume yd^3	Other Rock yd^3	Acidic or Reactive %
Production Rock Sites					
1350	Production rock/Pond Sediments	1978-1985	40,000		50
960	Residual Clean-Up Production rock	1987-1988	100		100
Mill Backslope (920 Area)	Production rock	1988-1989	25,000		75
Site C	Production rock	1987-1988	50,000		20
Site E	Production rock and till	1988-1994	270,000	40,500	15
Quarries					
Pit 405	Production rock, reclamation materials	1987-1988	13,000	4,000	20
Pit 6	Reclamation materials	1987-1988	0	16,300	=
Pit 174	Pyritic rock fill, reclamation materials	1987-1988	-	10,000	-
Pit 7	Reclamation materials	1987-1997	-	30,000	-

4.2.3.2 Site 960

Site 960 is an area adjacent to the road that connects the 920 area to the 1350 Portal. Production rock was placed at Site 960 in the 1980's. The site began to experience instability (cracks, significant slope movements, etc.) soon after deposition commenced. Deposition was consequently halted and a significant portion of the production rock was subsequently removed from this area. The site seemed to stabilize after some of the production rock was removed. Pete Condon indicated the site has not undergone further stability problems of significance following removal of some of the production rock.

At the time of the site visit, the ground was covered in snow. However, based on the performance record noted above and the fact that the site had no known history of significant stability problems prior to mine development, it is likely the site will remain physically stable post-closure.

HGCMC has estimated that 100% of the 100 yd^3 of the remaining production rock is potentially acid generating. As this rock has probably not fully acidified, the potential exists for loadings due

to leaching to increase, although the volume of material is insignificant compared to rock fill in the 920 area.

4.2.3.3 Mill Backslope

The mill backslope consists primarily of glaciofluvial silty sands and gravels, overlying a thick deposit of glaciolacustrine clayey silt, and has a history of stability problems dating back to the original site development in the late 1980's. The principal source of the instability was extremely high pore pressures within the glaciolacustrine silt unit. These pressures were successfully lowered by 20 to 30 feet over the course of about two months following the installation of 92 horizontal drains in 1988 (SRK, 1989). A manifold system consisting of flexible and rigid pipes was subsequently installed to convey the drain flow, which dropped from approximately 20,000 gallons per day to about 4,000 gallons per day over less than a year, to the drainage system on the floor of the mill site. A protective cover of production rock was placed over the lower half of the backslope (including the manifold system) to mitigate the effects of slope degradation by freeze-thaw action.

According to Pete Condon, some of the deep piezometers in the mill site area indicate that the piezometric levels have risen over time and are at or close to the levels at which significant slope movements occurred during site construction. Although flow data from the drainage system is no longer recorded (in fact, the locations of portions of the manifold system appear to have been lost over time), it is probable that many of the horizontal drains have become clogged during the past 20 years. Given the history of slope stability problems at the backslope, and the understanding that stability analyses reflecting these elevated piezometric pressures have not been undertaken, the current factor of safety against slope movements is unknown. Due to the severe consequences that could result from renewed movements of this backslope (mill operation could be impacted), SRK recommends that the following steps be undertaken:

- evaluate the current factor of safety against a failure of the mill site backslope;
- attempt to locate and clean out several of the horizontal drains with a view to improving their efficiency and, ultimately, lowering phreatic levels; and
- begin discussions with horizontal drain contractors.

This issue should be considered a high priority due to its potential for effects on the site operation.

Mill backslope rock is visibly pyritic production rock placed in the late 1980s before the production rock classification system was implemented to separate reactive rock (Class 4) for disposal underground. Seep monitoring data indicated that components of the rock are producing ARD, accompanied mainly by elevated sulfate, zinc and cadmium concentrations. HGCMC estimated 75% of the 25,000 yd^3 of rock is reactive. Based on this observation, drainage chemistry in the area can expect to worsen with time. If the drainage from the area is not completely contained by existing measures, metal loadings to Greens Creek could increase. Drainage from the mill backslope is routed to the mill site lined ditch and ultimately to Pond A for treatment, although the degree of containment is unknown.

4.2.3.4 Site C

Site C is located near the end of the B Road just below the 920 mill/concentrator facilities (Photo 12). The site received production rock in 1987 and 1988 and currently contains approximately 50,000 yd^3 of material. The 860 safety building and assay lab have been constructed on a portion of this site.

There are no significant physical stability issues at Site C. Cracks in the floor of the assay lab are almost certainly related to settlement of the fill on which the structure is founded.

Approximately 20% of the production rock is visually estimated by HGCMC to be within 10 to 20 years of the end of its lag period. The presence of locally elevated lead concentrations at nearby SW-565 is believed to originate as runoff from the road rather than Site C.

Water quality at this location is expected to worsen as more of the rock becomes acidic. The water at Site C is collected and pumped to the water treatment plant.

4.2.3.5 Site E

Site E is located 4.6 miles up the B Road, halfway between the Hawk Inlet port facility and the 920 mill facility (Photo 13 and Photo 14). Approximately 365,000 yd^3 of glacial till and production rock were placed at the site from 1988 to 1994. The glacial sediments were excavated from the 920 site during construction of the mill facility.

Klohn-Crippen Berger (KCB 2003) undertook a comprehensive assessment of the stability of this site and concluded that, although there may be some zones of loose material in the stored material and foundation, Site E is suitable for long-term production rock storage with a low risk of instability under static or design earthquake loading. Therefore, until the material is relocated (current plan), the risk of physical instability is low.

Eleven grid samples were taken at Site E in 2006. HGCMC estimates 15% of the 270,000 yd^3 of production rock and glacial till is within 10 to 20 years of the end of its lag period. During inspection of the site, components of the rock were observed to be pyritic and oxidized. One seep on the east side of the pile had a pH of 3. Monitoring data for seeps on the west side of the pile indicated pH-neutral conditions but elevated sulfate (exceeding 1000 mg/L) and zinc (10 to 20 mg/L), presumably reflecting the presence of production rock in the waste.

4.2.3.6 2.5 Mile B Road Cut

The section of the B Road referred to as the 2.5 mile road cut extends from approximately mile 2.4 to mile 2.7 and is the highest road cut on the B Road. Blast rock associated with the road construction in the late 1980's lies on the relatively flat natural ground well below the road.

The bedrock structure in the rock cut is dominated by joints which mainly dip into the slope. The main issues related to physical stability are therefore minor and will likely consist of gradual spalling and slope degradation due to weathering and freeze-thaw action. Larger slope failures are likely to occur in the long term, after closure.

The 2.5 mile B road cut intersects pyritic black shales which are visibly acidic. It is possible, though not confirmed, that natural faces in the area were acidic before construction of the road. HGCMC has estimated that all the rock in the area is potentially acid generating or already acidic. At the time of the visit, water in the ditch along the face was not visibly stained. Based on the characteristics of the rock, runoff from the faces is expected to be acidic during flushing events, though the effect on Zinc Creek may be limited due to the relatively small exposure involved compared to the flows in Zinc Creek. A vigorous grass community is established at the toe of this rock-cut face in the residual degradation material accumulated beneath this face.

Based on the strong degree of oxidation observed in the road cut and existing acidic conditions, water chemistry is not expected to worsen.

4.2.3.7 1.8 Mile Pullout

The 1.8 mile pullout is a fill that has been constructed adjacent to a 25-foot high road cut on the B road. There are no significant physical stability issues associated with this site.

Rock fill at the pullout originated from the 2.5 mile road cut and therefore consists of pyritic shales. A seep at this location is acidic and accompanied by elevated sulfate and iron concentrations. Based on the strong degree of oxidation observed in the road cut and existing acidic conditions, water chemistry is not expected to worsen.

4.2.3.8 Zinc Creek Bridge Abutment

The Zinc Creek Bridge is located at approximately mile 3.0 on the B road. The uphill abutment was constructed as a slight cut into the natural soils; the downhill abutment was constructed on fill. There are no significant physical stability issues associated with this site.

Rock fill used to construct the abutments originated from the 2.5 mile road cut and therefore consists of pyritic shales. The rock is visibly pyritic and oxidized. The rock appeared blocky; however Pete Condon indicated that the rock is finer beneath the surface armored layer. Small seeps draining the abutment had pH values near 3 and were iron-stained. The monitoring database indicated that there is possibly a slight effect on conductivity and iron concentrations in Zinc Creek due to the seeps.

Based on the strong degree of oxidation observed in the road cut and existing acidic conditions, water chemistry is not expected to worsen.

4.2.3.9 Pit 405

Pit 405 is located at 7.6 mile on the B road (Photo 15 and Photo 16). The pit was excavated to provide fill for construction of the B road in 1987 and other mine infrastructure, and then received about 20,000 yd^3 of production rock, likely of Class 3. The rock fill has been reclaimed and revegetated, and the remaining quarry face exposure contains pyritic phyllites. Iron oxide precipitates were observed in seepage emergent from the fill at the time of the site visit.

The quarry backslope above the backfill can be expected to degrade and slough with time. These developments are consistent with quarry backslopes at many other locations.

Water quality information is limited for this site. The downgradient surface water monitoring location was non-acidic and showed low zinc concentrations; however, it is suspected that the water is being diluted by other sources. HGCMC is planning to install a well in the fill to investigate groundwater chemistry to replace an earlier standpipe that was damaged. The data obtained will be used to make decisions about management of the rock and quarry face.

4.2.3.10 Pit 6

Pit 6, located at 4.6 mile on the B Road across from Site E, produced rock for construction of the B Road in 1987 (Photo 17 and Photo 18). Subsequently, 10,000 yd^3 of overburden stripped from Sites 23 and 920 were hauled to this location.

The quarry backslope above the backfill, particularly near the top of the slope, can be expected to degrade and slough with time. These developments are consistent with quarry backslopes at many other locations.

Samples collected from the rock face by HGCMC indicated the rock is not pyritic; however, pyrite was observed in the quarry face at the time of the visit. The difference is suspected to reflect that the highwalls currently accessible could not be reached prior to re-sloping of the overburden in the pit.

Monitoring indicates runoff from the pit is very dilute. Since pyrite has been observed in the quarry wall, there is a weak potential for localized degradation of water quality at Pit 6.

4.2.3.11 Pit 174

Pit 174, located at 3.3 mile on the B road, produced rock for construction of the B Road in 1987 (Photo 19 and Photo 20). There is 4,000 yd^3 of pyritic quarry production rock stockpiled across the road from the pit and one third of the quarry high wall is pyritic phyllite.

The quarry backslope above the backfill, particularly at its north end, can be expected to degrade and slough with time. These developments are consistent with quarry backslopes at many other locations.

Pete Condon indicated that seepage from the quarry is occasionally acidic.

4.2.3.12 Pit 5

Pit 5 is located at the north end of the TDF and was originally opened in 1987 to provide road construction materials. More recently (2002 to 2008), additional rock was quarried to construct roads and buttresses at the Tailings Disposal Facility. At the time of the audit, rock was being removed from the quarry as part of the expansion of the TDF, and the water treatment plant in the quarry was preparing for decommissioning. The quarry rock is argillite and locally pyritic, and is suspected by HGCMC to be the source of elevated sulfate concentrations in groundwater in the north part of the TDF and Further Creek. Locally acidic conditions in Further Creek are thought to be due to a former access road that was removed in 1997 and remobilization of iron from the peat and shallow sands below the west buttress berm. The water chemistry contrasts sharply with the elevated zinc concentrations in non-acidic waters in the tailings. Based on the visual characteristics of the rock, the conclusion that Further Creek is affected by rock from Pit 5 is reasonable.

4.2.3.13 Pit 7

Pit 7, located at 1.8 mile on the A road, was opened in 1987 for construction of the access road and other mine facilities (Photo 21 and Photo 22). It has been partially backfilled with peat, tree debris and gravel materials from construction of the TDF and development of the 1.5 mile A road sand pit. Seepage from the pit is heavily manganese/iron-stained and has a strong sulfide odor.

The south end of the backfill appears to be saturated and shows signs of past movement. Pete Condon believes that most of this movement occurred as material was actively being end-dumped into the pit. The final closure of this pit will need to take into account these conditions. Drainage measures will be required if the closure plan requires work in the toe area where past movements have occurred.

Minor iron-stained rock is observed on the south pit wall, but the drainage water chemistry is most likely influenced by the development of chemically reducing conditions, leading to dissolution of ferric oxyhydroxides in stored soils and peat materials from conversion of sulfate to hydrogen sulfide. Drainage is non-acidic, but has elevated iron and manganese concentrations. These conditions can be expected to persist until the organic matter is removed.

4.2.3.14 A Road

A road cut at 3.9 mile and fill area at 3.2 mile on the A Road were inspected and found to be composed of pyritic phyllite. No drainage monitoring data were available for these sites.

4.2.4 Other Sites (Reclamation and Miscellaneous Issues)

4.2.4.1 920 Area

Notwithstanding the comments and recommendations in Sections 4.2.6, the SRK team found that, in general, the water and drainage management systems at the 920 area are well designed and operated. The risk that contamination will leave the area is relatively low.

The SRK team has not checked all of the design elements; however the ditch/pond/pump system is understood to be adequately sized to handle the design flood events.

Rock fill in the 920 area has not yet acidified to the expected extent and it is not known if greater contaminant loads will reach Greens Creek in the future if drainage from the area is not fully contained by existing measures. HGCMC is monitoring seeps in the area to evaluate containment.

4.2.4.2 B Road

Based on information provided by E. Sundberg, one third of the B road is re-surfaced each year using 2-inch minus gravel provided by Jack Cewe Ltd. from their gravel pit at Treat Creek near Jervis Inlet in southwestern B.C. Discussions with personnel at Jack Cewe Ltd. indicate that this product is relatively high quality (i.e. it is well suited to the production of concrete and the standards for high quality concrete require a durable aggregate). The performance of this rock is apparently much better than the variety of rock types, including the local rock from the vicinity of the mine works, that have been used as road surfacing material over the operating life of the mine.

As regards to road maintenance, soft spots are sub-excavated and replaced with compacted granular material. After the road has been crowned, a minimum of 6 inches of this gravel is applied to the road surface. In addition, HGCMC has recently been replacing and adding culverts in conjunction with this re-rocking exercise. Last year, HGCMC started to install a new system of sediment traps (referred to as “burrito wraps”) that, based on feedback from staff and observations during the SRK site inspection, seem to be working much more efficiently than the previous system of hay bales. The burrito wraps, recommended by Dr. Richard C Warner of the University of Kentucky, are rock check dams wrapped in filter fabric to reduce the passage of sediment through the dams (ADEC 2007). They allow sediment to precipitate by gravity before the water passes over and through the dams. We understand that HGCMC has recently purchased a new suction truck that is used for removing fines that collect behind the sediment traps. Due to the increased efficiency of the “burritos”, HGCMC expects to have to clean out the sediment traps more frequently.

It would appear that actions have been taken, and new actions are planned, to mitigate the generation of sediment and loss of this sediment to the environment. These actions are, in our opinion, appropriate and reasonable for this road.

4.2.5 Underground Mine

The underground mine began operation in 1989. Operations were put on hold between 1993 and 1996. The mine has produced approximately 8 million tons of ore and currently has a mining rate of 1,680 tons per day. Structural fill in the mine is provided by cemented tailings, which HGCMC preferentially places back into the mine, with any residual trucked to the Tailings Disposal Facility. As described above, production rock is managed according to ARD potential with the most reactive (Class 4) rock being retained underground in completed areas of the mine. Most of the workings are below the 920 portal elevations (860'), the elevation of which is just above Greens Creek at the upper end of the site; therefore most of the workings are below the valley of Greens Creek. The bottom of the current mine workings is approximately 400' below sea level.

At the time of the audit, a study had been initiated primarily to understand the hydrology of the mine at closure and possible spill points from the workings, which could include faults, drill holes and the portals.

The study had not progressed sufficiently to evaluate possible management requirements for the mine water at closure. Current inflows to the mine are very low (some 40 gpm, with HGCMC providing an additional 100 gpm to satisfy underground water needs), indicating that low flows can be expected from the mine at closure. However, water quality may be degraded by contact with oxidized Class 4 production rock, mine walls and cemented tailings, leading to requirements for treatment of outflows, and exposed rock surfaces above the final flood level may contribute to metal loading to the mine pool and discharge from the flooded workings.

In the absence of modeling to predict flows and geochemical contributions, the need for and duration of treatment following flooding of the mine is unknown and could last for years to many decades depending on flow quantity and sources of loadings within the mine. Acceleration of the study on the underground mine hydrology and chemistry is recommended as it is anticipated that the water quality in the mine will be unacceptable for direct discharge (without treatment) after flooding due to the dissolution of weathering products.

4.2.6 NPDES Permit, Storm Water and Sediment Control

Storm water and sediment control is regulated under NPDES Permit AK004320-6, which is a combined Discharge and Storm Water Permit (term July 1, 2005 – July 1, 2010) issued by the EPA.

The NPDES permit sets effluent discharge limits for the two outfalls and establishes permit monitoring and limits for Storm Water Outfalls, Hawk Inlet water column, sediments, and bioassay sampling. Outfall 001 remains permitted as an emergency backup outfall for domestic waste water discharge, but has only been used once since June 17, 1999, when the sewage effluent line was re-routed to Outfall 002.

A review of Discharge Monitoring Reports (DMRs) indicated that Outfall 002 reports have been submitted as required and all measured parameters were within permit limits. Instrumentation excursions and data recording interruptions fell within allowable limits and were thoroughly documented by HGCMC as to the excursion.

HGCMC's 2005 Storm Water Monitoring Report showed numerous exceedances of State of Alaska water quality standards for lead and zinc from storm water outfalls. A discharge exception occurred on April 10, 2006, where a non-permitted discharge of mine drainage resulted from an upset condition (broken pipe joint).

The Hawk Inlet Monitoring Program includes quarterly water column and semi-annual bioassays and sediment sampling. Analytical results from this program are reported annually. There have been no documented comments or interpretation of the results received from EPA, ADEC, and USFS (the reviewing agencies) regarding data presented in the HGCMC annual reports. Considering the long-term sampling and monitoring that has occurred, some form of status or interpretation of the Hawk Inlet sites and an indication of whether the current requirements are adequate or require modification would be beneficial.

The HGCMC's Quality Assurance Project Plan dated August, 2005 was reviewed. A subsequent random records review indicated procedures and policies are being adhered to in regards to:

- Field Data Sheets;
- Sample Labeling;
- Chain of Custody;
- Holding Times (three exceptions – fecal coliform); and
- Analytical methods and results.

Quality Assurance/Quality Control of analytical methods and analysis should be consistent for both federal and state permits, which is not presently reflected in the permits:

- Currently, HGCMC uses Environmental Synectics, Inc. as a quality assurance (QA) reviewer for samples collected as required by the Fresh Water Monitoring Program (FWMP) and the Waste Management Permit #0211-BA001;
- The NPDES Permit does not require a QA review of Qualified Data, but relies on the annual NPDES QA Study audit process conducted nationwide on all laboratories analyzing NPDES-related samples.

Site inspections conducted at the 920 facilities, access roads, Tailings Disposal Facility (TDF), and Hawk Inlet facilities highlighted current Best Management Practices in place, maintenance issues, ongoing construction upgrades to the storm water runoff control system, and the need for additional controls.

Reviews of inspection reports and correspondence indicated that on July 7, 2006 and August 1, 2007, EPA completed National Pollution Discharge Elimination System (NPDES) Compliance

Inspections, resulting in Notices of Violations (letters dated April 25, 2007 and January 7, 2008), noting deficiencies, concerns, and violations.

HGCMC began addressing deficiencies and concerns expressed in the EPA letters regarding more effective storm water runoff controls, sampling, and sample stations during the inspections that precipitated the Notices. Numerous corrective and preventative actions have since been implemented.

HGCMC commissioned Dr. Richard C. Warner from the University of Kentucky to conduct the Comprehensive Site Compliance Evaluation to assess the site and identify the most effective Best Management Practices (BMP's) to address storm water runoff. The BMP Plan (Storm Water Pollution Prevention Plan) was revised (positively noted by EPA) and new BMP structures constructed. Implementation of the BMP Plan and upgrades to control storm water and contact water are discussed further.

Storm water runoff BMP control structures, maintenance practices, and the implementation of new aspects of the revised BMP Plan have improved overall sediment control at the site. However, each BMP has limited effectiveness that may require upgrading, and requires routine maintenance or replacement. These structures and practices along the access road show varying degrees of sediment control:

- There are in excess of 225 rock check dams providing small settling basins along the main A & B access roads and side roads to borrow pits. These structures demand routine maintenance to continue functioning as designed and will require additional removal of sediments after storm events.
- Silt fences and straw bales act as additional temporary controls. Both these BMP structures are primarily designed for use in short-term construction projects and require continuous adjustment or replacement.

Pipelines convey collected storm water and treated water from the 920 portal/mill area, Sites 23/D and C, and the Hawk Inlet area to the TDF Pond 7 and the new water treatment facility:

- There is an existing 8-inch HDPE pipeline to carry storm water and a 10-inch HDPE pipeline to convey treated process water from the 920 area, for a total capacity of approximately 2,700 gpm.
- HGCMC is currently installing an 18-inch HDPE pipeline from the 920 area to the TDF, which will provide an additional 6,000 gpm capacity.
- The Inflow Design Flood for Pond 7 containment and spillway include the inflow sources from Hawk Inlet facilities, 920 Site, Site D/Site 23, and the surface drainage area of the TDF.
- The worst case design for inflow (65 cfs) and outflow (70.4 cfs) for Pond 7 are based on a 500-year, 24-hour storm event.

Contact storm water from the 920 Portal, mill, tailings load-out, Site 23, Waste Dump Haul Road, Mine Access Road, and TDF have increased potential for contamination due to high concentrations

from mine production rock or quarry materials used in the construction of roads, dikes, and drainage structures and tracking of material on transport vehicles.

Insufficient characterization of construction materials from quarries and mine production rock early in the mine life resulted in storm water exposed to these sites having higher levels of contaminants than allowed by the Effluent Limitations and Monitoring Requirements for New Source Performance Standards in mine drainage from mines that produce copper, lead, zinc, gold, silver, or molybdenum bearing ores or any combination of these ores from open-pit or underground operations (40 CFR Subpart J § 440.104).

The general area from the 920 Portal to the western extent of Site 23 along the access road is the primary source area for higher contaminant loading in seepage and storm water and for potential vehicle tracking along the access road beyond Site 23. Additionally, some of the existing drainage ditches in the 920 Site/Site D/Site 23 are either not lined or sized to handle a 25-year, 24-hour storm event. Recommended improvements in storm water management include:

- Proper sizing and weather proofing of pumps and piping such that base flows and storm water runoff can be effectively managed in Ponds A, C, and D;
- Lining of ditches and collection ponds containing contact storm water;
- The collection of flow data to ensure that ditches, pipelines, pumping systems, containment structures, and treatment systems are appropriately designed; and
- Construction of a truck wash, located far enough down the access road from the load-out facility to ensure vehicles are not picking up additional contaminants from mine haul trucks delivering waste to Site 23.

Further identification of construction materials incorporated or exposed by construction with the potential for metal leaching or ARD used along the access road construction right-of-way need to be quantified and catalogued. Other material stockpiles and borrow pit areas along the access road (i.e. Site E, now scheduled for relocation to the TDF) that have higher potential for metal leaching and ARD are additional potential sources for storm water contamination that require further documentation. Additional options for encapsulation, treatment, and final disposal for concurrent and final closure should be investigated.

The TDF area presents additional potential for wind and water borne contaminants being mobilized in the vicinity outside of the TDF containment boundaries.

4.2.7 Bond

4.2.7.1 General

4.2.7.1.1 Documentation

(a) The estimate is documented in the GPO Appendix 14 – Attachment A, which includes both a text description of the reclamation plan and print-outs of the cost estimate spreadsheets.

(b) Section 7 of the text could be improved by adopting some of the conventions of a "basis of estimate" report. These would include a clear statement as to the effective date of the cost estimate, a discussion of the spreadsheet structure (e.g. a printout of the directory tree), a discussion of the project delivery assumptions (i.e. one year holding time, independent contractor, State and Federal oversight, etc.), and a discussion of the basis for direct and indirect costs (unit costs, quantity estimates, treatment of profits and overheads, etc.).

(c) The spreadsheet print-outs are complete but difficult to use on their own. It was very helpful for the auditor to examine the spreadsheets with the assistance of a HGCMC engineer. Consideration should be given to providing either electronic copies of the spreadsheets or a more detailed explanation and examples of how the printed sheets fit together.

4.2.7.1.2 Spreadsheet format

(a) The cost estimate was developed by HGCMC in a series of inter-linked spreadsheets, following a hierarchy of Total Cost – Element Cost – Task Cost – Cost Detail. The spreadsheets are organized in a set of directories with the corresponding hierarchy.

(b) Several items were tracked from the Total spreadsheet through the Element spreadsheet to the Task and Cost Detail spreadsheets. The linkages were correct in all cases.

(c) The spreadsheets include explanatory notes.

(d) The spreadsheets were initially developed from earlier forms for the 2001 estimate and have been further modified for the current estimate. Current HGCMC staff is familiar with all components of the spreadsheet.

4.2.7.1.3 Structure of the Estimate

(a) There is no universally agreed way to structure closure cost estimates.

(b) Guidelines to cost estimating terminology are available, for example from the Association for the Advancement of Cost Engineering. ADNR also has a document that provides guidance specific to mine closure costs, and the USFS has a training guide for reclamation bond estimation and administration.

(c) Generally, the structure of the HGCMC estimate conforms to these guidance documents, with the following exceptions:

- The "Administration" element in the HGCMC is accounted as a Direct Cost, but includes many items that would be considered Indirect Costs in conventional

terminology. Conventional use of the term "Indirect" means that costs are not directly and solely attributable to a single work area or task. Supervisory labor, transportation, and camp support costs are examples of items that would more conventionally be classed as Indirect Costs.

- The "Administration" element also includes fuel costs, which are most often attributed to individual Direct Cost elements. However, we have seen other sites where fuel costs are treated as Indirect, for example where bulk fuel is purchased by an owner outside of the general contractor arrangement.
- Some mine closure cost estimates distinguish between the active closure period and the long-term post-closure period. The distinction is helpful when long-term monitoring or water treatment costs are a substantial part of the total, as it allows different contingencies, inflation and/or discounting to be applied to costs that are further in the future.
- Contractor overhead, profit and insurance are implicit in the unit costs assumed for the HGCMC estimate. These are more conventionally treated as Indirect Costs.

4.2.7.2 Unit Costs

4.2.7.2.1 Labor

(a) Unit labor costs are presented in the "Unit Cost Estimate, Labor" spreadsheet.

(b) Most of the unit labor costs are based on Davis Bacon wages, which are generally higher than the corresponding Alaska wages. Fringes, burden and workman's compensation costs are included. An additional 10% contractor profit is added to the Davis Bacon derived wages.

(c) Unit labor costs for professionals are based on historic HGCMC costs. The basis appears to be consulting fee rates, which would include profit.

(d) Overtime is not included in the unit labor costs. Based on the amount of work planned for Years 1 and 2, it is likely that there would be significant overtime. A simple way to estimate the overtime cost would be as a percentage of hourly labor costs based on KGCMC overtime costs during operations.

4.2.7.2.2 Equipment

(a) The equipment costs used in the HGCMC estimate are summarized in a single spreadsheet.

(b) The version in the draft Appendix 14 Attachment A was lacking details about the size of some of the equipment. At the time of the audit, HGCMC staff was revising the spreadsheet to include equipment model numbers.

(c) Equipment costs are quoted on a per hour basis, derived from either rental quotes from local contractors, or from HGCMC costs.

(d) Several of the costs derived from rental quotes were checked against other sources and found to be in the correct range. However, it would be helpful to have a memo documenting the quotes (without naming the sources), and any adjustments made to them.

(e) The cost based on mine records appears to reflect maintenance materials only. If that is the case, they need to be revised to include ownership costs and maintenance labor costs. Insurance costs, overhead and profit also needs to be added, unless these are treated as Indirect Costs (see Section 4.2.7.1.3 d).

4.2.7.2.3 Materials

(a) Unit material costs are presented in the "Unit Cost Estimate, Materials" spreadsheet. Costs are based on historical KGCMC costs or 2007 quotes. Costs that were spot-checked are within range of experience elsewhere.

(b) It is not clear whether contractor profit has been added to all of the material costs. It is certainly included in those costs that were based on recent quotes, but is probably not in all of the KGCMC historical costs. Treating contractor profit as an Indirect Cost (see Section 4.2.7.1.3 d) would resolve that question.

4.2.7.2.4 Special Services

(a) Transportation costs are based on recent quotes.

(b) Camp support costs are based on the terms of the current contract, which includes different prices for different camp sizes. It is reasonable to assume that the camp would be available to third party reclamation contractors on similar terms. Ownership of the camp is independent, so it is possible that the camp will not be available to a reclamation contractor, but that is unlikely and should at most be treated as a risk issue rather than an estimated cost.

4.2.7.3 Direct Cost Elements

4.2.7.3.1 Administration

(a) The estimated fuel cost of $2.43 per gallon is commensurate with a crude oil price of about $85 per barrel, and is reasonably reflective of medium-term estimates. However, the basis of this estimate should be documented.

(b) Costs for the "Holding Year" are distributed through several spreadsheets in this group, but appear low, even in total. The assumptions about the "Holding Year" should be documented, and the estimate should be adjusted to allow for operation and maintenance of the water treatment and storm water management systems during the holding period.

(c) Water treatment costs are estimated using the "Post Closure Power and Water Treatment Cost Estimates". The estimates are obtained by multiplying estimated future flows by current power cost (per gpm) and current treatment reagent costs (costs per gallon). This method is reasonable for power costs. For treatment reagents, however, the method implicitly assumes that future water quality will be the same as current water quality. This is unlikely to be the

case. A better method is to distinguish between those costs that vary only with flowrate (e.g. power) and those that vary with both flowrate and contaminant concentration (e.g. reagents, sludge disposal). If estimates of future concentrations are not available, conservative assumptions should be made.

(d) Water treatment sludge disposal costs do not appear to be included, probably because they are currently very low. However, sludge disposal costs will be higher after closure of the TDF, and should therefore be included as a line item.

(e) Water treatment Operator costs are captured under the "Post-Closure Personnel Estimates", but trade labor costs are not.

(f) The "Post-Closure Personnel Estimates" for Years 1 and 2 also include costs for a Supervisor and Project Manager. Given the volume of work planned for Years 1 and 2, at least two Crew Foremen should also be included either under this category or under the respective tasks. Trade labor costs (see previous item) could also be captured under this category.

(g) The "Post Closure Engineered Cover Maintenance" spreadsheet uses a dollar per acre basis to estimate maintenance costs for the Site 23 and tailings covers. The per acre unit cost is in keeping with experience elsewhere. A minor improvement to this section would be to show a decreasing level of maintenance in each of the first three to five years, and a periodic "repair" cost over the longer term.

4.2.7.3.2 Roads

(a) Costs for the reclamation of roads are estimated in a series of spreadsheets, each dealing with a particular section of the road.

(b) Estimates for removal of acidic or "short lag" materials are built up using conventional cycle time calculations, and the comments made in Section 4.2.7.3.3 (d) through (g) apply here.

(c) No additional costs are included for storm water management. The site's storm water management BMP's would apply during removal of the road. Although it is unreasonable to prepare detailed storm water management plans at this time, it would be appropriate to add an allowance for such measures.

4.2.7.3.3 Production Rock Sites

(a) The element "Production Rock Sites" includes the relocation of production rock from Sites 1350, 960, C, D and E, as well as covering of production rock in Site 23. Placement of growth media or replacement fill, seeding, and installation of monitoring wells in each site are also included.

(b) The estimates assume that all of the production rock sites will need to be reclaimed at closure. HGCMC staff stated that they did not account for concurrent reclamation in order to make the overall estimate conservative. However, it is overly conservative to assume a combination of completely developed production rock and tailings sites with no reclamation. A more conventional approach would be to estimate the areas of tailings and production rock that will

be exposed in each year of the remaining production, and select the year with the maximum total disturbance as the basis for the estimate.

(c) The estimates for relocation of rock include separate estimates for hauling "short lag" rock to the underground and other rock to the TDF. Both sets of estimates are based on conventional cycle time calculations.

(d) The correction factors used in the cycle time calculations are not documented. Correction factors are generally needed in such calculations to reduce theoretical productivities to more realistic estimates. Important factors in this case will include the material swell factor, operator efficiency, and wait times.

(e) The cycle time calculations appear to assume an optimal combination of equipment for each site. In reality, the number of trucks, excavators and operators is unlikely to vary much over the two-year closure period. A constant fleet size should be chosen, and the resulting inefficiencies accounted for.

(f) The estimates for hauling to the mine assume that the underground will be open. Costs for continued underground ventilation, supervision and safety should be added either to this element or to the Indirect Costs.

(g) Identification and segregation of material into the "short lag" and "other" categories will require field supervision similar to grade control at an open pit mine. An allowance for the required supervision should be included in the estimate. It would be reasonable to assume that one geologist or geochemist will need to be assigned to each relocation crew. Analytical costs should be negligible, as most of the "grade control" could be accomplished using field tests.

(h) Costs for cover construction are also based in part on conventional cycle time calculations, and the above comments apply.

4.2.7.3.4 Tailings

(a) The estimate assumes that all of the tailings pile will need to be reclaimed at closure. This is overly conservative, for the reasons discussed in Section 4.2.7.3.3 (b).

(b) The cost estimates for constructing the tailings cover are based on cycle time calculations, and the comments made in Section 4.2.7.3.3 (d) apply.

(c) Construction of low permeability layers over large areas in the wet local climate will inevitably result in some areas failing quality assurance (QA) tests. A factor of 10% wastage should be included to allow for removal and re-covering of areas that fail to meet moisture or density specifications.

4.2.7.3.5 Site General

(a) The element "Site General" includes estimates for demolition of buildings and removal of contaminated materials.

(b) The basis for the demolition estimates is an estimate prepared in 2001 by a salvage/demolition contractor. Estimates for selected buildings were checked against estimates from other SRK projects and found to be in the same range.

(c) The estimated material removal costs are for cleanup of contaminated or pyritic materials, mostly below the mill area. The estimation method is the same as for the Production Rock sites and the comments under Section 4.2.7.3.3 (a) apply.

(d) The estimate for scrap shipping allows for five barge loads each containing 3000-5000 tons of scrap steel and salvage.

(e) Estimates of the total volume of waste steel and concrete rubble would be useful to estimate the total volume of disposal space that will be required.

(f) Mobilization of specialized demolition equipment is included under the tabs "Miscellaneous Demo Equipment Costs" and "Scrap Shipping and Specialty equipment for Cleanup".

(g) Structures completed since the 2001 inspections, such as the new water treatment plant, are included in the estimate. New additions to the Site General buildings include the TDF water treatment plant, the 920 Administration expansion (proposed for 2008, but now delayed), a simple 920 tailings storage addition, and a Hawk Inlet camp expansion (also scheduled for 2008, but now delayed).

4.2.7.3.6 Water Systems

(a) The element "Water Systems" captures the demolition and cleanup of water management facilities that fall outside the other areas.

(b) Decommissioning of the outfall is covered under the tab "NPDES 002 Outfall Pipeline". The assumption is that the pipe would be sealed with concrete, rather than removed. It is quite possible that HGCMC will continue to utilize the outfall pipeline post-closure, allowing continued marine discharge in preference to freshwater discharge of residual water.

4.2.7.3.7 Maintenance/Monitoring

(a) The element "Maintenance and Monitoring" includes only monitoring costs and no maintenance costs.

(b) The monitoring costs are largely analytical costs, but there is allowance for consulting costs that could be put towards annual reporting. The consulting costs are probably adequate for the long term, but higher costs should be allowed for in Years 1 and 2.

4.2.7.4 Indirect Costs

4.2.7.4.1 Regulatory Agency Oversight

The estimate allows for "Regulatory Agency Oversight" at 8% of Direct Costs. This is reasonable given the number of agencies involved. However, it would be preferable to specify exactly what such oversight will entail. Items that could be included are the costs of developing a contract, contract supervision, and construction quality control (QC). In general, construction management costs for a project of this scale are likely to be less than 5% of Direct Costs, but particular requirements, for example for construction QC, can quickly increase that amount. Having the "oversight" requirements better defined will reduce the risks of over- and under-estimates in this category.

4.2.7.4.2 Freight

The estimate includes freight at 5% of Direct Costs. It would be preferable to take contractor mobilization and demobilization out of that estimate, and estimate the remaining freight cost on the basis of material requirements.

4.2.7.4.3 Contingency

A 10% contingency is applied. Most estimators would apply a higher contingency to costs that are not based on detailed designs. A contingency of 20% would be more common. However, it is important to also consider the level of conservatism that is built into each element and indirect cost, as well as the methods used to account for future uncertainties (see Section 4.2.7.4.6, *Inflation and Discounting* below).

4.2.7.4.4 Engineering Re-Design

The estimate includes provision for "Engineering Re-Design" at 2% of the Direct Costs, as per the USFS guideline. The percentage is reasonable for a project of this scale and complexity.

4.2.7.4.5 Contractor Overhead, Insurance and Profit

(a) As discussed in Section 4.2.7.1.3 (d), contractor overhead and profit are commonly included as Indirect Cost. For a project of this scale, an estimated contractor profit of 10% of Direct Costs is reasonable, and total contractor overheads should be less than 5% of Direct Costs.

(b) If the above approach is taken, it would be important to remove overhead and profit from each of the Unit Costs and Direct Costs.

4.2.7.4.6 Inflation and Discounting

(a) Inflation is not included in the estimate. However, it has been the policy of the Forest Service to compensate for inflation by retaining any interest gained from investment of the financial security. This approach is likely to be conservative.

(b) Long-term costs, including any of the post-closure costs in this plan, should be discounted using a net present value method.

(c) In the NPV calculations, it is important to distinguish two time frames. One time frame starts with Year 1 of the closure plan and continues through all closure and post-closure activities. It is certainly appropriate to apply an NPV calculation to the closure and post-closure periods, so that all costs are brought forward to a common point in time (Year 1). The discount rate in this case is normally set by government policy.

(d) The other relevant time period is the bond-holding period between the present day and Year 1 of the closure plan. Depending on the remaining mine life, the financial security posted by HGCMC may be held by the State for many years or decades. In general, it is not good practice to include the bond-holding period in the same NPV calculation as is applied to the closure period. The reason is that the appropriate level of discounting applied during the bond-holding period depends on the terms of the financial instrument, and can range from zero (no discounting) to levels substantially greater than the closure period rate. Choice of the appropriate discount rate (if any) for the bond-holding period can only be made as part of a detailed analysis of the financial instrument selected by HGCMC and the State, and is beyond the scope of this audit.

4.2.8 Closure and Reclamation

4.2.8.1 Documentation

4.2.8.1.1 Closure and Reclamation Requirements

(a) Requirements related to closure and reclamation of the site occur in all of the following documents:

- CFR Title 36 Parks Forests and Public Property, Part 228 Minerals, sections 228.8, 228.10, 228.13, 228.80
- Forest Service Manual sections 2840.2, 2840.3, 2840.5, 2842, 2843, 2844, 2846
- Tongass National Forest Land and Resource Management Plan (2008)
- Greens Creek Final Environmental Impact Statement (1983)
- 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 (March 1988)
- Environmental Assessment for Additional Waste Rock Disposal Capacity at Greens Creek Mine, Admiralty Island National Monument, Alaska (1992)
- Greens Creek Tailings Disposal FEIS (2003)
- Alaska Mining Reclamation Regulations (11 AAC 97)
- Alaska Mining Statutes on Reclamation (Title 27.19)
- Waste Management Permit 0211-BA001 sections 2.3, 2.4, 2.5, 2.12, 3.3, 5.3, 6.6 and 9.1
- General Plan of Operations Appendix 14 “Reclamation Plan”

- General Plan of Operations Appendix 3 "Tailings Impoundment"
- Certificate of Approval to Operate a Dam (Pond 7) AK00307
- MOU between USFS, ADEC, ADNR, and KGCMC Concerning Reclamation/Closure Bonding and Periodic Cooperative Audits

(b) Consolidating the closure and reclamation requirements in the various statutes, regulations, assessments, permits and plans would reduce the potential for contradictions and make both compliance and oversight simpler.

(c) Sections 1.4 and 1.5 of GPO Appendix 14 "Reclamation Plan" collate and summarize the statutory and regulatory requirements. They are a good starting point for consolidation, but the permit requirements should be added.

4.2.8.1.2 GPO Appendix 14 "Reclamation Plan"

(a) The GPO Appendix 14 makes commitments for addressing most of the closure and reclamation requirements. Further details are provided in Attachment A, which confusingly is also called "Reclamation Plan". Listing the other Attachments in the overall table of contents would make them more accessible to the reader.

(b) The Waste Management Permit makes a distinction between closure and post-closure (e.g. section 2.4 and 2.5). The GPO Appendix 14 blurs the distinction between the two (e.g. "Administrative" costs in Attachment A). Experience elsewhere indicates that it is reasonable for both the closure and post-closure periods to be covered in one document, but that the document should be clear about which activities and costs are associated with each.

(c) The GPO is referenced in the Waste Management Permit. Minor changes to the GPO Appendix 14 are possible without re-permitting, and so it is an appropriate means to deal with plans that are (a) changing as new information is gained and (b) unlikely to be implemented until many years in the future.

4.2.8.2 Proposed Closure Methods

4.2.8.2.1 Engineered Soil Cover

(a) The cover design process used to arrive at the current multi-layer cover design is well documented and in keeping with the state of the art at the time. However, the intent of a test plot is to obtain information that can be used to improve the design. The reclamation plan therefore needs to remain flexible about the cover design. Both the Waste Management Permit and the GPO Appendix 14 Attachment A include language that reflects this approach.

(b) Recent trends in the state of the art of cover design are moving away from multi-layer systems to designs with fewer, but thicker, layers. These trends are in part attributable to difficulties with the construction and maintenance of complex covers. Options for building simpler but equally effective covers at Greens Creek should be evaluated.

(c) Another recent trend in cover design is a decreasing reliance on lysimeters as a means to estimate infiltration through the cover. Lysimeters have been shown to provide misleading results. Many of the factors contributing to the confusion are understood, but some are not. The barometric effects noted in the 2007 O'Kane Consultants report are an example of an effect that is not yet well understood, and could cause the infiltration measured in the lysimeter to be much higher than infiltration over the cover as a whole.

(d) The recent investigations by Oregon State University have significantly improved the test plot monitoring system, in particular by adding means to directly measure "interflow" (the flow of water within the cover). With the improved measurement of interflow, it should be possible to calculate a complete cover water balance that will allow an independent estimate of infiltration.

(e) If the water balance shows that infiltration is a small percentage of the other flows, further improvements might be needed to make the estimate completely reliable. These might include cutting off the interflow from uphill of the monitored area, and careful monitoring of evapotranspiration.

(f) The modeling initiated by Oregon State University holds promise. With the amount of data available from the OSU tests and recent monitoring, it should be possible to use the model to re-calibrate the soil water characteristic curves for each cover material. Once those curves have been re-calibrated to be representative of field conditions, the model will be capable of predicting the performance of other cover designs.

(g) One weakness of the OSU model, and most other soil cover models, is the treatment of the upper boundary condition. It may be necessary to use a combination of direct measurements and coupled models to arrive at a defensible upper boundary condition.

(h) One of the primary functions of the soil cover will be to inhibit oxygen transfer into the production rock or tailings. This objective should be seen as distinct from the objective of minimizing infiltration, for two reasons. First, minimizing oxygen transfer will require cover designs that do not minimize infiltration. Second, experts in the field of soil cover design tend to focus on infiltration and may not have the expertise needed to assess oxygen flux through covers.

(i) The second factor above often leads to oxygen monitoring being treated as an afterthought in cover tests. In particular, cover experts often think that oxygen flux can simply be calculated from the outputs of soil water monitoring, which is not the case. It is essential to include oxygen monitoring in the cover testing program.

(j) There are many good examples of methods to measure oxygen concentrations within and below a soil cover. The most successful method in our experience is also the simplest. It consists of pushing steel tubes through the barrier layer and withdrawing samples of the gas into either an oxygen monitor or a gas sampling bag. It is important to repeat such measurements under different moisture conditions and different barometric conditions.

(k) The best methods for the long-term measurement of oxygen below a soil cover are similar. A probe is placed through the cover and connected to an automatic gas sampling device. Samples are withdrawn on an hourly or daily basis. It is important that the sampling frequency be varied to demonstrate that excessive sampling is not drawing air into the cover.

(l) There are currently no reliable methods for very long-term in-situ monitoring of gas composition under a soil cover. The state of the art is to use intrusive methods to intensively monitor a test cell or completed cover area to determine the combinations of soil moisture and atmospheric conditions that lead to oxygen flux.

(m) Instrumentation to measure soil and waste temperatures should be added to the Site 23 test area. The oxidation of sulfides generates heat, which can be measured as changes in temperature. Long-term temperature profiles can be used to estimate heat fluxes, which can be translated to oxidation rates. Thermistors or themocouples are easily installed in the waste and the soil cover and will generate reliable temperature data for many years. Also, the heat capacity of the rock causes temperatures to be much more stable than oxygen concentrations, meaning that the temperature data generally provide more robust estimates of long-term oxidation rates.

(n) The soil cover design proposed for the tailings is the same as that proposed for the Site 23 production rock. However, there are differences between the two materials and the two sites that may require differences in the design. An additional cover test should be constructed on the tailings pile. That test should await the finding of the current OSU investigations so that any cover design variants arising from that work can be considered in the design of the new test area.

4.2.8.2.2 Production Rock Relocation

(a) The GPO Appendix 14 Attachment A presents plans for relocating production rock to both the TDF and the underground. The plans follow the conditions of the Waste Management Permit prohibiting Class 4 production rock disposal in surface facilities (Section 1.1.9) and maximizing the amount of Class 3 production rock placed underground (Section 2.2.12).

(b) Placing rock underground after closure will entail many practical difficulties, including proper identification of the rock classes, control of the lime dosage, the need to keep the mine open, the need to keep the road to the mine open, and the control of two fleets hauling rock in two different directions from many sources.

(c) Given the practical difficulties, it would be prudent to explore the options for depositing some Class 4 and more Class 3 production rock in the tailings pile. The options explored should range from incorporating the production rock during tailings deposition to building separate cells for production rock at closure.

4.2.8.2.3 Reclamation Slope Angles

(a) The Waste Management Permit and the GPO Appendix 14 Attachment A refer to final slope angles of 3H:1V. The 3H:1V requirement is normally specified to allow ease of compaction of

a barrier layer. However, it is possible to achieve adequate compaction on steeper slopes. In some cases, for example where re-sloping to 3H:1V would significantly increase the disturbed footprint or encroach on stream corridors, it may be desirable to adopt steeper slopes. Slope and cover stability calculations would need to be checked in such cases. The permit and the plan should allow the flexibility to vary the final slopes where stability is not limiting.

(b) Current best practice in reclamation includes "landform engineering" to establish slopes that are conducive to storm water management and that fit in with the surrounding topography. The former is a well established reclamation goal, and the latter would meet the requirements of the Tongass National Forest Land and Resource Management Plan (TLRMP) that the Nonwilderness National Monument provide the "same natural setting and recreation experience" as the adjacent wilderness National Monument areas …". The principles of landform engineering should be reviewed and a conceptual landform plan developed for Site 23 and the tailings pile. Recent work in the field has shown that natural looking landforms can in many cases be achieved with minimal regrading, but it is certainly preferable to have a conceptual plan in place before facilities reach their final build-out.

4.2.8.2.4 Long-term Water Treatment

(a) The need for long-term water treatment represents the greatest uncertainty in the Reclamation Plan and cost estimate. HGCMC should continue to collect the data required to assess long-term water quality, treatment requirements and treatment options. One suggestion would be to construct some passive treatment systems now (or in the near future) to gather the data needed to demonstrate their effectiveness. This could allow the potential costs associated with future water treatment to be bounded despite the current uncertainty in long-term water quality.

(b) The ongoing mine hydrology study will provide one significant input to that question. There are precedents for such studies at other mines and these should be reviewed.

(c) Site staff have a very good understanding of the production rock, haul road and tailings geochemistry, which are also important inputs into the question of long-term water treatment. The geochemical understanding should be integrated with the cover test results and the site hydrology to create a site-wide water and load balance.

(d) The site-wide water and load balance should be used to examine the risk that long-term water collection and treatment will be required.

(e) It is likely that, based on the currently limited understanding of cover performance, the site-wide water and load balance will show there is a non-negligible risk that seepage will need to be collected and treated in the long term. If active treatment is the only treatment method available, costs will be very significant.

(f) In order to put bounds on the cost risks associated with long-term post-closure water treatment, it would be helpful to test passive treatment methods during the operating life of the mine. The Sulfate Reduction Monitoring Program is investigating one such method. Other

methods that should be investigated include anoxic limestone drains, biocells, porous reactive barriers, and engineered wetlands.

(g) There is a link between the geochemical questions and long-term water treatment costs. The cost estimate assumes that the cost of treating water will continue at the current rate of $0.02 per gallon. However, if contaminant levels in the water delivered to the treatment plant were to increase, the unit cost of treatment would also increase. One objective of continuing the geochemical and water quality monitoring, and undertaking the recommended mine water studies, should be to determine whether future trends will result in increased water treatment costs. The $0.02 per gallon assumption is reasonable, but it needs to be revisited as estimates of future water quality become better defined.

4.2.8.3 Other Closure-Related Information

4.2.8.3.1 Public Consultation

(a) Annual public meetings are conducted as required under the Waste Management Permit.

(b) Current best practices for mine closure and reclamation include public involvement in the plan development. Records of public consultation on the closure plan should be referenced in the GPO Appendix 14.

4.2.8.3.2 Concurrent Closure

(a) Concurrent closure minimizes the total disturbed area and provides an opportunity to monitor the performance of covers and reclamation measures. However, at other sites, concurrent reclamation is often delayed, and much of the value is lost.

(b) Plans for concurrent reclamation should be formalized in the Greens Creek GPO and reflected in permit conditions.

4.2.8.3.3 Suspension Plan

(a) Base metal mines often experience extended periods of temporary shutdown.

(b) The GPO Appendix 14 includes a provision for a one-year “Holding Year” prior to implementation of the major site closure measures.

(c) The Waste Management Permit only requires submittal of a Conceptual Temporary Closure Plan within 30 days <u>after</u> a mill shutdown and a Detailed Temporary Closure Plan within 60 days.

(d) Given both the possibility of an extended shutdown and the need for a holding year, it would be prudent for a clear plan to be derived and documented.

(e) The permit provision 2.3.3 should be modified to require submission of a Conceptual Temporary Closure Plan within a specified time after the permit is issued.

(f) Details of the plan will depend on circumstances, and are appropriately required only after mill shutdown.

4.2.9 Fresh Water Monitoring Plan

Overall, the Greens Creek Fresh Water Monitoring Plan (FWMP) has developed into a comprehensive site wide monitoring plan. The agencies have participated in the development, review and, where appropriate, the approval of the FWMP (USFS, USFWS, EPA, ADEC, ADNR, ADF&G and Alaska Office of the Governor). It evolved into a single document after revising and combining the 1988 Greens Creek Fresh Water Monitoring Manual and the 1992 General Plan of Operations, Appendix 1 in 1995.

The 1995 revisions were made to update the information goals for monitoring and the standard procedures for sample collection, laboratory analysis, data handling, data analysis, and information utilization. The pro-active 2000 revisions to the FWMP were the result of HGCMC sponsored interagency regulatory review of the Greens Creek Mine. The revised document incorporates changes requested and approved by the regulatory agencies and requirements established in the Final Environmental Impact Statement (FEIS), Record of Decision (ROD), and Environmental Assessments (EA).

FWMP Modification and Document Revisions are set forth in the FWMP using eight criteria and a process for the company or USFS to modify the plan. Over the operating life of the project, the monitoring sites and specific sampling locations have been continuously reviewed. As additional areas are impacted by expansions, evaluations by the company and agencies as to additional surface and groundwater monitoring sites may be required.

4.2.9.1 Documentation Review

Procedures, field notes from sampling events, Chain-of-Custody, analytical results of analysis, Quality Assurance (QA) of analytical results and analytical methods, and the 2007 FWMP Annual Report were reviewed. It was found that:

- A random review of file records of sampling events indicated a conscientious approach to recording information during water sample collection;
- Water samples collected were documented and proper Chain-of-Custody procedures were followed through shipping and final receipt by the analytical laboratories;
- Generally, the analytical laboratories performed well with the exception of Analytica Alaska, Inc., which often had analytical equipment out of service for extended periods of time. As a result, the samples needed to be shipped to another lab and some holding times were exceeded, resulting in additional re-sampling costs for HGCMC;
- QA of analytical results and analytical methods by an outside data management firm has been thorough and comprehensive;

- The 2007 FWMP Annual Report provided extensive data and the statistical evaluation of results and trends. There were no responses or comments received from the agencies after their respective reviews of the annual report.

4.2.9.2 Suite of Analytical Parameters

The current monitoring station locations, frequency of sample collection at each station and the analysis each sample is subjected to were reviewed in detail. Currently, Appendix 1 of the General Plan of Operations (Revision 5, October 6, 2000) provides a detailed explanation of the freshwater monitoring program for the site. According to that document, monitoring site selection is determined based upon an annual review of the Regulatory Information Goals (RIGs), Management Information Goals (MAGs), and Monitoring Information Goals (MIGs) necessary to meet those information needs, and an analysis and interpretation of previous data.

According to Appendix 1, the Regulatory Information Goals are designed to ensure that:

- surface and groundwater resources and their related beneficial uses are protected and maintained [Clean Water Act (CWA), Alaska Water Quality Standards -18AAC 70 (AWQS), Environmental Assessment 1988 (EA, 1988)];
- human health and the environment are protected (CWA, AWQS);
- water quality criteria are met (AWQS);
- NEPA (National Environmental Policy Act) required monitoring is accomplished; and
- Admiralty National Monument water quality values are protected (NEPA, Alaska National Interest Land Conservation Act "ANILCA").

Similarly, Management Information Goals are developed from the water quality management functions of HGCMC and the regulatory agencies. Management Information Goals also define the type of monitoring information needed and are designed to:

- ensure the specific methods and procedures stated in the FWMP are implemented;
- evaluate the effectiveness of the FWMP annually, using the information collected through monitoring;
- collect data for designing specific reclamation needs and additional resource protection requirements, if needed (EA 1988, EA 1992);
- ensure monitoring plans are generated (NEPA, Final Environmental Impact Statement (1983), EA 1988, EA 1992);
- validate the assumptions and predictions of the 1988 and 1992 EAs;
- ensure Admiralty National Monument water quality values are adequately maintained (NEPA, EA 1988, ANILCA); and
- ensure the economic efficiency of the FWMP.

MIGs are site-specific qualitative statements based on the Regulatory Information Goals and Management Information Goals, which describe the information expectations of the monitoring program. Sites are selected and Monitoring Information Goals are developed based on their ability

to generate the data needed to address one or more Regulatory/Management Information Goals. Monitoring Information Goals applicable to a given site are listed in the individual monitoring site summaries referenced in Section 4.1 of Appendix 1.

Monitoring frequency at each site is determined based upon the results of previous data analysis, planned future uses of the data and changes in mine operations.

The suite of analyses to be monitored at a particular site in a given month is determined based upon an annual review of the Regulatory/Management Information Goals, the Monitoring Information Goals necessary to meet those information needs and the results of previous data analysis. The analyte suites currently in the monitoring schedule include suites for both water chemistry and biological monitoring. The parameters included in the following sampling suites are described in Table 4-3:

- Suite P – surface water only;
- Suite Q – groundwater and surface water conducted twice per year;
- Suite R – aquatic life monitoring.

The monitoring schedule for each site is provided in Table 5-2 of the General Plan of Operations Appendix 1[5]. A review of this table indicates that the expanded suite of analysis (Suite Q) for surface waters must be conducted twice per year and that the sampling must be conducted in December and February.

In reviewing this monitoring program, two concerns were noted. The first concern is related to the scheduled sampling dates for the Suite Q (the expanded suite of analyses or parameters). As the schedule currently is structured, both of the Suite Q sampling campaigns occur during the winter and no expanded suite of analyses is conducted during the summer. The second concern is related to the limited suite of parameters required for analysis within Suite Q.

An operation such as the Greens Creek mine has the potential to impact the surface aquatic environment in a number of ways and through a number of different pathways, including surface water flows and groundwater discharges. The design of the aquatic monitoring program, including the frequency and scheduling of sample collection and the parameters included in the sample analysis, is of critical importance in order to assess the potential impacts of operations on the receiving environment, to design and implement mitigation measures if required and to ensure the facility can be decommissioned to the satisfaction of the both the land owner, the relevant regulatory agencies and the public.

Individual potential contaminants of concern resulting from the facilities operation may take various forms or be more or less toxic to the aquatic environment depending on such things as the speciation or valence state of a particular element when it enters the receiving water body, the

[5] The table is incorrectly referenced in the text as Table 5-1.

synergistic interaction of one element with others within the liquid and/or the pH and temperature of the receiving water body itself. In addition, the concentration of nutrients and the physical properties of surface waters can also have a significant impact on certain components of the aquatic ecosystem.

In order to account for all potential changes to the surface water quality exiting the site and to provide a more complete understanding of the water quality, SRK recommends that consideration be given to including a Suite S of parameters for analysis, as shown in Table 4-3. It is further recommended that consideration be given to replacing Suite Q, as it applies to surface water quality stations, with Suite S during the February and July[6] scheduled monitoring campaigns. Additionally, the collection of stream flow measurements when collecting surface water samples is recommended to allow an assessment of chemical loading.

4.2.9.3 Additional Stations

It is anticipated that the location of monitoring stations downgradient of the expanded tailings management area will be reviewed and changes made as the Tailings Disposal Facility expands. In particular, it is anticipated that new compliance stations will be established based on the size and location of the TDF expansion. These new stations will be required to demonstrate that waters generated from within the facility are not exiting the containment structures in an unacceptable manner. In addition, it is anticipated that compliance monitoring points will be required for the newly established Pond 7.

Permit Sections 2.6.1, 2.8.1, 2.8.1.1.2 and Alaska Solid Waste Regulations 18 AAC 60.810(b) and 18 AAC 60.825(c) define compliance requirements as specified by the State of Alaska. Prior to commissioning the expanded tailings management area, SRK recommends that HGCMC submit for review and approval by the agencies a proposal that identifies appropriate monitoring stations for the expanded tailings management area, a schedule of sampling frequency, and the suite of analytical parameters that each sample will be subjected to. The submission should also include a commitment by HGCMC to report the results of that program on an annual basis and in a format acceptable to the regulatory agencies.

[6] See discussion of biomonitoring program in Section 4.2.11.2.1.

Table 4-3: Fresh Water Monitoring Program with Recommendations

Suite P (current)	Suite Q (current)	Suite R (current)	Suite S (recommended)
Conductivity, pH, Temperature, Hardness, Sulfate, Total Alkalinity, Dissolved Arsenic, Dissolved Cadmium, Dissolved Copper, Dissolved Lead, Dissolved Mercury, Dissolved Zinc	Conductivity, pH, Temperature, Hardness, Sulfate, Total Alkalinity, Dissolved Arsenic, Dissolved Barium, Dissolved Cadmium, Dissolved Chromium, Dissolved Copper, Dissolved Lead, Dissolved Mercury, Dissolved Nickel, Dissolved Selenium Dissolved Silver Dissolved Zinc	Juvenile fish sampled to determine relative abundance and distribution and a sub-sample from each sample site analyzed for whole body concentrations of total Cadmium, Copper, Lead, Selenium, Silver and Zinc. Metals reported as total per dried weight of tissue. Laboratory also to report percent moisture of samples so that wet weight values can be calculated. Water temperature measured. Epiphyte samples collected for estimates of biomass, as Chlorophyll-a, b, and c. Water samples collected for Standardized Laboratory Toxicity Testing[7] (e.g. Microdot, or other suitable test). Aquatic invertebrate samples collected to determine abundance and community structure.	**Inorganic ions** – Bicarbonate, Calcium, Carbonate, Chloride, Magnesium, Potassium, Sodium, Sulfate **Metals** – Aluminum, Barium, Boron, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Thallium, Tin, Titanium, Uranium, Zinc **Nutrients** – Ammonia as nitrogen, Nitrate, Total organic carbon, Phosphorus, Total Kedah nitrogen, Total nitrogen **Trace elements** - Antimony, Arsenic, Beryllium, Cobalt, Fluoride, Strontium, Vanadium **Physical properties** – pH, Specific conductivity, Sum of ions, Total alkalinity, Total dissolved solids, Total hardness, Total suspended solids, Turbidity **Organics** – total petroleum hydrocarbons (TPH)

[7] The toxicity testing component of the Greens Creek Biomonitoring Program was suspended after the 2003 sampling period (*Aquatic Biomonitoring Report, Greens Creek Mine 2006)*

4.2.9.4 Monitoring Site Locations & Map

The physical location of the various compliance monitoring sites is not clearly documented (i.e. specific latitude & longitude) in Waste Management Permit #0211-BA001 (WMP 0211-BA001). In addition, the map available in subsection 4.2 of Appendix 1 does not provide a concise location of the various monitoring stations and includes both compliance and non-compliance monitoring sites. Attachment A of Appendix 1 (Revision 5, October 6, 2000) of the General Plan of Operations does provide this information, however Attachment A to Appendix 1 did not form part of the original electronic copy of General Plan of Operations, Appendix 1 (also labeled "Revision 5, October 6, 2000) provided for review. This fact indicates that there is more than one electronic version or copy of Appendix 1 (one which includes Attachment A and one which does not) and the copies are not consistent. By extension of certain conditions contained within WMP 0211-BA001, Appendix 1 forms a significant part of the regulatory requirements for the site as it defines compliance monitoring stations and monitoring requirements. As such, a single common version of the document should be in use by all parties concerned (the operator, site personnel and all regulatory agencies). Differing versions or copies of the same regulatory document which are not consistent has the potential of causing significant ambiguity in exercising and enforcing the requirements of the Waste Management Permit.

Both the General Plan of Operations, Appendix 1 and the renewal of the Waste Management Permit for the site would benefit if the compliance sites were located on a single map drawn specifically for that purpose and any additional, non-compliance monitoring sites located on a separate map. The non-compliance site map should not form part of the new Waste Management Permit.

SRK recommends a detailed description of the physical locations (i.e. specific latitude & longitude) of all compliance sampling locations be provided within the new Waste Management Permit issued to the site. The new Waste Management Permit issued to the site should also include a detailed map showing the location of all relevant compliance monitoring stations.

SRK recommends a detailed map showing the location of compliance monitoring stations be included in a revised Appendix 1. A separate map showing the location of non-compliance sampling locations should also be included in the revised Appendix 1.

4.2.9.5 Exceedances of Water Quality Standard at Points of Compliance

Subsections 2.2.3, 2.6.4, 2.6.5 and 7.1.2 of Waste Management Permit #0211-BA001 include requirements for controlling water quality at the site and measures to be taken when a statistically significant change in water quality is detected at a point of compliance or a water quality standard is exceeded at any surface water point of compliance as a result of the surface water monitoring program. A review of the results reported in the *Fresh Water Monitoring Program Annual Report,*

Water Year 2006 showed that lead and zinc parameters at some monitoring stations were consistently in exceedance of the established standard. This included:

- pH Exceedances (both low and high) – Sites 58, 27, 29, 32, 59 and 28
- Alkalinity Exceedances – Sites 29 and 32
- Arsenic Exceedances (Drinking Water) – Sites 28 and 29
- Lead Exceedances – Sites 27, 29, 32 and 9

Section 2.6.5 of the Waste Management Permit states that "*problems found during visual monitoring, or an exceedance of a water quality standard during surface or groundwater monitoring at points of compliance, or a statistically significant change found in groundwater monitoring results that suggests a problem shall be reported to the Department within 10 days of discovery. The report shall include a plan to correct the problem or state the actions taken to mitigate a problem needing immediate attention. The plan requires Departmental approval before implementation, except that advance approval is not required for actions taken to mitigate a problem needing immediate attention.*" Evidence of compliance with subsection 2.6.5 of the Waste Management Permit could not be located during the audit, particularly as it relates to reporting within 10 days of discovery and that the referenced reports "*include a plan to correct the problem or state the actions taken to mitigate a problem.*"

The 2006 report states that one exceedance of AWQS occurred in the 920 Area at Site 13 during the reporting period. The exceedance was for a sulfate value of 252 mg/L, which is above the AWQS (250 mg/L). Exceedance of the applicable State standard for samples collected in the TDF area were also identified for pH (both low and high), low alkalinity, and elevated concentrations of arsenic and lead. According to the report, the shallow wells (sites 58, 27, 29, and 32) continued to display their long history of exceedances due to the low-pH, low-alkalinity water that naturally characterizes these sites. In addition, a single exceedance for arsenic occurred at Site 29 with the explanation given that the measured concentration was now an exceedance due to the recently lowered AWQS for total arsenic (from 50 µg/L to 10 µg/L); however, the value reported, 20 mg/L, is well within historic norms for the site. Five exceedances for dissolved lead occurred at the three, downgradient shallow wells (sites 27, 29 and 32). The report states that these exceedances continue the recent history of low to moderate levels of lead that may in part be due to minor amounts of tailings escaping the containment controls around the impoundment due to fugitive dust or tracking. According to the report, the single deep, downgradient well, Site 28, continued trends similar to prior years with high pH and elevated arsenic levels that are naturally associated with the marine unit that the well is completed in.

A review of the 2007 freshwater monitoring report provides a similar discussion, which includes a number of exceedances of State water quality standards at many of the same locations. Based on a review of the graphical representation in the 2007 report, this includes:

- pH exceedances (both low and high) at Sites 13 (field), 27, 28, 29, 32, 48 (lab), 49 (field), 54 (lab), 58, 59 (lab) and 60

- Total Alkalinity exceedances at Sites 9, 27, 29, 32, 58 and 60
- Total Sulfate exceedances at Sites 13 and 60
- Arsenic Exceedances at Sites 28, 29 (27 at limit)
- Lead exceedances at Sites 9, 27, 29, 32 and 57
- Cadmium exceedances at Site 57 (at 1.51 µg/L dissolved)
- Zinc exceedances at Site 27 and 57 (at 288 µg/L dissolved)
- Mercury exceedance at Site 60

Based on these results and the way in which the Waste Management Permit is currently written, the permittee is, in some instances, consistently in contravention of the permit because, based on a review of historical data, a number of stations identified are consistently in non-compliance. Allowing such a situation to continue will undermine the integrity of the regulatory framework and will reduce public confidence in both the regulatory system and their confidence that the site is being monitored and operated in a manner that adequately protects the environment in the short-, medium- and long-term.

Adherence to conditions such as those specified in the noted section of Permit 0211-BA001 is required in two separate ways: complying with the standard itself and, in the event that the standard is exceeded, complying with the required follow-up action(s). From reviewing both the 2006 and 2007 Fresh Water Monitoring Program Annual Reports, as well as other relevant documentation, it is not evident that the requirements specified in subsection 7.1.2 have or are being met for the monitoring stations discussed.

In addition, subsection 7.1.2 is very specific in the actions required once an exceedance is identified; however the practicality and applicability of some of the requirements are questionable, particularly as they apply to exceedances at certain stations that appear to be consistent from one monitoring cycle to the next.

SRK recommends that HGCMC prepare an “Action Plan” that:

- Assesses the location and suitability of the stations in terms of the objectives of the monitoring program;
- Assesses the historical and current water quality at the identified stations;
- Assesses the expected trends in concentrations at each station;
- Assesses the significance and short-, medium- and long-term risk(s) posed by currently observed and predicted future concentrations to the surface biophysical environment;
- Proposes site specific “action levels” at which, should a concentration reach the specified level, additional mitigation activities will be implemented; and
- Provides a description of the form such mitigation would potentially take.

The statement “an exceedance of a water quality standard during surface or groundwater monitoring at points of compliance, or a statistically significant change found in groundwater

monitoring results that suggests a problem shall be reported to the Department within 10 days of discovery" is too ambiguous a statement to be included in a regulatory instrument such as the Waste Management Permit. It is unclear whether the permittee should report a non-compliance value within 10 days of taking the water sample (in the case of those monitoring stations with a history of non-compliance), when the results of a particular sampling event are received from the analytical laboratory, or after conducting the statistical analysis referenced.

SRK recommends that the HGCMC General Plan of Operations, Appendix 1, Fresh Water Monitoring Plan be revised in a manner that separates groundwater and surface water monitoring into separate and distinct programs. It is further recommended that any future Waste Management Permits issued to HGCMC reference the groundwater and surface water monitoring programs as distinct and separate and, wherever possible, contain concise language that provides clarity in all aspects of the permits requirements.

4.2.10 Spills and Releases

4.2.10.1 Spill Reporting

4.2.10.1.1 Spill Reporting by HGCMC Employees

The policy at the Greens Creek mine site is that employees report spills to the Environmental Department, which subsequently reports the spills to the appropriate agencies. The goal is for all spills to be reported by employees to the Environmental Department, including spills that may not be reportable to the agencies (e.g. spills of oil or fuel of less than 1 gallon to land).

HGCMC implemented the Environmental Small Spill Report in March of 2008 in an effort to enhance and facilitate reporting of small spills (less than 10 gallons of oil or fuel) by employees to the Environmental Department. The Environmental Small Spill Report is a small-sized card that can fit in an employee's pocket and can easily be stored in vehicles. HGCMC believes that this new report has increased the spills that are reported. A review of recent spill reports by SRK revealed several reports of spills of less than 1 gallon (e.g. 2 cups of oil), which are not required to be reported to the agencies. This indicates that employees are in fact reporting small spills. This would also indicate that there is a good possibility that the majority of spills are reported to the Environmental Department.

A formal Incident Report is required for immediately reportable spills (e.g. any amount of a hazardous substance spilled to water, etc.) and spills of more than 10 gallons of fuel or oil to land. The following notes on the Small Spill Report convey information to employees on reporting of such spills:

- "Immediately report any spill to water"; and
- "more than 10 gallons require a formal Incident Report"

The auditors recommend that further clarification be added to the Small Spill Report to indicate that spills of any amount of a hazardous substance other than oil or fuel must be reported immediately. This would clarify that the note regarding reporting more than 10 gallons through a formal incident report refers only to oil and fuel. Although employees are likely aware of this detail, it should be on the Small Spill Report to ensure that the instructions are clear. This is especially important in dealing with contractors.

Although HGCMC is recording some spills that are not reportable to the agencies, this information can be useful for other purposes. For example, examining trends in spills could reveal specific types of recurring spills that could be reduced or prevented by changes to operations, maintenance, etc. Furthermore, the auditors believe that the policy that HGCMC has instituted to report all spills, regardless of size, is the best way to ensure that all spills that are required to be reported to the agencies are properly reported. The information is passed on directly to the Environmental Department personnel, which have the tools and knowledge to assess the appropriate reporting requirements.

There is no absolute method to ensure and demonstrate that 100% of spills are reported at any facility, however, the reporting of small spills of less than one gallon is an indicator that HGCMC is close to achieving this goal. During an inspection of the concentrate storage building at the Hawk Inlet area, there appeared to be evidence of two separate oil spills on the ground outside the building that had not been cleaned up and possibly not reported. The quantity appeared to be less than a gallon, which would not be reportable to the agencies. As stated, it is not possible to ensure that every spill will be reported and managed appropriately by employees. However, inspections of areas can reveal spills that have not been reported or cleaned up. Corrective actions can then be taken to address these spills.

4.2.10.1.2 Spill Reporting to Agencies – HGCMC Responsibility

The Environmental Department manages all spill reporting to the agencies. Like many facilities in Alaska, determining the required reporting can be a complex task. HGCMC is required to report to the following agencies depending on the type and quantity of substance spilled and the spill media:

- National Response Center
- Alaska Department of Environmental Conservation
- US Department of Agriculture Forest Service
- US Coast Guard
- US Environmental Protection Agency
- Alaska Department of Fish and Game
- Alaska Department of Natural Resources

The Environmental Department currently uses an emergency contact list sheet and spreadsheets to determine reportable quantities and the agencies requiring notification. They have made recent improvements to their spill reporting procedures, which have helped facilitate agency reporting. However, the required reporting procedure is not documented in one consolidated document.

HGCMC should develop, document, and submit for review and approval by the agencies a standard operating procedure for reporting to the agencies, which includes a more streamlined, centralized method, such as a single table of reportable quantities and reporting requirements.

Without a written procedure to review, it was difficult to assess if HGCMC is reporting spills to the agencies appropriately. SRK reviewed the spill registers from 2001 to 2007. The registers have a column entitled "Reportable", which appears only to be spills that are *immediately* reportable. Spills that are reportable on a monthly basis had "No" entered under the Reportable column, whereas they are indeed reportable to ADEC. This column should either be changed to "Immediately Reportable" or should only be marked as not reportable when the spill is not reportable to any agency. There are also columns to indicate which agencies were reported to. On the 2007 register, HGCMC began indicating which spills were reported to ADEC monthly, which was not done in previous registers. This is a good improvement, and should be continued.

SRK reviewed the Spill Reporting Procedure flow sheet and the Environmental Small Spill Report card. These tend to indicate a misunderstanding of the spill reporting requirements. 18 AAC 75.300 states that spills must be reported:

"(1) as soon as the person has knowledge of a

(A) discharge or release of a hazardous substance other than oil;

(B) discharge or release of oil to water;"

According to Alaska Statutes 46.09.900 (4), a hazardous substance is defined as:

(A)…" an element or compound that, when it enters into or on the surface or subsurface land or water of the state, presents an imminent and substantial danger to the public health or welfare, or to fish, animals, vegetation, or any part of the natural habitat in which fish, animals, or wildlife may be found; or

(B) a substance defined as a hazardous substance under 42 U.S.C. 9601 - 9657 (Comprehensive Environmental Response, Compensation, and Liability Act of 1980);

Note that "hazardous substance" does not include uncontaminated crude oil or uncontaminated refined oil".

Both the Spill Reporting Procedure flow sheet and Small Spill Report appear to apply the requirements for spills of *oil* to chemicals. The only spills that employees are instructed to report immediately are spills to water. The flow sheet specifically indicates that a spill of a chemical that is not to water or greater than 55 gallons is NOT immediately reportable. *ANY quantity of a hazardous substance that is discharged or released is immediately reportable to ADEC, with the exception of spills of oil to land of 55 gallons or less or spills of oil to secondary containment, which have alternate reporting requirements.* HGCMC should revise current spill reporting instructions to comply with the State of Alaska spill reporting regulations and, as mentioned above, develop a standard operating procedure for review and approval by the agencies. HGCMC and the agencies may be able to agree to alternate reporting for certain spill types or quantities. However,

without written approval from ADEC, HGCMC's current spill reporting written policies are not in compliance with the State of Alaska spill reporting regulations.

4.2.10.1.3 Spill Reporting at the Underground Mine

Section 5.2.2 of Waste Management Permit #0211-BA001 contains stipulations relating to the underground disposal of wastes, including: "*The permittee shall notify the Department of a discharge of any hazardous substance at the facility in compliance with 18 AAC 75, Article 3.*"

HGCMC manages the underground mine as secondary containment, therefore, spills of oil/fuel less than 55 gallons are not reported to the agencies. According to HGCMC, there is an agreement with the state to manage the underground mine as secondary containment, however, no supporting documentation was produced to verify this during the audit. HGCMC must ensure that a written agreement with the agencies supporting their handling of spills at the underground mine is on file and can be produced during an audit in order to demonstrate compliance with their Waste Management Permit and the State of Alaska spill reporting regulations.

4.2.10.1.4 Spill Reporting to Agencies – Agency Responsibility

Spills of hazardous substances are reported to the ADEC Spill Prevention and Response Division. However, if the spill is related to the water treatment works, it must also be reported to the Division of Water within the same agency.

ADEC is in the process of developing a spill reporting form to assist in the uniform reporting of all spills. The department anticipates that the single form will cover all substances. ADEC should implement the use of the new spill report form to allow HGCMC and other similar operations in Alaska to report spills more efficiently.

The regulations under 18 AAC 75.300 (a) specify the requirements for reporting discharges of oil to land. On the ADEC website, the Division of Spill Prevention and Response provides the following instructions for reporting spills of oil to land:

> *TO LAND: Any release of oil in excess of 55 gallons must be reported as soon as the person has knowledge of the discharge. Any release of oil in excess of 10 gallons but less than 55 gallons must be reported within 48 hours after the person has knowledge of the discharge. A person in charge of a facility or operation shall maintain, and provide to the Department on a monthly basis, a written record of any discharges of oil from 1 to 10 gallons.*

The instructions on the ADEC website should be changed to be consistent with the regulations stipulated in 18 AAC 75, which state that spills of **55 gallons or less** are reportable within 48 hours.

The spill reporting regulations require immediate reporting of spills of any amount of a hazardous substance and reporting either immediately, within 48 hours or monthly for spills of oil, depending

on the quantity of oil spilled and the receiving media. The complexity of the reporting requirements for different types of spills can make it difficult for operations to understand and comply with the regulations. Furthermore, being required to report spills to more than one department within the same agency (ADEC) depending on the substance spilled adds to the complexity. ADEC should consider streamlining their spill reporting procedures to facilitate the understanding of the requirements and increase the efficiency of spill reporting.

4.2.10.1.5 Spill Reporting Documentation

The ADEC spill reporting regulations under 18 AAC 75.300 (a) state that for spills requiring immediate or 48-hour reporting, "*…a person in charge of a facility or operation shall notify the department by telephone, and immediately afterwards send the department a written notice by facsimile, hand delivery, or first class mail, informing the department about a discharge or release of a hazardous substance at or from the facility…*".

Furthermore, 18 AAC 75.300 (e) states "*Unless the department determines that a written report is not needed for the department to ascertain any threat to human health, safety, or welfare, or to the environment, a written report must be submitted to the department within 15 days after containment and cleanup are completed or, if no cleanup occurs, within 15 days after the discharge or release… The report must contain the information specified in (f) of this section.*"

The current procedure for notifying the agencies of immediately or 48-hour reportable spills is to contact ADEC and other required agencies by telephone. A written report is sent to ADEC, Spill Prevention and Response (SPAR) if requested. Therefore, there are times when no report is provided, which does not comply with the regulations. There are provisions under the state regulations for alternate reporting of small spills upon a written agreement between the agency and the facility owner; however, HGCMC does not currently have such an agreement with ADEC.

In addition, at no time does HGCMC provide the information required within 15 days. For this latter requirement, since ADEC SPAR has stated they do not require a report, it would not constitute a violation, provided HGCMC could substantiate that ADEC specifically instructed them not to provide the report.

SRK recommends that HGCMC record spills that are reportable immediately or within 48-hours on the form located on the ADEC spill reporting web page. This report covers the requirements of both 18 AAC 75.300 (a) and (e). Alternatively, HCGMC could enter into a written agreement with ADEC for alternate reporting, which the auditors feel is less preferable from a compliance standpoint. It is also recommended that ADEC SPAR provide guidance that is consistent with the reporting regulations in 18 AAC 75.300.

4.2.10.1.6 Spill Cleanup Procedures

HGCMC does not have a standard operating procedure that includes instructions for assessing the effectiveness of spill cleanup in cases where agencies request confirmation sampling. A procedure should be developed that includes locating and marking sample locations, preparing a drawing of the spill site and sample locations, agency communication/approval, required equipment, sampling procedures, analytical methods, cleanup standards, etc.

4.2.10.2 Current Infrastructure

This task was combined with the evaluation of the containment and storage of hazardous substances in Section 4.2.10.5.

4.2.10.3 Type and Size of Spills

The draft document "*Summary of Oil and Hazardous Substance Spills at Mining Facilities (July 1, 1995 to June 30, 2005)*" by ADEC, dated April 2008, provides a detailed analysis of spills of oil and other hazardous substances occurring at mining facilities in Alaska over a 10-year period from 1995 to 2005. The mines reviewed by the ADEC Prevention and Emergency Response Program (PERP) included Red Dog, Fort Knox, Usibelli Coal and Greens Creek. The report is intended to assist ADEC with the development of prevention program initiatives for regulated and unregulated entities and assist in identifying facilities where regulatory inspections and exercises may be conducted to prevent future spills.

The report concluded that mining facilities should focus on preventive measures for hydraulic oil spills resulting from line failure. The most prevalent type of material spilled was hydraulic oil for all the mines examined, including Greens Creek Mine. The leading cause of spills was found to be structural/mechanical for all the mines examined, with line failure being the most prevalent cause within this category. A summary of the report findings is provided in Table 4-4.

Table 4-4: Summary of 10-Year Review of Spills at Alaska Mines

Cause/Product Spilled	Red Dog	Fort Knox	Usibelli	Greens Creek
Total Spills Reported	1,283	568	390	206
Average Spill Size (gal)	591	168	26	401
Average Spill Size (lbs)	11,853	23	0	5,529
Average Spills/Year	128	57	39	21
Average Spills/Month	11	5	3	2
Average Gallons/Year	75,878	9,497	1,026	7,986
Average Pounds/Year	112,606	7	0	3,871
Number of Employees	> 400	> 400	75	> 250
***Spill Causes*[1]**				
Unknown	2%	5.3%	10.5%	2%
Accident	2%	2%	1%	2%

Cause/Product Spilled	Red Dog	Fort Knox	Usibelli	Greens Creek
Human Factors	17%	11%	11%	17%
Other	3%	4%	3%	17%
Structural/Mechanical	76%	78%	74%	62%
Line Failure	24%	37%	34%	24%
Spilled Products[1]				
Process Water	13%	7%	0%	15%
Unknown	0.3%	0%	1%	1%
Extremely Hazardous Substance	1%	1%	0%	1%
Hazardous Substance	22%	10%	8%	6%
Noncrude Oil	64%	82%	91%	91%
Hydraulic Oil Spills	31%	50%	44%	45%

Notes: 1. Percentage of spill causes and products based on the total number of spills

During 2000, ADEC took regulatory action against Greens Creek Mine. KGCMC worked with ADEC to develop monthly spill reporting procedures, resulting in an increase in spill numbers during and after the year 2000. As a result, the number of spills during the study period increased over time. This increase in reported spills during the review, coupled with the Greens Creek Mine policy of not reporting oil spills of less than 55 gallons or less underground due to their treatment of the underground mine as secondary containment makes it difficult to compare the data from Greens Creek mine with the other mines reviewed in the report.

Without accounting for the spills underground at Greens Creek Mine that are not reported, the 10-year report would tend to indicate that Greens Creek Mine either has a smaller number of spill occurrences than the other similar-sized mines in the report (Red Dog and Fort Knox) or not all reportable spills are being reported. With the inclusion of spills underground that would otherwise be reportable (e.g. spills of oil between 1 and 55 gallons), Greens Creek Mine appears to have a similar number of spills in comparison to Red Dog and Fort Knox. For example, in March 2008, there were 13 spills that occurred including underground spills (excluding oil spills of less than 1 gallon). This is actually slightly higher than the average monthly spills at Red Dog and Fort Knox mines.

Upon reviewing the spills by type and substance, Greens Creek Mine appears to be similar to Red Dog, Fort Knox and Usibelli mines. However, the number of hydraulic oil spills and spills resulting from a faulty hydraulic hose may be significantly higher if underground spills of oil between 1 and 55 gallons were included. Nearly every one of the spills that occurred in March of 2008 was due to a faulty hydraulic hose.

Operations that track and analyze their spill data will often conclude that a change in preventive maintenance procedures can reduce the number of spills caused by mechanical failure, such as a broken hydraulic line. For example, the Fort Knox mine implemented an automatic hose replacement program in 2006 to help reduce the number of spills caused by line failure. HGCMC

should review their spill data, including spills underground to establish trends in spill occurrences. In addition, HGCMC should consult with other operations such as Fort Knox to determine if the hose replacement program has proven to be successful. If other operations are reducing the number of spills with preventive maintenance, HGCMC should consider adopting these same measures to reduce spills.

4.2.10.4 Tracking of Tailings and Concentrate

During the course of the May 08, 2008 site surface inspection, particular attention was given to the potential for tracking of materials by haul vehicles exiting three separate areas related to concentrate and tailings loading and transport. These included the concentrate loading facility at the mill, the tailings loading facility at the mill and the return road for trucks returning from the Tailings Disposal Facility.

4.2.10.4.1 Concentrate Loading Facility

The area was found to be well maintained at the time of the inspection and no concerns were noted. From an OH&S perspective, the audible alarm on one of the filter dump warnings was not functioning properly at the time of the inspections, however the visual alarm was functioning – this was identified to the Mill Supervisor at the time of the inspection.

Prior to leaving the area, each truck is washed before exiting the load-out facility. The area of the truck wash was also inspected and found to be in good order. Splash was retained within the building and containment and collection of the wash water appeared adequate. No trucks were in the facility at the time of the inspection. It was not clear during the inspection, how often the truck wash is inspected to ensure all nozzles and flows are performing properly or if individual drivers or environmental personnel at the site perform spot audits of the trucks themselves and of the truck washing facility performance. Consideration should be given to such a program if not already in place.

4.2.10.4.2 Tailings Loading Facility

The mill loading and transport route of tailings from the load-out facility to the TDF was inspected and the process discussed with William Oelklaus. It was noted during the inspection that no truck wash takes place after the loading of tailings. Although significant care is taken, the area immediately outside of the tailings load-out building clearly showed that tailings were located on the ground and that some tailings will be retained on the transport truck when it departs the area (particularly on the tires and wheel cowlings/mud flaps). During the inspection it was noted that this material is being tracked around the first corner (of the mill) after a truck departs from the tailings load-out facility. Although, any tailings material dislodged from a truck would likely be contained within the catchment area surrounding the mill, the slow rate of speed and limited vibration is not likely to dislodge all of the material before the truck exits the secondary containment area around the mill. As a result, the potential does exist for tailings to be tracked off

of the mill site proper and deposited in areas of the B-road that do not have secondary containment. It was not possible to ascertain the significance of this type of activity, although discussions on site by HGCMC personnel did acknowledge that such excursions may be a source responsible for increased concentrations in certain parameters at a storm water outfall monitoring station immediately outside the mill proper area.

SRK recommends that consideration be given to requiring HGCMC to construct truck wash capabilities in close proximity to the tailings load-out facility at the mill site and requiring both the tailings trucks and the equipment hauling tailings from the mill for underground placement as backfill to be washed before exiting the area. Because of the nature of the loading operation, the wash could potentially be limited to the lower extremities of the vehicles (tires, mud flaps and undercarriage).

Until such a facility is constructed, increased housekeeping is required of the transport route to minimize the amount of tailings immediately in front of the load-out facilities and to limit the transfer of tailings to the tires etc. of the transport vehicles.

The inspection of the tailings holding area of the mill facility also identified tailings on the upper most surface of the containment walls of the facility. Discussions with site personnel indicated that during times when the transport of tailings away from the mill facility is delayed, tailings are stockpiled in the area. The visual observation of tailings on top of the wall indicate that additional care must be taken to ensure that all tailings are retained within the holding facility at all times and that stockpiled tailings must not be allowed to exceed the height of the surrounding retaining walls.

4.2.10.4.3 Tailings Disposal Facility Truck Wash

The TDF truck wash was also inspected and found to be in good order. Prior to leaving the TDF, each truck is washed. Splash was retained within the building and containment and collection of the wash water appeared adequate. No trucks were in the facility at the time of the inspection. It was not clear during the inspection how often the truck wash is inspected to ensure all nozzles and flows are performing properly or if individual drivers or environmental personnel at the site perform spot audits of the trucks themselves and of the truck washing facility performance. Consideration should be given to such a program if not already in place.

4.2.10.5 Infrastructure / Containment and Storage of Hazardous Substances

In order to complete this task, site inspections of surface facilities at the Greens Creek site were conducted on Monday May 4, 2008 and Thursday May 8, 2008. During the May 8 inspection, particular attention was given to current infrastructure, including tanks, piping, valves, mechanical and electrical equipment, to assess the condition of the infrastructure in terms of environmental protection. During both days of inspection, particular attention was given to the storage and management of chemicals, mill reagents and fuel in order to assess the potential of spills and unanticipated discharges occurring at the facility. The inspection was conducted by Don Hovdebo

and Kathleen Willman of SRK accompanied by William Oelklaus of HGCMC. A copy of the Site Inspection Report is located in Appendix D.

During the May 8, 2008 inspection, four items were identified that were recommended for immediate follow-up. These were:

1. The lined ditch immediately below the equipment wash area at the mill – approximate 40 to 50% of the ditch was blocked by gravel/sediments, significantly reducing the capacity of the ditch. SRK recommends immediate removal of the blockage (Photo 23 and Photo 24).
2. The area of construction for the temporary fresh water intake line (near the potable water treatment plant) – the area poses a high potential to impact the quality of Greens Creek due to the flushing of fines directly into the Creek upstream of the weir. SRK recommends stabilization of the area as soon as possible to prevent the unnecessary deposition of silt into Greens Creek upstream of the intake weir (Photo 25).
3. Secondary containment on the transformer located behind the old water treatment plant at the Tailings Disposal Facility was found to be full of water, eliminating the secondary containment capabilities of the facility. SRK recommends removal of precipitation water from secondary containment as soon as possible (Photo 3).
4. Secondary containment for the tailings thickener (largest thickener closet to the tailings load-out area). As it is currently constructed, the newly installed concrete containment would direct any unanticipated discharge from this thickener into the road area west of the thickener. This is a risk area for a puncture of the thickener based on indications on the side of the wall of the tank (small dents and scratches primarily) that it has been struck by equipment (presumably). SRK recommends improvement of the secondary containment of the tailings thickener in the vicinity of the tailings load-out area as soon as possible to reduce the potential of discharge to the road area in the event of an unanticipated discharge from the tailings thickener (Photo 26 and Photo 27).

The items for which SRK recommends immediate action were identified to William Oelklaus of HGCMC during the May 8, 2008 inspection and were again raised during the May 10, 2008 meeting held with the regulatory agencies and representatives of HGCMC at ADEC, Juneau office.

Other than the items identified above, the site was found to be well maintained and no other immediate concerns were identified. During the inspection, no observable evidence of significant corrosion, disrepair beyond what would normally be expected in an operation of the size and age of the Greens Creek facility were identified. No areas of neglect were identified during the inspection.

Physical confirmation or testing of the integrity (by x-ray or other means) of piping, valves, secondary containment and associated facilities was not conducted (and was not included in the scope of the inspection), however visual observation found these components to be generally clean, well maintained and of sufficient quality to perform the required function.

Although not requiring immediate follow-up, the various pipelines crossing Greens Creek between the underground mine and mill area do not have appropriate secondary containment to contain the material and prevent it from entering the creek in the event of a rupture or other type of failure (Photo 28). A discussion of the situation was held with William Oelklaus, who indicated that the risk of an unanticipated discharge had been identified and work had begun on identifying methods to reduce the risk posed by lines to Greens Creek.

SRK recommends that HGCMC submit for review and approval a plan to provide secondary containment of all lines passing across Greens Creek from the mine to the mill area (in the vicinity of the bridge). Once approval of the planned activity is received, HGCMC should be required to implement the proposed changes as soon as practical.

As these examples show, the effectiveness of chemical/fuel storage and associated secondary containment at a facility such as the Greens Creek site is in large part dependant on the diligence of the operator to regularly evaluate the condition of all chemical storage facilities (large and small), pipelines, secondary containment facilities, containment ponds and lined ditches throughout the site to ensure that they are all in good repair and in a condition that allows them to fulfill their intended purpose. Situations such as allowing the secondary containment at the old water treatment plant transformer to remain filled with precipitation water entirely eliminated the ability of the containment to fulfill its function. In that instance, a leak of oil would result in a discharge to the environment because there essentially was no secondary containment.

The site inspection conducted on May 8, 2008 found the majority of the chemical/fuel storage facilities and associated secondary containment to be in good condition and well maintained; however, continually changing circumstances at the site make it incumbent on the operator to be diligent in the inspection and management of such materials and storage facilities. For example, on May 8, 2008 a barge of materials was delivered to the site and the materials were in the process of being delivered throughout the site. A repeat of the May 8, 2008 inspection the following day may have identified materials not stored in the appropriate location or with the appropriate containment. Similarly, a large precipitation event may fill secondary containment facilities with precipitation water, thus reducing the available volume of the facility.

For these reasons, regular daily inspections of such facilities are required by the operator and should be a significant focus of inspection by representatives of the regulatory agencies whenever on site.

As discussed in Section 4.1.11, Waste Management Permit #0211-BA001 subsection 3.4.3 requires that the permittee "*by January 29, 2006 provide sufficient storage to contain and control the 24-hour, 25-year storm event*". A recent and up-to-date site water balance, which includes accurate containment pond volumes, average flowrates at specific locations and pumping capacities, was not available during the audit. In addition, during the May 8, 2008 site inspection, site personnel could not provide accurate average flows or containment volumes for a number of different lined

containment ponds located throughout the facility. SRK recommends that HGCMC prepare a current and detailed site water balance for the entire site.

4.2.10.6 Spill Prevention, Control and Countermeasure (SPCC) Plan

The Greens Creek Mine Site is required to have a Spill Prevention, Control and Countermeasures (SPCC) Plan, as specified in 40 CFR 112.3 based on the fact that the aggregate aboveground storage capacity of the facility is greater than 1,320 gallons of oil. The requirements for the SPCC Plan are provided in 40 CFR 112.7. The Plan must be certified by a licensed Professional Engineer.

The Greens Creek Mine Site has a certified SPCC Plan in place. The last revision is dated September 9, 2006. The engineering certification states:

> *"I hereby certify that I have reviewed this SPCC Plan, and having examined the facility and being familiar with the provisions of 40 CFR § Part 112, attest that it has been prepared in accordance with good engineering practice."*

The auditors did not review the SPCC Plan for compliance against the requirements of 40 CFR 112. The engineering certification indicates that the Plan meets the provision of these regulations. A review of compliance with some of the requirements of the SPCC Plan is discussed in Section 4.1.13, General Compliance.

The SPCC Plan was also reviewed from the perspective of whether or not it achieved the overall goal of minimizing the risk to the environment associated with spills of oil. Page 5-4 of the Spill Prevention Control and Countermeasure Plan refers to an "Emergency Response Plan" and a review of that plan is considered essential in assessing the effectiveness of the SPCC Plan. A request has been made for a copy of the Emergency Response Plan referenced for review; however it was not made available at the time of issuance of the audit report.

In general, the document appears to achieve the desired goal of a SPCC Plan. SRK noted the following:

- Section 1.2.3 states "Any observed spill (regardless of size) must be reported immediately to the Environmental Manager or other member of the Environmental Department. This is not consistent with the existing HGCMC written policy for spills of oil to land of 10 gallons or less, which do not require immediate notification to the Environmental Department;
- The Plan refers to Figures 1 through 4, however, none of the figures are numbered;
- Some of the legends and sections of the drawings are too small to read;
- Section 3 states: "All spills regardless of the quantity, whether or not it is "reportable" by state and federal regulations, is reported to the Environmental Manager or other members of the KGCMC Environmental staff… A summary of oil spill events for the years 2001 through 2005 is presented in Appendix E". The number of spills shown in Appendix E is not representative of the number of spills that would typically occur at an operation like Greens Creek mine if all spills regardless of size and whether or not they were reportable were

shown as stated in Section 3. For example, there are four spills listed in 2005. The auditors can only conclude that Appendix E does not in fact show all spills as is stated in Section 3 or all spills were not being reported to the Environmental Department from 2001 to 2005;

- Section 3 also states that the summary in Appendix E includes a description of the spill and corrective actions taken. Corrective actions are not shown in Appendix E;
- Section 3 further indicates that methods for preventing recurrence are indicated by the corrective actions and can be used for SPCC Plan training. Given that the corrective actions are not provided in Appendix E and only a fraction of the spills that likely occurred during the years shown are actually listed, the summary in Appendix E cannot achieve the stated goal of indicating methods of preventing recurrence or for use as training.

4.2.11 Audit of the Agencies

4.2.11.1 General

The detailed Scope of Work included specific areas to be evaluated within each agency as follows:

- ADNR – evaluate whether:
  - Biomonitoring sites are appropriate and adequate;
  - Biological surveys and monitoring are adequate to ensure environmental protection of fresh and marine waters;
  - Water use and dam safety regulations are applied appropriately at the Greens site.
- ADEC and USFS:
  - Evaluate whether oversight of facility is adequate;
  - Evaluate and/or recommend improvements regarding oversight, compliance and record keeping.

The regulatory performance of ADEC and USFS was assessed by reviewing in detail the ADEC 401 Certification of NPDES Permit AK004320-6, Waste Management Permit #0211-BA001, and Air Quality Operating Permit No. 302TVP02, conducting random spot checks of each office's document retention/record keeping, and conducting interviews with persons directly involved in the day-to-day regulation of the Greens Creek operation.

Generally, all persons interviewed were found to have a good to excellent knowledge of the site and site operations, and their respective regulatory requirements, documentation and individual and departmental roles and responsibilities in performing specific duties as a regulatory agency.

In an effort to improve the effectiveness and efficiency of the regulatory oversight of the Greens Creek operation, SRK recommends that the creation of a formal Agency Joint Regulatory Group (JRG) for the Greens Creek project be considered. Similar to the Large Mine Permitting Team concept currently employed, the JRG would be composed of representatives of the various federal and state agencies with a direct and significant regulatory oversight of the facility and would meet on a monthly or bi-monthly basis to assess current site operations and activities, review the result

of recent inspections, coordinate activities and schedule and outline areas of foci for upcoming inspections by member agency representatives.

The JRG structure and regular meetings would also afford the opportunity for agencies with fewer resources and or opportunities to inspect the site to identify areas or activities of significance from their perspective and request the inspecting agency for a particular month to follow-up on these areas or activities. Representatives of the various members of the JRG would also conduct at least one joint inspection of the site per year generally immediately after reviewing the annual reports and before issuing comments on those reports to HGCMC.

During the audit, it was noted that the agencies did not provide comments or feedback to HGCMC on the 2007 annual reports submitted by HGCMC. SRK recommends that the agencies improve follow-up on reporting to ensure that the required reporting is submitted, reviewed and responded to in a timely manner.

Continuing education is an important component for the continuing operation of any regulatory agencies. The exploration and mining industry and the effective environmental regulation of the industry is a dynamic process with continual changes in the regulatory requirements in many jurisdictions, improving methods of conducting environmental audits and advances in virtually all aspects of effluent treatment technologies, impact assessment tools and monitoring equipment. In order to maintain effective and efficient regulatory oversight of the industry, it is important that both federal and state regulatory professionals continually improve their understanding of the both the industry they regulate and the methods/tools available to help them complete their duties in a professional manner. Resources need to be allocated on an annual basis to ensure that regulatory personnel attend appropriate conferences, training sessions and forums required to continually upgrade and enhance their knowledge and understanding of the industry that they are charged to regulate on behalf of the public.

4.2.11.2 ADNR

4.2.11.2.1 Biomonitoring Sites

In order to complete this task, the General Plan of Operations - Appendix 1 was reviewed as were the *Aquatic Biomonitoring Report, Greens Creek Mine 2006*, and *Aquatic Biomonitoring Report, Greens Creek Mine 2007*.

This was followed by a site inspection on Monday May 5, 2008 and Thursday May 8, 2008, during which particular attention was paid to the location of sampling stations as identified in the monitoring program and the position of each station in relation to site activities, surface features and potential contaminant transport paths such as surface water flows, prevailing winds, etc. A copy of the Site Inspection Report is provided in Appendix D.

Based on this review, the biomonitoring program is considered appropriate for the size of the site and its current activities.

During the review of the General Plan of Operations Appendix 1 it was noted that the scheduling of the biomonitoring program in relation to surface water sample collection and analysis was not specified. Subsection 2.11.2 of Waste Management Permit #0211-BA001 states “Biological monitoring shall be conducted in July of each year as close in time as practical with the water chemistry monitoring required under Appendix 1, of the GPO using "suite P" parameters and methods.”

Consideration should be given to requiring the collection of surface water samples for analysis at the same time and same location as the biological monitoring sample collection and that the surface water sample be subjected to analysis of:

- Inorganic ions - Bicarbonate, calcium, carbonate, chloride, magnesium, potassium, sodium, sulfate
- Metals – Aluminum, barium, boron, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, tin, titanium, uranium, zinc
- Nutrients – Ammonia as nitrogen, nitrate, total organic carbon, phosphorus, Total Kjeldahl nitrogen (TKN), total nitrogen
- Trace elements – Antimony, arsenic, beryllium, cobalt, fluoride, strontium, vanadium
- Physical properties – pH, specific conductivity, sum of ions, total alkalinity, total dissolved solids, total hardness, total suspended solids, turbidity
- Organics – total petroleum hydrocarbons (TPH)

Experience on similar sites has shown that statistically significant changes in biological populations from year to year are not necessarily the result of changes in the concentration of parameters traditionally equated with a mining operation (i.e. heavy metals), but may be the result of changes in the organics found within the system, the effects of extreme flow conditions (both high and low flows) on the biological components within the system, the synergistic effect of changes in the water column constituents or the speciation of certain parameters in site specific circumstances. Collection of a water sample and submitting it to the recommended larger suite of parameter analysis provides a more complete assessment of the limnological condition of the site at the time of the biomonitoring and provides a more complete data set to assess should statistically significant changes in the biological population be identified.

4.2.11.2.2 Biological Surveys and Monitoring

An environmental monitoring program does not in and of itself ensure environmental protection of fresh or marine waters. Biological surveys and environmental monitoring programs should be designed and implemented in a manner that identifies statistically significant changes in a population or component of the ecosystem. As such, monitoring programs should be of sufficient rigor to allow for an informed assessment of whether or not an observed change is statistically significant and to assist in the determination as to whether or not an observed change in the population, community structure or contaminant uptake is likely to cause a significant adverse affect to the population as a whole.

The current biomonitoring program conducted at the HGCMC site is considered to be appropriate and of sufficient rigor to allow for an informed assessment of whether or not an observed change is statistically significant and to assist in the determination as to whether or not an observed change in the population, community structure or contaminant uptake is likely to cause a significant adverse affect to the population as a whole.

In most aquatic organisms in which the reproductive rates are generally high and on which selective pressures are strong, the value of one, or even (in some instances) thousands of individual organisms to the population is rather immaterial insofar as the long-term structure and fate of the population is concerned.

In aquatic populations where less than 1% of the viable zygotes are normally expected to mature and reproduce, it would be incorrect to conclude that all observed changes in the population or community structure would necessarily be harmful to the exposed population. Recruitment in fish populations is not often related to the total number of eggs and offspring produced, but more typically to physical and chemical conditions of the rearing area and the availability of food for the young fish (except at the edge of the geographic range where environmental conditions are of major importance). For this reason, care must be taken in assessing the results of the biomonitoring program and concluding that a statistical change from one year to the next (should such be observed) is a direct result of impacts from the mining operation.

4.2.11.2.3 Dam Safety Regulations

ADNR recently authorized the decommissioning of Pond 6, which will be buried with tailings as part of the ongoing TDF operation. Information provided by ADNR indicates that, according to the State of Alaska Dam Safety Regulations, the containment structure at Pond 7 is the only official dam on site. The retaining structures at Pond A near the mill site and the pond below Site D do not meet dam classification criteria. Pond A was declared as being non-jurisdictional following review of a Hazard Potential Classification and Jurisdictional Review form submitted by HGCMC. The latter is simply too small to be classified as a dam.

Following a review of the dam safety regulations and the reports related to the design and construction of the works at Pond 7, it is the opinion of the SRK team that the Alaska Dam Safety regulations are adequately applied to the HGCMC facilities.

4.2.11.2.4 Water Use Rights

Based upon a review of the water use authorizations at the Greens Creek Mine, as discussed in Section 4.1.12, the water rights regulations appear to be adequately applied to KGCMC operations, with the exception of Temporary Water Use Permit (TWUP) J2000-10 discussed below. ADNR issues Temporary Water Use Permits and Water Rights Certificates based on priority and use. HGCMC has demonstrated both requirements under the old existing water rights purchase from the cannery and in applying for the permits under the newer authorization regulations.

The one exception is TWUP J2000-10, which expired on 10/25/05 and has not been administratively extended or reissued by the ADNR Division of Mining, Land and Water, due to a backlog in the Department. As a result, KGCMC is at risk of another entity over-filing on their current TWUP. In this case, ADNR would have to defend KGCMC since they are the priority user.

4.2.11.3 ADEC

4.2.11.3.1 ADEC Oversight

Waste Management Permit #0211-BA001 provides one of the foundations for the regulatory oversight of the HGCMC site and, as such, contains a number of site-specific terms and conditions over and above applicable Alaska State general standards, requirements and limitations. In order to exercise effective due diligence on behalf of the State, it is important that the agency responsible for specific State Chapter(s) and permits issued pursuant to such ensure that all conditions identified in the permit are met. During this audit of the facility and the Alaska Department of Environment Conservation, evidence of compliance with certain conditions specified within *Waste Management Permit 0211-BA001* could not be confirmed. The most significant of these include:

- **Tree Blow-Down Study**

  Subsection 2.4.8 of the WMP states that within two years of the issuance of the permit (i.e. by November 7, 2005), conduct a qualitative and quantitative study performed by a qualified plant or soil scientist that addresses long-term issues related to tree blow-down on the final cover system, incorporate the findings into the reclamation plan as appropriate and insure that the study shall provide reliable information on whether or not tree blow-down may cause deterioration of the integrity of the final cover system over time or change any of the design assumptions.

  Evidence of compliance with this section of the Waste Management Permit was not found. SRK recommends ADEC request the submission of the study required by subsection 2.4.8 of *Waste Management Permit 0211-BA001*.

- **Freshwater Monitoring Results**

The Freshwater Monitoring Program (FWMP) 2007 Annual Report documents water quality concentrations for certain parameters which are higher than those specified in the water quality standard (WQS) at specific points of compliance (i.e. those related to the Tailings Disposal Facility). For example, the report identifies:

- pH levels both above and below the specified water quality standard at Sites 58, 27, 29, 32, 59 and 28
- Alkalinity concentrations above the standard at Sites 29 and 32
- Lead concentrations above the standard at Sites 27, 29,32 and 9
- Arsenic concentrations above the Drinking Water Standards at Sites 28 and 29

The Fresh Water Monitoring Plan 2007 Annual Report does state that the natural conditions may be the cause of some of the exceedances (Pg. 1), however sufficient data and data analysis is not provided in the document to assess the validity of the statement.

Page 6, Item 1, of the Waste Management Permit 0211-BA001 cover letter states that the permit waives the regulatory requirement specified in 18 AAC 70.020 which specifies a requirement for groundwater samples to be analyzed for total recoverable metals. As a result, total recoverable is only required at the Greens Creek site if the analysis of dissolved constituents shows the water quality at a particular station to be at the point of, or closely approaching, the State water quality standards.

During the course of the audit, there was no evidence that total recoverable analyses were conducted at the sites that have demonstrated non-compliance. Unless this data was overlooked during the audit review, compliance with this condition of the WMP can not be demonstrated. HGCMC noted that this permit clause is no longer effective; however documentation of this from ADEC was not available at the time of the audit.

SRK recommends that ADEC require HGCMC to implement total recoverable metals analysis at the monitoring stations where previous analysis of dissolved constituents showed the water quality to be at or approaching the State prescribed water quality standards. If this clause of the Waste Management Permit is no longer valid, ADEC should provide HGCMC with documentation to substantiate it.

It was also noted during the audit that representatives of the ADEC do not conduct their own independent compliance water sampling. The decision not to do so may be the result of a policy decision by the Department; however ADEC may wish to review that policy from time to time by reviewing the practices of other similar departments in comparable jurisdictions.

- **Water Quality Non-compliance (Exceedances)**

Section 2.2 subsection 2.2.4 of the Waste Management Permit 0211-BA001 (WMP), states: "the permittee shall not cause a violation of 18 AAC 70 water quality regulations at or beyond all points of compliance."

Subsection 2.6.5 of Waste Management Permit 0211-BA001 requires that an exceedance of a water quality standard during surface or groundwater monitoring at points of compliance, or a statistically significant change found in groundwater monitoring results that suggests a problem shall be reported to the Department within 10 days of discovery. The report shall include a plan to correct the problem or state the actions taken to mitigate a problem needing immediate attention. The plan requires Departmental approval before implementation, except that advance approval is not required for actions taken to mitigate a problem needing immediate attention."

Subsection 7.1.2 of the same permit identifies specific actions that must be taken in the event that an exceedance is identified. As discussed previously, adherence to conditions such as those specified in the noted section of Permit 0211-BA001 is required in two separate ways: complying with the standard itself and, in the event that the standard is exceeded, complying with the required follow-up action(s). From reviewing both the 2006 and 2007 Fresh Water Monitoring Program Annual Reports, as well as other relevant documentation, it is not evident that the requirements specified in subsection 7.1.2 have or are being met for the monitoring stations discussed.

SRK recommends that ADEC request HGCMC to comply with the requirements of Waste Management Permit 0211-BA002 by preparing and submitting an "Action Plan" that:

- Assesses the location and suitability of the stations in terms of the objectives of the monitoring program;
- Assesses the historical and current water quality at the identified stations;
- Assesses the expected trends in concentrations at each station;
- Assesses the significance and short-, medium- and long-term risk(s) posed by currently observed and predicted future concentrations to the surface biophysical environment;
- Proposes site specific "action levels" at which, should concentration reach the specified level, additional mitigation activities will be implemented; and,
- Provides a description of the form such mitigation would potentially take.

Regulatory instruments such as the Waste Management Permit establish conditions that require compliance by the permittee. However, the establishment of such conditions also places a duty on the permit issuing agency to ensure that compliance is met. During the course of the audit, it was noted that in a number of instances, compliance with conditions established within Waste Management Permit 0211-BA002 was not being enforced in a timely manner by Alaska Department of Environmental Conservation. This undermines the integrity of the regulatory framework and will reduce public confidence in both the regulatory agency and their

confidence that the site is being inspected, monitored and operated in a manner that adequately protects the environment in the short-, medium- and long-term.

SRK recommends that ADEC exercise increased diligence in requiring that HGCMC comply with all conditions specified within Waste Management Permit 0211-BA002 in a timely manner and within the timelines established by the permit conditions.

- **Inconsistencies & Ambiguity – Waste Management Permit 0211-BA001 & General Plan of Operations**

As the Waste Management Permit 0211-BA001 forms one of the foundations for the State of Alaska regulation of the Greens Creek operation, that permit prescribes certain conditions and requirements that must be met by the operator in order to meet the requirements of the State. Subsections 2.6.1, 6.2.3, 8.1.1, 9.1.2, of Waste Management Permit and the November 07, 2003 cover letter to the permit make reference to the General Plan of Operations (GPO) which results in that document becoming an additional instrument in the regulation of the site.

The November 7, 2003 cover letter to Waste Management Permit 0211-BA001 states "If there is a conflict between the GPO and the regulations or this permit, then the regulations or the permit, as the case may be, take precedence unless otherwise specified.

During the course of the review the original electronic copy provided of the General Plan of Operations – Appendix A (Revision 5, October 6, 2000) was 82 pages long and did not included Attachment A. Subsequent to a request, a second electronic copy of the General Plan of Operations Appendix 1 (also labeled Revision 5, October 6, 2000) was provided. The second copy of the document was 132 pages long and included Attachment A and Attachment B. This would seem to indicate that there is more than one electronic version or copy of Appendix 1 (one which includes Attachment A and one which does not) and the copies are not consistent.

By extension of certain conditions contained within WMP 0211-BA001, Appendix 1 forms a significant part of the regulatory requirements for the site as it defines compliance monitoring stations and monitoring requirements. As such, a single common version of the document should be in use by all parties concerned (the operator, site personnel and all regulatory agencies). Differing versions or copies of the same regulatory document which are not consistent has the potential of causing significant ambiguity in exercising and enforcing the requirements of the Waste Management Permit.

Inconsistencies between the documents also have the potential to cause significant ambiguity in exercising and enforcing the requirements of the Waste Management Permit. For example, Page 33 of the General Plan of Operations - Appendix 3 states "In addition to the indicator parameters (suite H from the FWMP), common ions will also be analyzed. Revision 5 (October 6, 2000) of GPO Appendix 1 Fresh Water Monitoring Plan does not include a suite H.

Subsection 3.6.2 of Permit 0211-BA001 states "Analyze four samples of fresh tailings each quarter for the Net Neutralizing Potential and exposed tailings annually for paste pH in accordance with Appendix 3 Section 4 of the GPO" and Table 1 indicates a frequency of "Four per quarter annually" for chemistry, NPP, and paste pH samples. The General Plan of Operations, Appendix 3 Section 4 (April 23, 2004) states "a minimum of 20 samples but not less than one sample per 2 acres covered by tailings, will be collected for analysis of paste pH".

SRK recommends a detailed review and revision of the General Plan of Operations be conducted by HGCMC and suggested changes submitted to the USFS, ADEC and ADNR for review and comment prior to the issuance of a new Waste Management Permit.

SRK also recommends a detailed review of the current Waste Management Permit 0211-BA001 be conducted by ADEC, ADNR and the USFS based on the proposed revised General Plan of Operations submitted by HGCMC and a new Waste Management Permit issued that conforms to the revised General Plan of Operations.

- **New Construction**

Subsection 3.4.6 of the Waste Management Permit 0211-BA001 states that the permittee shall design all new process piping, chemical mix tanks, and facilities containing hazardous or toxic materials to allow for routine inspections for leaks.

During the May, 2008 site inspection, a new water line was being installed from the mill facilities area to the water treatment plant located near the tailing management area. When questioned as to how the new line would be installed, site personnel indicated that the line would be buried in a manner similar to the existing line because of route, access and road allowance restrictions. If the construction is completed as described by site personnel, the new water line will be in direct violation of subsection 3.4.6 of the permit. Increasing the flexibility of the permit requirements may be required in the future in order to avoid site specific conditions and situations that force the operator to be non-compliance.

4.2.11.3.2 Improvements in Oversight, Compliance and Recordkeeping

An assessment of ADEC was completed by conducting a detailed review of the State of Alaska, DEC 401 Certification of NPDES Permit No. AK-004320-6, the State of Alaska Waste Management Permit 0211-BA001, the State of Alaska Air Quality Operating Permit No. 302TVP02, conducting random spot checks of each office's document retention/record keeping and conducting interviews with persons directly involved in the day-to-day regulation of the Greens Creek operation. A relatively large portion of the audit time was focused on this agency as it has a large portion of the environment related regulatory oversight.

Generally, all persons interviewed were found to have a good to excellent knowledge of the site, site operations, their own respective regulatory requirements, documentation and of their individual and departmental roles and responsibility in performing specific duties as a regulatory agency. The

document retention, logging and filing was found to be fair to good although it is recommended that date received stamps be included on all documents formally received by the Department.

Currently, the Greens Creek site is subject to approximately 53 separate permits and approvals issued by approximately 15 separate government agencies. ADEC alone has numerous statutes related to the type of facility under discussion and the following regulatory oversight instruments related specifically to the Greens Creek Operation:

- Air Quality Permit
- Waste Water Quality Certification and Permit
- Solid Waste Permit
- Drinking Water
- Waste Water
- Food Service Permit
- Petroleum Handling
- Spill reporting
- Toxic Inventory Release Reporting

The effort and expense expended by the department to administer all of the separate permits by separate individuals and separate divisions within the department is significant.

SRK recommends ADEC consider amalgamating the various permits into a single "Approval to Operate". Experience has shown that such an Approval to Operate can be written in a manner that respects, meets and exceeds the legislated mandates of the various statutes and divisional mandates involved. It has been implemented in other jurisdictions and is generally not as difficult as first imagined. A small working group of individuals from within the department, each with an understanding of their own applicable statutes and requirements, can generally develop such an draft Approval to Operate in a timely and effective manner.

In the United States, federal agencies were required by Executive Order 13148 to have an Environmental Management Systems (EMS) at appropriate facilities by December 31, 2005. An EMS can help an organization to reduce its impact on the environment, but more importantly it can help an organization to improve its efficiency of operations. An EMS is a set of processes and practices used to achieve these ends.

According to the United States Environmental Protection Agency, an EMS can result in both business and environmental benefits. For example, an EMS can assist an organization to:

- Improve environmental performance
- Enhance its due diligence requirements
- Prevent pollution and conserve resources
- Reduce/mitigate risks
- Increase efficiency
- Reduce costs

- Enhance employee morale and possibly enhance recruitment of new employees
- Enhance image with public and the clients it regulates
- Achieve/improve employee awareness of environmental issues and responsibilities

SRK recommends that consideration be given to implementing a management system similar to an EMS within ADEC in order to enhance the due diligence of the department's activities, particularly as they relate to the department's regulatory functions.

During the course of the review of the regulatory agencies activities related to the Greens Creek operation, it was apparent that significant differences exist between the frequency of site inspections conducted by representative of the USFS when compared to the number conducted by representatives of the Alaska Department of Environmental Conservation and between its Divisions. By way of example, during the previous fiscal year, the USFS conducted a site inspection of the facility an average of once every 12 days while the ADEC inspections were limited to, on average, one inspection every 122 days. This is particularly significant, when the regulatory mandates of the two agencies are considered.

A review of the most significant areas of Waste Management Permit 0211-BA001 that require site inspection to confirm compliance was conducted. The most significant areas are listed in Table 4-5.

Table 4-5: Waste Management Permit Inspection Requirements

Permit Section	Permit Requirement	Method of Confirming Adherence/Compliance to Permit Condition
2.2.2	Minimize run-on water from entering the facility from up gradient sources of surface and groundwater.	Confirmation required by DEC site inspection
2.2.11	Control wind-blown airborne particulate dispersion	Confirmation required by DEC site inspection
2.6.2	The permittee shall use the approved parameters, methods and procedures prescribed in the FWMP	Audit of sample collection methods and procedures by DEC during site inspection
2.6.4	An exceedance of a water quality standard	Compliance sampling by DEC during inspection
2.7.1	Conduct monthly visual checks of the facility when operations are in process, using an inspection checklist, in addition to any daily or weekly visual inspections	Audit during DEC site inspection or require submission of documentation of inspection electronically to ADEC
2.7.2	Document total precipitation and average temperature since the last checklist inspection	Audit during DEC site inspection or require submission of documentation to ADEC
2.8.1	The permittee shall follow procedures outlined in the FWMP	Audit of procedures by DEC during site inspection
2.9.1	The permittee shall sample and analyze all seeps of any contact water found during visual monitoring where the seeps migrate beyond seepage and run-off control structures	Uncertain how compliance with this condition could be assessed. The seeps may be temporary and only identified by the operator during his/her visual inspection.
2.12.1	Conduct visual monitoring semi-annually, in accordance with section 2.7 of this permit	Appears to contradict section 2.7 which specifies "monthly"
2.12.	Conduct an annual inspection for…	Should reference that a suitably qualified person conduct the inspection

Permit Section	Permit Requirement	Method of Confirming Adherence/Compliance to Permit Condition
2.12.9	The permittee shall also record the rate of leachate discharged from the facilities at the frequency shown in Table 1	No frequency is provided in Table 1 of the permit
3.1	They shall contain no less than 10% solids by weight and shall be treated with lime so that a pH of 12 is maintained in the solids after one hour of contact before disposal	Uncertain how confirmation of compliance is assured.
3.2	The tailings facility shall be constructed, operated and managed according to the operations plan	Requires frequent confirmation by DEC site inspection
3.3	The tailings area development shall follow the design and operational plans and objectives…	Requires frequent confirmation by DEC site inspection
3.4.4	The permittee shall provide and maintain secondary containment for all process piping, chemical mix tanks, and facilities containing hazardous or toxic materials	Requires frequent confirmation by DEC site inspection
4.1	The facilities shall be constructed, managed, maintained and operated in accordance with Appendix 11 of the GPO	Confirmation required by DEC site inspection
5.1	Types of waste allowed	Confirmation required by DEC site inspection
5.2	All spills must be cleaned up in accordance with an approved spill plan and to the satisfaction of the Department	Confirmation required by DEC site inspection
6.2.2	Copies of the laboratory reports with QA/QC information shall be made available for Departmental review on site.	Confirmation required by DEC site inspection
6.4.1	The permittee shall maintain a copy of the records listed in Table 3 in the facility's operating record.	Confirmation required by DEC site inspection

It is important to note that in certain instances; a detailed inspection of a number of facilities throughout the site is required to order to insure compliance of a single identified item (i.e. secondary containment, hazardous materials and waste dangerous goods storage and handling, etc.). In addition, the table does not include required regulatory follow-up on activities such as the clean-up of spills, the inspection of areas of completed construction or current construction (to ensure compliance with design specifications) or additional investigations that will arise from time to time. Based on this information and the observation made during the May 4 and 8 site inspections, the current average of one inspection every 122 days (average) is not sufficient to ensure adequate regulatory oversight of the HGCMC operation by the Alaska Department of Environmental Conservation.

SRK recommends representatives of ADEC conduct a joint inspection of the HGCMC site once per month in coordination with the USFS. The USFS would conduct a separate inspection at a mid-point between the joint inspections (i.e. two inspections/month).

During the review, it was also noted that significant lag time exists between the date of ADEC inspections and the delivery of the final inspection report to the Greens Creek operation. ADEC provides a draft inspection report to HGCMC for review prior to issuing the final report, which

provides an opportunity to correct errors and/or misunderstandings regarding communications or observations at the site. Although this increases the time it takes to issue the final inspection report, ADEC believes it is an appropriate mechanism to achieve an accurate and comprehensive inspection report. Inspections are conducted primarily to confirm compliance, however they are also an effective tool in the identification of areas of potentially developing risk and therefore should be provided to the site as soon as possible after the inspection is completed. Significant issues are conveyed verbally by ADEC to HGCMC and contained in the subsequent inspection report. Consideration should be given to submitting a completed short "site inspection" form before leaving the site to provide a written record of significant issues requiring action, rather than solely relying on verbal communications.

In addition to conducting interviews of individual officers, the "time spent" in terms of a percentage of overall work load for two regulatory officers in separate Divisions (Water and the Solid Waste Program) of the ADEC was also assessed in order to gain an understanding of the efficiencies and effectiveness of the regulatory activities conducted by the agency. In one instance, 11% of the employees total time was spent on the Greens Creek project in the past physical year and in the other, 18% of the total time was dedicated to the project. In addition, an additional 10% of the officer's time was spent on document logging, filing and other administrative activities related to the project, in large part, because of a current shortage of clerical staff within the department. It was also noted that with increasing mineral exploration and development taking place within Alaska (i.e. Kensington project, etc), additional projects will continue to require the attention and time of individual officers with specialized, mine related expertise, within the Department.

It was also noted that officers responsible for mining operations are also responsible for other types of industrial and/or public health related activities (i.e. municipal landfills, municipal potable water treatment facilities, etc.). While the regulation of these activities are no less important from a public policy perspective and there is undoubtedly some cross over in knowledge and expertise applied, many jurisdictions have recognized a need to focus the regulatory activities of individual officers on areas based on the nature and type of risk posed by the activity. In this way, individual officers develop and retain a specific expertise that serves to increase their efficiency and enhance the overall delivery of the department's mandate.

SRK recommends that consideration be given by ADEC to establishing a Mining Division and assigning individual sites to individual officers. Each officer would then be responsible for the co-ordination of all of the various permits issued by the Department, site inspections and inspection follow-up on behalf of all Divisions within the department and be responsible for the review and permitting of the site.

4.2.11.4 USFS

4.2.11.4.1 USFS Oversight

An assessment of the USFS was completed by conducting a detailed review of the relevant documents provided including but not limited to USFS inspection reports, conducting random spot checks of the office's document retention/record keeping and conducting an interview with the persons directly involved in the day-to-day regulation of the Greens Creek operation.

Generally, the person primarily responsible for the site inspection and regulation of the Greens Creek site within the USFS was relatively new to the position, but found to have a good knowledge of the site, site operations, and the USFS regulatory requirements, documentation and of their individual and agency roles and responsibility in performing specific duties as a regulatory agency. The document retention, logging and filing was found to be good to excellent, although it appears to be a personal initiative as opposed to a generic USFS document logging and filing system.

During the course of the review of the regulatory agencies activities related to the Greens Creek operation, it was apparent that significant discrepancy exists between the frequency of site inspections conducted by representative of the USFS when compared to the number conducted by representatives of the Alaska Department of Environmental Conservation and between Divisions of the ADEC. By way of example, during the previous fiscal year, the USFS conducted a site inspection of the facility an average of once every 12 days while the ADEC inspections were limited to, on average, one inspection every 122 days. This is particularly significant, when the regulatory mandates of the two agencies are considered.

SRK recommends representatives of the USFS conduct a joint inspection of the HGCMC site once per month in coordination with ADEC, along with a separate inspection scheduled for a mid-point between the joint inspections (i.e. two inspections/month).

The current USFS representative responsible for the Greens Creek site would benefit significantly by the recommended creation of a formal Agency Joint Regulatory Group (JRG) for the Greens Creek project as described in Section 4.2.11.1. The JRG structure and regular meetings of the Group would afford the opportunity for the sharing of both industry and site specific knowledge, history and experience, to identify areas/activities of potential risk (from each agencies perspective), assist the USFS to broaden its inspections to address areas of identified risk that could potentially impact the exercise of its mandate and ensure that each agencies activities compliment rather than duplicate another's.

4.2.11.4.2 Improvements to Oversight, Compliance and Recordkeeping

As the agency responsible for the management of the lands on which the site is operating and for those issues related to land tenure, the USFS will ultimately be responsible for the institutional control of the site once all obligations with respect to decommissioning and reclamation are

completed and the specified post closure monitoring period (minimum of 30 years as specified in Waste Management Permit 0211-BA001) for the site is complete.

In order to allow for the effective planning and regulatory assessment of the final rehabilitation planning of the Greens Creek site a clear set of "end-point criterion" should be established for the site. This criterion is necessary in order to allow the regulatory authorities, the public and ultimately the USFS (the "landlord") to judge whether or not the site operator has fulfilled all obligations with respect to the decommissioning and reclamation of the sites. The criterion is also important as it will define when the site can be returned to the land base of the National Monument or into the institutional control of the USFS.

Experience has shown that the development of "end-point criteria" and the development of an effective institutional control management framework within government is a process that involves significant internal discussion, substantial public consultations and in most cases the development and enactment of entirely new legislation. As such the process often will require multiple years to conclude.

SRK recommends the USFS begin a process to define an appropriate institutional control management framework for application to decommissioned/reclaimed industrial sites over which it has administrative or regulatory responsibility.

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5 Conclusions

The environmental audit of the Greens Creek Mine was conducted from April 28 to 30 and May 05 to 09, 2008. The auditors received the full cooperation of HGCMC and agency staff throughout the audit. In general, the Greens Creek Mine was found to be well managed with respect to oversight by HGCMC personnel and the agencies, and in compliance with the majority of the applicable permits, plans, approvals and regulations. Most of the major findings are issues that both HGCMC and the agencies were aware of as areas of concern prior to the audit, and in many cases, were already actively being addressed.

5.1 Ranking of Findings

In order to summarize major results of the audit, the findings presented in Section 4 were ranked by significance level, as outlined in Table 5-1, based on the following considerations:

- The potential for causing an impact to the environment or non-compliance; or
- The ability of management and agency oversight to protect the environment; or
- The potential cost to the operation for cost reviews.

These three considerations therefore apply broadly to three types of assessments performed for this audit (environmental predictions, HGCMC and agency management systems, and bond review). No attempt has been made to assess the cost of non-compliance aspects. Significance Level 3 findings are considered to be management improvements, but do not currently present a concern for environmental effects or non-compliance. Findings assigned Significance Level 3 are presented in Section 4. Recommendations to address the significant findings are also provided in the following sections.

Table 5-1: Significance Levels for Ranking of Findings

Significance Level	Environmental Systems		Management and Permits		Cost to Operation
1	Currently causing an environmental effect	**OR**	Management systems fail to protect environment and reputations of mine and agencies	**OR**	Items exceeding $5 million
2	Has potential to cause an environmental effect or result in non-compliance or is non-compliant with permit requirements, policies or standards	**OR**	Contradictory or ambiguous management and permit requirements	**OR**	Items between $1 million and $5 million
3	In compliance but opportunities to improve practices	**OR**	Management improvements at mine or agency oversight.	**OR**	Items less than $1 million

5.2 Major Findings

5.2.1 Tailings Disposal Facility

The auditors concluded that the understanding of the geochemistry and physical stability of the tailings pile is well advanced. Significant changes in water quality (including acidification) are not expected during the operational period.

Significance Level 1:

- It is not clear if fugitive dust is causing an impact to surrounding soils, water, vegetation and biota. This should be evaluated.

Significance level 2:

- The tailings are potentially acid generating, leading to a potential for acidification of surface runoff at some point in the future. Placement of covers will mitigate this issue;
- Water chemistry predictions in the EIS indicated that water treatment may not be required after the mine closes. However, the benefit of treatment with organic matter and the effect of soil covers needs to be evaluated to confirm the modeling results.

The auditors recommend:

- Submission of an air quality monitoring plan to quantify the extent and concentration of potential contaminants resulting from fugitive dust from the tailings pile, including an assessment of the potential impacts to terrestrial and aquatic ecosystem components, and, if warranted, a screening level ecological risk assessment;
- Design and implementation of a cover test program comparable to the facility at Site 23 to develop design criteria for final covers on the tailings pile at closure (Section 4.2.8.2.1);
- Installation of instruments in the tailings to confirm the conceptual geochemical model in the FEIS and reporting of updates annually;
- Evaluation of organic content in the current tailings and the SRMP site for long-term sustainability of sulfate reduction;
- Update and periodic review of source water quality modeling to reflect new findings from the SRMP and the effect of soil covers.

5.2.2 Production Rock Site 23 and Site D

Construction, management and water quality prediction at this site are appropriate and reasonable for the facilities.

Significance Level 1:

- Seepage from D Pond Berm contains some constituents above ADEC Water Quality Standards and is discharging directly into Greens Creek.

Significance Level 2:

- Site D material is potentially liquefiable and, consistent with current plans, Site D material needs to be removed prior to or during closure;
- During relocation of Site D production rock, mobilization of oxidation products can be expected by meteoric water. The potential for water quality to exceed standards needs to be evaluated and managed accordingly;
- It is not known if native soils beneath Site D contain products of production rock weathering. Reclamation of native materials should consider measures to limit leaching of these weathering products when they are exposed.

The auditors recommend:

- Removal of D Pond Berm as planned by HGCMC. The physical stability of Site 23/D and the stability and functionality of the drains and water management controls at Site 23 will have to be monitored as part of this work.
- Installation of an additional slope inclinometer at Site 23 to provide more information on small movements at depth. The stability of the site should be re-evaluated with the incorporation of the additional data from the new inclinometer to examine the impact of the removal of Site D on stability;
- Update of modeling to estimate long-term water quality from the site and the requirements for water treatment at the site both in terms of technology selection and duration. It is recommended that this be periodically reviewed and consider:
    - The performance of the cover in terms of water infiltration and oxygen entry;
    - Oxygen and water penetration into the production rock from upslope and through the foundation;
    - Leaching of the inventory of oxidation products accumulated prior to final cover placement and construction, and draindown of stored pore waters; and
    - Monitoring methods to verify water chemistry predictions.

5.2.3 Inactive Production Rock Sites and Quarries

HGCMC has diligently identified all locations of quarrying and filling and the management needs for each. HGCMC knows the quantities of rock removed from each location and the uses of the rock. The type of rock that has been backfilled into each location is also known.

Significance Level 2:

- During relocation of rock fill, mobilization of oxidation products can be expected by meteoric water. It is not known if water quality could exceed standards and result in a need to manage runoff accordingly;
- Similarly, it is not known if native soils beneath the rock fills contain products of production rock weathering and if there is a need to reclaim native materials to limit leaching of these weathering products when they are exposed;

- Rock fill in 920 and 960 areas has not yet acidified to the expected extent. The potential for acidification to result in greater contaminant loads reaching Greens Creek in the future needs to be evaluated;
- The potential for mill backslope instability needs to be addressed due to its potential to affect the operation of the mill.

The auditors recommend:

- Initiation of measures to improve mill backslope stability;
- Compilation of a database of available geochemical information (solids and waters) for each location for inclusion in annual reports;
- Preparation of an overall water and load balance for Greens Creek to consider the current and future significance of these sources and the relative benefits of moving rock compared to the potential effects from removal (short term water quality effects due to flushing), and management of impacted foundation materials.

5.2.4 Underground Mine

A hydrology study is in progress to predict the chemistry of water exiting the mine during flooding, but results were not available at the time of the audit.

Significance Level 2:

- Drainage points from mine during flooding are unknown;
- Water quality trends at closure are unknown leading to uncertainties about need for treatment and decommissioning of site access.

The auditors recommend acceleration of the study of underground mine hydrology and chemistry because it is expected that water quality in the mine will be unacceptable for direct discharge after flooding due to the dissolution of weathering products.

5.2.5 Storm Water and Sediment Control

Insufficient characterization of construction materials from quarries and mine production rock early in the mine life resulted in storm water exposed to certain sites having higher levels of contaminants than allowed by the Effluent Limitations and Monitoring Requirements for the New Source Performance Standards. HGCMC commissioned Dr. Richard C. Warner from the University of Kentucky to conduct the Comprehensive Site Compliance Evaluation to assess the site and identify the most effective Best Management Practices (BMP's) to address storm water runoff. The BMP Plan was revised and new BMP structures constructed.

Significance Level 1:

- The 920 Portal, mill, tailings load-out, Site 23, waste dump haul road, mine access road, and Tailings Disposal Facility have increased potential for contamination of storm water due to

high concentrations from mine production rock or quarry materials used in construction of roads, dikes, and drainage structures and tracking of material on transport vehicles.

The auditors recommend the following:

- Maintenance of BMP structures including:
  - Sediment removal from check dam and settling ponds;
  - Replacement of straw bales and silt fences until more efficient BMP's can be installed.
- Adequate sizing and weather proofing of pumps and piping to handle base flow and storm water runoff in Ponds A, C, and D;
- Lining of ditches and collection ponds containing contact storm water;
- Collection of flow data to design adequate collection structures (ditches), containment, pumping, and treatment;
- Investigation of additional options for encapsulation, treatment, and final disposal for concurrent and final closure;
- Further identification of construction materials incorporated or exposed by construction with the potential for metal leaching or ARD used along the access road construction right-of-way;
- Construction of a truck wash between the tailings load-out facility and the Tailings Disposal Facility.

5.2.6 Bond Review

The cost estimate is well documented and easy to follow. The current HGCMC staff understands all of the components, including those dating from earlier plans. The findings presented in this section are potentially of Significance Level 2 and focus on items that could have significant cost implications. Details are provided in Section 4.

Unit Cost Inputs

- Equipment
  - Ownership, insurance, maintenance labor, overhead and profit need to be checked in some unit costs;
  - Equipment types need to be defined.
- Labor
  - Overtime costs should be added to the estimate.
- Materials
  - Contractor profit and freight components need to be checked.

Element Costs

- "Administration"
  - Requirements for one-year "Holding Period" need to be better defined and costed;

  - Long-term treatment costs need to consider possible changes in influent chemistry;
  - Need additional supervision of foreman during Years 1 and 2.

- Production Rock Sites
  - Efficiency and correction factors need to be documented;
  - Need to assume constant fleet rather than optimal fleet for each task;
  - Costs for keeping underground open while backfilling Class 3 or 4 rock should be considered.

- Tailings
  - A wastage factor should be included in cover construction to allow for covers that do not meet specifications and need to be re-built.

Indirect Costs

- Contingency
  - 20% more usual for costs that are not based on detailed design.

- Post-closure costs
  - Should be discounted using a net present value method.

5.2.7 Closure and Reclamation

The Reclamation Plan is well thought out and appropriately documented given the amount of time prior to closure. Most of the findings relate to presentation of the Plan and the need for flexibility in the permits and General Plan of Operations (GPO).

Significance Level 2:

- The need for long-term water treatment represents the greatest uncertainty in the Reclamation Plan and cost estimate. The site should continue to collect the data needed for assessing long-term water quality, treatment requirements and treatment options.

5.2.8 Fresh Water Monitoring Plan

Over the operating life of the project the monitoring sites and specific sampling locations have been continuously reviewed. As additional areas are impacted by expansions, evaluations by the company and agencies as to additional surface and groundwater monitoring sites may be required.

Significance Level 1 – None

Significance Level 2:

- Evidence of compliance with subsections 2.6.5 and 7.1.2 of the Waste Management Permit could not be located during the audit (reporting to ADEC of an exceedance of a water quality standard during surface or groundwater monitoring at points of compliance or a statistically significant change in water quality).

The auditors recommend:

- Consideration be given to expanding the suite of analytical parameters for specific stations during the February and July scheduled monitoring campaigns;
- Preparation of an "Action Plan" that assesses the existing monitoring program, water quality data and potential risks to the environment, and proposes action levels for implementing mitigation measures;
- Collection of stream flow measurements when collecting surface water samples.

5.2.9 Spills and Releases

The spill reporting system appears to be working and HGCMC is streamlining the process. The majority of secondary containment installations inspected were appropriate and well maintained. The storage of hazardous materials storage inspected was satisfactory, although some improvements could be made.

Significance Level 2:

- The Spill Reporting Procedure flow sheet and Small Spill Report used by HGCMC appear to apply the requirements for spills of oil to spills of chemicals, which have more stringent reporting requirements;
- HGCMC was not able to produce documentation from ADEC supporting their current procedure for managing the underground mine as secondary containment;
- Approximately 40 to 50% of the lined ditch immediately below the equipment wash area at the mill was blocked by gravel/sediments (Photo 23 and Photo 24), significantly reducing the capacity of the ditch;
- The area of construction for the temporary fresh water intake line near the potable water treatment plant poses a potential to impact the quality of Greens Creek due to the flushing of fines directly into the creek upstream of the weir (Photo 25);
- During the surface inspection on May 8, secondary containment on the transformer located behind the old water treatment plant at the Tailings Disposal Facility was found to be full of water, eliminating the containment capacity (Photo 3). Inspections of secondary containment of transformer areas could not be verified during the audit;
- As it is currently constructed, the concrete containment for the tailings thickener would direct unanticipated discharge from this thickener into the road area west of the thickener (Photo 26 and Photo 27);
- The various pipelines crossing Greens Creek between the underground mine and mill area do not have appropriate secondary containment to contain the material and prevent it from entering the creek in the event of a rupture or other type of failure (Photo 28);
- HGCMC cannot substantiate that sufficient storage to contain and control the 24-hour, 25-year storm event is provided, as required Section 3.4.3 of the Waste Management Permit.

The auditors recommend:

- Preparation of a Standard Operating Procedure for agency spill reporting for review and approval by the agencies and further clarification on the Small Spill Report and Spill Reporting flow sheet regarding the immediate reporting of spills of any amount of hazardous substance;
- Improvements or modifications to secondary containment as required to address the findings noted above and regular, documented inspections of secondary containment facilities;
- Preparation of a current and detailed site water and load balance for the entire site.

5.2.10 Audit of the Agencies

Records retention and organization was found to be good to excellent. The understanding of individual legislative mandates, agency roles and responsibilities, and individual knowledge of duties and site operations in terms of the regulatory mandate was found to be high.

Significance Level 1:

- The large number of permits and authorizations (>50) imposes a significant administrative burden distracting from the efficient and effective management of environmental risks.

Significance Level 2:

- There is no evidence of any regulatory agency conducting independent compliance sampling;
- Agency follow-up on ensuring that required reporting is submitted, reviewed and responded to in a timely manner requires improvement;
- Inconsistencies between requirements specified within the Waste Management Permit and the GPO and appendices were identified;
- A significant lag time was noted between the date of ADEC inspections and the delivery of the inspection report to the Greens Creek operation;
- There is a significant imbalance between the USFS and ADEC frequency of site compliance inspections. Representatives of ADEC should increase the frequency of compliance inspections of the Greens Creek operations.

The auditors recommend that:

- The creation of a formal Agency Joint Regulatory Group (JRG) for the Greens Creek project be considered;
- ADEC exercise increased diligence in requiring that HGCMC comply with all conditions specified in the Waste Management Permit in a timely manner and within the timelines established by the permit conditions (Section 4.2.11.3.1);
- Inconsistencies between the Waste Management Permit and GPO and ambiguities in the Permit be addressed during the next renewal.

5.2.11 General Compliance

The following findings of non-compliance (Significance Level 2) were made during the audit and should be addressed as soon as possible:

- Waivers from sampling Synthetic Organic Contaminants (SOC) and other organic contaminants (OOC) for PWS 119205 and PWS 113560 expired on December 31, 2007 and require an extension (Section 4.1.10);
- Temporary Water Use Authorizations #J2000-10 expired and needs to be administratively extended or reissued (Section 4.1.12);
- The tree blow-down study required by subsection 2.4.8 of the Waste Management Permit has not been submitted;
- A number of monthly inspections required by the Waste Management Permit were not on record;
- Tailings and production rock have not been analyzed for paste pH since 2005, which is required by the Waste Management Permit and GPO Appendices 3 and 11;
- Hazardous waste storage areas were being inspected monthly rather than weekly as required in 40 CFR 265 Subpart I; and
- During the inspection on May 8, 2008, a container of hazardous waste at the 920 Area was not labeled as required in 262.34.

The auditors recommend that:

- HGCMC develop a Resource Conservation and Recovery Act (RCRA) compliance program and that the requirements of RCRA be included in the Compliance Matrix;
- HGCMC and the agencies ensure that requests and approvals for modifications to monitoring and sampling programs or agreements that allow a deviation from any regulatory or permit clause that have been approved informally be documented (see Sections 4.1.10, 4.1.12, 4.2.10.1.3, 4.2.11.3.1, 4.2.9).

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Appendices

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Appendix A
Regulatory Requirements of the Audit

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Regulatory Requirements of the Audit

The requirements of the audit are specified in Waste Management Permit #0211-BA001, dated November 7, 2003, Section 8.1, and the Memorandum of Understanding between the Unites States Department of Agriculture Forest Service, the State of Alaska Departments of Environmental Conservation and Natural Resources and HGCMC, dated May 23, 2007, Section 1.(b) as follows:

Waste Management Permit, Section 8.1, Facility Audit:

"8.1.1 Prior to the renewal of this permit every five years (expected in 2008), in coordination with a review of the General Plan of Operations, and prior to and in preparation for the termination of this permit, a facility audit shall be conducted at the expense of the permittee. The Department, in consultation with other agencies having land use management or regulatory authority over the facility and the permittee, shall mutually set the audit scope, and select a qualified auditor. The company will bear the burden of contract management during the audit process. To qualify, an auditor must:

8.1.1.1 Certify that no relationship exists through professional, financial, or personal reasons that could bias the auditor's judgment or the audit results and that no self-serving interest in the outcome of the audit exists;

8.1.1.2 Demonstrate a commitment to professional and ethical standards generally accepted in the environmental auditing profession; and

8.1.1.3 Demonstrate a professional proficiency in the specific areas of hardrock mining, associated environmental issues, and current federal/state regulatory programs and climate, and an appropriate working knowledge and appreciation of management principles, quantitative methods, and computerized information systems.

8.1.2 The intent of the audits will be to determine if both the facility management and regulatory controls of the facility provide reasonable assurances that the facility and controls are functioning as intended. The scope of subsequent audits may be revised as mutually agreed upon prior to initiation of each audit, to address specific issues or objectives not previously identified in this permit. Identification of such issues or objectives may be accomplished through a joint permittee/agency meeting prior to the audit.

8.1.3 The audit will be an objective, systematic, documented review of the conditions, operations, and practices related to permit requirements and facility management conducted under this permit. The audit shall evaluate:

8.1.3.1 the permittee's compliance with all federal, State and local permits and authorizations related to the permitted facility, and specific compliance with the conditions of this permit;

8.1.3.2 The permittee's compliance with internal environmental policies, plans, and procedures, and established environmental management systems and policies, are subject to updating, amendment, or revision upon mutual agreement of the parties;

8.1.3.3 the reliability and integrity of information relating to facility reporting and compliance;

8.1.3.4 the adequacy of the Department's permit and other agencies' oversight of the facility;

8.1.3.5 the condition of containment structures;

8.1.3.6 laboratories and sample analysis procedures;

8.1.3.7 the pollution prevention strategy in section 10.8 of this permit; and,

8.1.3.8 the adequacy of the closure and post-closure bonding, including the collection, treatment and long-term disposal of contact water.

8.1.4 The Department and permittee will use the audit results to assist in:

8.1.4.1 updating, renewing, or amending this permit,

8.1.4.2 updating policies, plans, and procedures,

8.1.4.3 determining compliance with this permit, and

8.1.4.4 determining the adequacy of the closure and post-closure bonding, including the collection, treatment and long-term disposal of contact water.

8.1.5 The facility audit may be a component of, or combined with, an audit required by other agencies' permits or approvals or agreements pertaining to the Greens Creek Mine."

MOU, Section 1, Coordination of Reclamation Plan Requirement and Periodic Audits:

"(b) The parties agree to coordinate periodic audits for the purpose of reviewing KGCMC's performance under its permits and approvals, and the agencies' regulatory oversight of such performance, and to aid in updating the detailed plan component of the Reclamation Plan and evaluating the bond amount. Such audits shall occur every five years, commencing in 2008, and shall be timed so that the auditor's site visit can occur during the snow-free season, far enough in advance of the deadline for KGCMC's submittal of a Reclamation Plan update that the results of the audit can be taken into account in that update. In January of the audit year, the parties shall confer to agree upon the minimum qualifications of and process for selecting an independent, third-party auditor, and to set the minimum requirements for the scope of the audit. The purpose of the audit will be to determine whether KGCMC's environmental management systems and the regulatory controls in place provide reasonable assurances that environmental objectives in the General Plan of Operations and relevant permits and approvals are being met and that the systems and controls are functioning as intended. The audit results will be used by KGCMC and the agencies to assist in updating, renewing, or issuing approvals and permits, in updating policies, plans and procedures, and in determining compliance with permits and approvals."

Appendix B
Audit Matrix

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Preliminary Audit Matrix (note: based only on information available in the RFP)

A. General Areas of Interest

The primary areas of concern relate to the permitted KGCMC facilities under the waste management permit (e.g. Tailings, Site 23/D and Underground). The auditor will be required to evaluate reports, documents and plans for the various facilities; conduct site inspections as needed; and determine whether the design, construction, operation, management and proposed closure of these facilities are appropriate to minimize both short and long-term impacts to the environment. The evaluation will include an assessment of the geotechnical stability of the sites and the likelihood that seepage and run-off from each site will meet water quality standards during both mine operation and after mine closure and reclamation. If the data to allow these assessments are found to be lacking, the auditor will provide recommendations for work to provide the needed data. If the assessment reveals the likelihood that geotechnical stability issues exist, the auditor will provide recommendations for modifications to the design, construction, management and proposed closure of these facilities in order to ensure long-term geotechnical stability.

If the assessment indicates the likelihood that post-closure water treatment will be necessary, then the auditor will provide recommendations for modifications to the reclamation or closure plans. The auditor will also be required to evaluate the proposed reclamation and post-closure cost estimate to determine if adequate funding has been provided should the agencies need to close the site. The WMP references the GPO. The auditor will review the WMP and GPO for conflicts and inconsistencies and make recommendations as needed.

Other areas of interest include the following:

Task		Auditor	Issues/Questions etc.
1	Evaluation of other inactive production rock sites and quarries that have the ability to produce ARD and leach metals. A similar assessment as indicated in the primary areas with regard to short and long-term impacts to the environment should be made. Provide recommendations;	SD	Review geological and geochemical characterization data and interpretations including mineralogy, static and kinetic tests. Review water quality modeling. Review seepage and runoff monitoring data. Detailed site inspections
2	Assessment of storm water management and effects;	BJ	Are the facilities adequately sized; Are all stormwater accounted for; Is there adequate separation of clean and contaminated waters; How will stormwater management change at closure; Are there areas that could be prone to erosion
3	Assess whether sufficient bonding exists to cover costs for reclamation and post-closure activities including water treatment, site monitoring and maintenance for the overall facility;	DH	Are all estimates adequately described and supported; How do they compare with SRK database of closure costs elsewhere;
4	Assess whether additional monitoring is required of the overall mine site in order to ensure environmental protection or as a check on performance (Appendices 1, 3, 11 of the GPO);	DHov/BJ	Should also consider assessing current monitoring plan to ensure appropriate data available for effective closure and post-closure planning and to assess closure success. The monitoring will also be assessed if it is appropriate to need and risk. This will ensure all monitoring currently done is required and delivering value.
5	Assess whether spills and releases are properly reported, monitored and handled;	KW/DHov	
6	Assess whether the various agencies are performing effectively;	DHov	Effectiveness will be determined by understanding the risk profile and comparing it to the boundaries of responsibility, jurisdiction, personnel competency, organizational capacity and actual delivery.
7	Identify structures or sites that have been constructed or substantially modified since the last complete bond review and assess the impact of these structures or sites on project bonding requirements, such as but not limited to: the 860 Geology Building, the proposed tailings storage building, the A-Road aggregate pit, the tails load-out facility, concrete around the thickener tanks, two non-permanent substations, the 1350 vent raises and the turbine generator). Results of the audit will be considered during agency review of the revised project closure and post-closure cost estimates for submittal during the solid waste management permit renewal.	DH	Do the designs allow adequate containment against spills etc.; Have material balances for demolition and/or salvage of building materials been completed; What is actually different from previous plans
8	Recommend a schedule for initiation of reclamation on inactive sites.	DH	What can be concurrently reclaimed?
9	Evaluate whether Hawk Inlet is adequately protected from contamination by concentrate storage or handling practices. Are there any procedures or practices that could enhance environmental protection? Make recommendations as necessary.	DHov/BJ	How do facilities compare to current and historical concentrate handling operations at tidewater elsewhere (Red Dog DMTS, Skagway, Britannia)

B Specific Areas of Interest

1 Tailings Facility

Evaluate the adequacy of the various studies and reports that form the basis for decision making in addressing short and

A Evaluate long-term Water Treatment

	1	Do long-term water quality predictions appear reasonable? Were the methodologies appropriate in determining the hydrological analysis?	SD	Review geochemical characterization data and interpretations. Review geochemical and hydrological modeling methods and comparison with monitoring data.
	2	Evaluate whether the treatment of leachate will be necessary after closure.	SD	Compare predictions and prediction uncertainty with permit requirements and other water quality standards.
	3	Evaluate proposed methods and duration for post-closure water treatment at the tailings facility.	SD	Review water treatment technologies selected. Review treatment testwork. Compare effectiveness with industry experience.
	4	Make recommendations that will help to avoid or reduce the need for long-term water treatment.	SD	Consolidate above findings and recommend conceptual modifications to reduce uncertainties in predictions

Task			Auditor	Issues/Questions etc.
	B	Evaluate whether the diversion structures at the tailings facility will convey potential run-on water around the facility in perpetuity.	CCS	Catchment areas, design flood, ditch design criteria, field inspection
	C	Evaluate whether there is sufficient information from the Sulfate Reduction Monitoring Program (SRMP) to determine the efficacy of adding, long-term, carbon to the pile. Assess whether there is anything else that can be done to determine best environmental management practices to aid in the prevention or minimization of long-term impacts at the tailings facility.	SD	Evaluate understanding of the current geochemical conditions and the ability to predict the effect of reducing conditions on stability and instability of secondary minerals.
	D	Evaluate whether the information presented is appropriate to determine the efficacy of placing various Classes, including Class 4 waste rock into the tailings facility. Are best management practices available for the placement of this material in the tailings site such that geochemical and geotechnical issues are adequately handled?	SD + CCS	Evaluate the procedures for selection, handling and placement of the various Classes; evaluate the Tailings Facility design. Evaluate understanding of the current geochemical conditions and the ability to predict the effect of co-disposing PAG rock with the tailings.
	E	Evaluate whether geotechnical assessments are complete and accurate. Make recommendations if needed.	CCS	Evaluate the geotechnical aspects of the facility design/operation
2	**Site 23/D**			
	A	Production Rock Site 23		
		Evaluate the adequacy of the various studies and reports that form the basis for decision making. Evaluate whether the information is sufficient to address short and long-term problems. Evaluate whether the various components of the waste management system are appropriate for protection of the environment. Make recommendations as needed.		
	1	Evaluate long-term Water Treatment.		
		a. Do long-term water quality predictions appear reasonable? Were the methodologies appropriate in determining the hydrological analysis?	SD	Review geological and geochemical characterization data and interpretations including mineralogy, static and kinetic tests. Review water quality modeling. Review seepage and runoff monitoring data.
		b. Evaluate whether the treatment of leachate will be necessary after closure.	SD	Compare predictions and prediction uncertainty with permit requirements and other water quality standards.
		c. Make recommendations that will help to avoid or reduce the need for long-term water treatment.	SD	Consolidate above findings and recommend conceptual modifications.
	2	Evaluate whether geotechnical assessments are complete and accurate. Make recommendations if needed.	CCS	Evaluate the geotechnical aspects of the facility design/operation
	3	Evaluate whether the water management practices and diversion structures will convey potential run-on water around the facility in perpetuity.	CCS	Evaluate the water management design criteria, as well as the catchment areas, design flood(s) and the water management design (operational and closure)
	4	Evaluate the mine waste rock operational characterization / segregation program.	SD	Review sampling methods. Review laboratory procedures. Review interpretation of data and communication to operational staff.
	5	Engineered Soil Cover System & Initial Plot		
		a. Evaluate whether the proposed engineered soil cover system is effectively being monitored and modeled to prevent long-term water treatment at the waste disposal sites and adverse impact to the environment, post-closure. What additional work or recommendations can be made to demonstrate the cover system will effectively protect the receiving environment from adverse post-closure impacts? Is there a more effective system available than an engineered soil cover system?	DH	Is the cover objective adequately defined; What other (including non cover) options have been evaluated; Has issues such as constructability and longevity been addressed; How accessible would the site be to closure monitoring; Is there and adequate waste load balance for the site?
		b. Evaluate whether it is reasonable and feasible to measure oxygen under the cover system, long-term, post-closure without disrupting the integrity of the system.	DH	Compare with monitoring programs elsewhere (SRK. OKC, AANSTO)
		c. Evaluate whether the proposed engineered soil cover will operate as designed, or sufficiently adequately to protect post-closure water quality when considering the possibility that percolation through the system is greater than that originally modeled. What impact would additional flow rates through the cover have on the various disposal facilities and treatment of water post-closure? Are there recommendations to improve the design, monitoring and overall effectiveness of the cover system?	DH	As above, plus comparison to cover system elsewhere (SRK review of international state of the art in waste rock covers 2003, SRK review of northern covers 2007)
		d. Evaluate whether the study that is considering post-closure effects of trees on cover integrity is adequate in design and scope.	DH	
	B	Site D		
	1	Evaluate the impact of the removal of Site D on the geotechnical stability of Site 23. Will Site 23 and the various drains, run-on and run-off controls be stable after the removal of the Site D materials?	CCS	Evaluate the design and construction of Sites 23 and D, as well as performance data and analytical reports dealing with stability
3	**Other Inactive Production Rock Sites and Quarries** Other inactive production rock sites and quarries may have the ability to produce ARD and leach metals over the long-term.			
	Inactive Production Rock Sites			
	A	Site 1350		Evaluate the geotechnical aspects of the site design/operation

Task			Auditor	Issues/Questions etc.
	B	Site 960	SD + CCS	Evaluate the geotechnical aspects of the site design/operation. Review geological and geochemical characterization data and interpretations and modeling. Review seepage and runoff chemistry.
	C	Mill Backslope	SD + CCS	Evaluate the performance of the mill backslope and its drainage system. Review geological and geochemical characterization data and interpretations and modeling. Review seepage and runoff chemistry.
	D	Site C	SD + CCS	Evaluate the geotechnical aspects of the facility design/operation. Review geological and geochemical characterization data and interpretations and modeling. Review seepage and runoff chemistry.
	E	Site E. The current plan is to move this material in its entirety to the tailings facility during 2008-9. Assess whether the reduction of tailings capacity at the tailings facility, due to the placement of Site E material in this facility, will impact the currently proposed life-of mine tailings disposal management plan. How would premature closure affect this plan or the bond, prior to the re-location of Site E material at the tailings facility?	SD + CCS	Evaluate the quantity of waste at Site E and the storage capacity of the Tailings Facility in the context of the current LOM and the potential impacts of premature closure. Review geological and geochemical characterization data and interpretations and modeling. Review seepage and runoff chemistry.
	F	2.5 Mile B-Road Cut	SD + CCS	Evaluate the geotechnical aspects of the road cut design/performance. Review geological and geochemical characterization data and interpretations and modeling. Review seepage and runoff chemistry.
	G	1.8 Mile Pullout	SD + CCS	Evaluate the geotechnical aspects of the road cut design/performance. Review geological and geochemical characterization data and interpretations and modeling. Review seepage and runoff chemistry.
	H	Zinc Creek Bridge Abutment. Are there additional Best Management Practices that could or should be used at this site to reduce pollutants from reaching the creek? Is there any water quality concerns related to the drainage from this area presently entering the creek?	SD + CCS	Evaluate the geotechnical aspects of the design/performance of the abutments. Review geological and geochemical characterization data and interpretations and modeling. Review seepage and runoff chemistry.
	Quarries		SD + CCS	
	A	Pit 405	SD +	Evaluate the geotechnical aspects of the quarry design/performance. Review geological and geochemical characterization data and interpretations and modeling. Review seepage and runoff chemistry.
	B	Pit 6	SD +	
	C	Pit 174	SD +	
	D	Pit 5	SD +	
	E	Pit 7	SD +	
4	**Other Sites – Reclamation and Miscellaneous**			
	Evaluate whether the information presented is appropriate for decision making concerning the sites below. Evaluate whether			
	A	Waste Rock Site C	SD + CCS	Evaluate the geotechnical aspects of the site design/operation. Review geological and geochemical characterization data and interpretations and modeling. Review seepage and runoff chemistry.
	B	920 Area. Is the 920 area properly designed and operated such that contamination will not leave the containment area? Are run-on and run-off controls adequate to handle a 10-year 24-hour storm event? Are stormwater ponds adequately sized? Are the unlined concrete pads used in high traffic areas considered adequate for containment? Evaluate whether the redesign of the batch plant sump is adequate.	CCS	Evaluate the water management design criteria, as well as the catchment areas, design flood(s), storage capacity and the ditch/pond/sump design (operational and closure)
	C	920 Portal. Evaluate whether the reclamation plan has adequately addressed the closure of the underground workings and portals.	CCS	Evaluate the closure plan for the underground workings and portals
	D	Waste Rock Site 960		
	1	Evaluate whether the reclamation earth work has been adequately addressed at this site.	CCS	Evaluate the geotechnical aspects of the site design/operation/closure.
	2	Recommend duration or milestone event(s) of monitoring at this site prior to crediting the bond with completed concurrent reclamation.	DH	
	E	1350 Portal. Evaluate whether the reclamation plan has adequately addressed the closure of the underground workings and portals.	CCS	Evaluate the closure plan for the underground workings and portals.
	F	B Road. Evaluate whether the current schedule of re-rocking one third of this road per year is adequate. Is rock quality adequate to minimize sedimentation? Is the road rock adequate or does it break down too rapidly and produces excessive fines that are easily transported as suspended sediment.	CCS	Evaluate the road maintenance program in the context of the mine geology and mine plan.
5	**Storm water and Sediment Control**			
	A	Evaluate whether the sediment control system has been adequately designed. Is there the need for sediment ponds and traps of different designs than those currently on site?	BJ	Is there any measure of the performance of the existing system; Are there defined problem areas; Are there restrictions to using open water bodies; Are there defined TSS targets.
	B	Recommend other methods that could be used to effectively mitigate sediment transport and manage storm water as appropriate.	BJ	Ditto above

Task			Auditor	Issues/Questions etc.
6	**Bond**			
	A	Evaluate whether current closure and post-closure care information from the tailings, production rock sites 23/D, underground and overall facility is sufficient to determine an accurate bond.	DH	
	B	The Forest Service bonding guide recommends percentage ranges for various indirect costs for engineering redesign costs; mobilization and demobilization; contractor's costs (i.e. profit, overhead, etc…); agency project management; and contingencies (both "design" and "bid" contingencies). Based on industry protocol, recommend the appropriate percentages to use for each of these indirect costs.	DH	Compare absolute numbers to experience elsewhere as check on assumed percentages. Compare percentages to RS Means guidelines.
	C	The current KGCMC Reclamation Accrual Account addresses short-term inflation through maintaining the accumulated interest from the account over the 5-year interim between full recalculation of the reclamation closure costs. Assuming the company modifies the bonds for any changes in the facility, does the procedure described above adequately provide for closure costs through these interim update periods? If not, then please recommend an inflation rate based on the method provided on pages 49-50 of the Forest Service bonding guide.	DH	Review accrual account details.
	D	Are labor rates the appropriate Davis-Bacon rates as necessary? Are labor rates adequate when compared to industry standards, if these exceed Davis-Bacon wages? Are labor rates at least equal to State of Alaska required wage rates ("Little Davis-Bacon")?	DH	
	E	Have labor rates been properly adjusted for necessary burden such as, but not limited to: Alaska Workman's Comp Insurance, FICA tax and Social Security, etc.	DH	
	F	The agencies believe that there are typically overtime costs associated with remote construction projects. Do labor rates include adjustment for expected overtime? If not, what work schedules would you assume for a remote job of this type and duration and how would this affect labor rates?	DH	
	G	Are there energy cost changes due to the availability of electricity from the intertie?	DH	
	H	Are equipment sizing and cycle times adequate and representative of required tasks?	DH	Check with SRK calculation sheets (based on CAT handbook)
	I	Do equipment costs reflect standard equipment rental rates or industry standard equipment ownership, operating & maintenance costs?	DH	Compare to SRK database of northern Canadian and Alaskan costs. Request one confirmatory quote from Alaskan contractor. Check assumptions re fuel costs.
	J	The accommodation at Hawk Inlet, referred to as "Shift Housing", may not be available to a reclamation work force due to this facility being located on private land. Confirm the availability of the Hawk Inlet camp in the event that the mine operator defaults on their closure obligations. If the camp is not available, recommend a plan for either daily transportation to Admiralty Island or a temporary work camp site, including required land transportation to the work sites.	DH	Calculate possible cost implications. Compare to cost of maintaining shift housing.
	K	Recommend updated costs to the site for fixed wing, helicopter, and boat transportation.	DH	
	L	Verify that mobilization and demobilization costs are adequate.	DH	Check percentage. Check from first principles basis according to equipment fleet needs.
	M	Verify that disposal costs for items shipped off site are adequate.	DH	
	N	Is there proper accounting with respect to the duration and timing that individual pieces of equipment will be needed to perform the various closure tasks in sequence?	DH	
	O	Do reseeding costs account for the currently approved Forest Service seed mix? To achieve the required return of the genotypic plant communities, KGCMC will plant a temporary, soil stabilization seed mix, allowing the surrounding climax plant communities to naturally reseed themselves.	DH	
	P	Does the current bond amount account for the need for equipment and labor for the future removal of Outfall 002 and other tasks associated with water treatment needs?	DH	
	Q	Has the treatment of seepage water at Site 23 been included in the bond amount? If not, recommend a cost.	DH	
	R	Was re-mobilization of the 100-ton marine crane/barge between Young Bay and Hawk Inlet considered when costing for the current bond?	DH	
	S	The Forest Service does not consider salvage of materials as a credit towards bond reduction. Please provide costing for disposal fees for all materials that would be removed from the site.	DH	Contact local contractor for quotes.
7	**Monitoring**			
	A	Fresh Water Monitoring Plan		
	1	Evaluate whether the number and location of monitoring sites is adequate to demonstrate environmental compliance or to indicate environmental problems.	DHov/BJ	Evaluate corporate EMS - SOPs/Chain of Custody/Analytical Methods/QAQC programs/Laboratory Accreditation/Data management, etc.
	2	Evaluate whether there is any additional monitoring that should be done to demonstrate environmental compliance or to indicate environmental problems.	DHov/BJ	
	3	Evaluate and/or recommend actions that can be undertaken with regard to exceedances of a water quality standard at points of compliance.	DHov/BJ	
8	**Spills and Releases**			

Task			Auditor	Issues/Questions etc.
	A	Evaluate whether KGCMC filed the necessary reportable spills to the appropriate agencies in a timely fashion.	DHov/KW	
	B	Evaluate whether the current infrastructure, including tanks, piping, valves, mechanical and electrical equipment are in adequate repair to be environmentally protective, e.g. with respect to the frequency of breaks due to corrosion, age, etc.	DHov/KW	
	C	Evaluate whether the type and size of spills that routinely occur at this mine are commensurate with the activity and consistent with the type and size of spills that occur at other similar sized mining operations.	DHov/KW	
	D	Evaluate whether tracking of tailings/cons is a significant environmental issue at this mine especially on the roads near the tailings facility, the road leading out from the tails load-out and near the concentrates shed.	DHov/KW	Inspection
	E	Evaluate whether chemicals, mill reagents and fuel are adequately stored (including labeling, inventory, firewalls, blast walls, distance, etc.) to reduce the opportunity for spills, explosions, and fires.	DHov/KW	Inspection, Review of manifests
	F	Evaluate whether the Spill Prevention, Containment and Contingency Plan is adequate to address any foreseeable onsite spills.	DHov/KW	
9	**Audit of the Agencies**			
	A	General		Evaluate state/federal institutional control management framework as it applies to site, post closure land use & decommissioning criteria/objectives (water, surface disturbance etc.)
	1	Evaluate whether site inspections and oversight is adequate in coverage and record keeping for all agencies.	DHov	
	2	Evaluate and/or recommend improvements to site inspections and oversight for all agencies.	DHov	
	3	Evaluate whether each Agency is meeting the requirements of their various enabling laws, rules, and regulations.	DHov	
	B	ADNR	DHov	Interview inspectors and review typical project files
	1	Evaluate whether Biomonitoring sites are appropriate and adequate.	DHov	
	2	Evaluate whether biological surveys and monitoring are adequate to ensure environmental protection of fresh and marine waters.	DHov	What about terrestrial populations?
	3	Evaluate whether Alaska Dam Safety regulations are adequately applied to the KGCMC facilities.	CCS	
	4	Evaluate whether the Alaska Water Rights regulations are adequately applied to the KGCMC operations.	BJ	
	C	ADEC	DHov	Interview inspectors and review typical project files
	1	Evaluate whether ADEC oversight of the facility has been adequate.	DHov	
	2	Evaluate and/or recommend improvements regarding oversight, compliance and record keeping for this facility.	DHov	
	D	Forest Service	DHov	Interview inspectors and review typical project files
	1	Evaluate whether Forest Service oversight of the facility is adequate.	DHov	
	2	Evaluate and/or recommend improvements regarding oversight, compliance and record keeping for this facility.	DHov	

Key to Auditor Identifiers

SD = Stephen Day
CCS = Cam Scott
KW = Kathleen Willman
DHov = Don Hovdebo
DH = Daryl Hockley
BJ = Bill Jeffress

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Appendix C
List of Documents Provided by ADEC

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Kennecott Greens Creek Mining Company

Waste Disposal Permit Documents And Other Related Documents by Chronology

1. Hanging File Folder – Greens Creek - Permit #8712-BA004

A. May 27, 1988 – Department of Governmental Coordination Conclusive Consistency Determination Hawk Inlet 1 – State I.D. No. AK8804-1-02J

For mine tailings impoundment faclity in Tributary Creek, access roads to the tailings disposal area, and a marine outfall line for effluent discharge in Hawk Inlet.

B. June 2, 1988 – ADEC Issues Certificate of Reasonable Assurance Under Section 401 of the Clean Water Act for Proposed Tailings Impoundment in Tributary Creek

Note: This file cannot be found. However, this is the date that the 401 Cert was issued.

C. June 2, 1988 – ADEC Solid Waste Disposal Permit No. 8712-BA014, Hawk Inlet

For disposal of an average of 60 lbs per day of incinerator ash and 60 lbs per day of sewage sludge. After mine production commences, the landfill site will be folled over with dry tailings. Subsequently the ash and dewatered sludge would be deposited in the dry tailings area and covered on the day of deposit with dry tailings. Permit to expire December 31, 1990.

D. June 21, 1988 – U.S. Army Corp of Engineers Issues Permit No. 4-880269 under Section 404 of the Clean Water Act

To place fill material in wetlands for the construction of tailings and impoundment embankments. Approximately 75,000 cubic yards of quarry rock, sands and gravel, and glacial till will be placed to create a main embankment, and a saddle embankment, to create a drainage pond and tailings storage area. Another 8,000 cubic yards of mill tailings and quarry rock will be placed to construct crossroads and drains within the tailings storage area. All work will be performed in accordance with the attached plans, 7 sheets dated February 1988.

E. June 8, 1989 – Site Visit by Ann Tiplady

F. September 5, 1989 – Site Fly-Over by Ann Tiplady

G. December 4, 1990 – KGCMC to ADEC Request Renewal of Permit With List of Items Needed From Pre-Application Meeting.

Request included disposal of incidental wastes into the tailings disposal site.

H. January 9, 1991 – ADEC Letter to KGCMC Requesting New Permit Application With Attachments

I. March 8, 1991 – Inspection Report by Ed Emswiler

J. March 11, 1991 – Application for Solid Waste Disposal Permit

1) Solid Waste Permit Application for Tailings Disposal Facility

Request was for approximately 21,900 pounds of sewage sludge and incinerator ash per year in the Greens Creek disposal area.

a. Attachment – Narrative

b. Attachment – Related maps

c. Attachment – Lease for use of land

d. Attachment – Environmental Assessment for proposed changes to the General Plan of Operation and relevant portions of the Upper Cannery Tailings Impoundment Geotechnical Investigation and Materials Testing Report.

K. May 2, 1991 – Letter from ADEC to KGCMC Requesting Additional Information

L. September 24, 1991 – KGCMC Submits Additional Information

M. October 8, 1991 - ADEC Solid Waste Disposal Permit No. 8712-BA014, Hawk Inlet

For disposal of an average of 60 lbs per day of incinerator ash and 60 lbs per day of sewage sludge. After mine production commences, the landfill site will be folled over with dry tailings. Subsequently the ash and dewatered sludge would be deposited in the dry tailings area and covered on the day of deposit with dry tailings. Permit to expire December 31, 1993.

N. March 18, 1992 – KGCMC Requests Disposal of Soot in Tailings

O. March 31, 1992 – ADEC Gives Approval for Disposal of Soot in Tailings

P. April 30, 1992 – KGCMC Requests Backfill of C/D Waste to Underground Facilities

Q. July 29, 1992 – ADEC Gives Approval to Backfill of C/D Waste to Underground Facilities

R. April 20, 1994 – KGCMC to ADEC Request to Renew Solid Waste Disposal Permit

Renewal to be based on permit application material submitted by KGCMC for the 1991 permit.

S. June 28, 1994 - ADEC Solid Waste Disposal Permit No. 8712-BA014, Hawk Inlet

For disposal of an average of 60 lbs per day of incinerator ash and 60 lbs per day of sewage sludge. After mine production commences, the landfill site will be folled over with dry tailings. Subsequently the ash and dewatered sludge would be deposited in the dry tailings area and covered on the day of deposit with dry tailings. Permit to expire December 31, 1998.

T. November 10, 1994 – KGCMC to ADEC Request for Short-Term Waiver of Title 18, Chapter 60 Permit Requirements for Underground Disposal

Request that ADEC exercise discretion to grant KGCMC a short term waiver to the permit requirements in 18 AAC 60.200 while permit for underground disposal is processed. Activity is to dispose no more than 600 cubic yards of sludge resulting from wastewater treatment in an underground stope.

U. November 10, 1994 – Application for Solid Waste Disposal Permit

1) Solid Waste Permit Application for Below Ground Disposal Facility

a. Cover Letter – November 10, 1994

b. Solid Waste Disposal Permit Application with 7 Attachments

i. Attachment 1 - USDA Forest Service Lease Document

ii. Attachment 2 – Status Map of Greens Creek Mine Improvements - Underground

iii. Attachment 3 – General Location Map Proposed Disposal Area – Underground

iv. Attachment 4 – Zone 8 Proposed Sludge Disposal Area – Underground

v. Attachment 5 – Ferric Chloride Addition Process

vi. Attachment 6 – Flow Measurements – Underground

vii. Attachment 7 – KGCMC Reclamation and Closure Plan Review – August 1994

2) Coastal Project Questionaire – DGC

3) Request for Short-Term Waiver of Solid Waste Permit Requirements

a. Attachment – TCLP results of sludge from process water

4) Supplementary Information

a. Permit Index – list of all current operational permits

b. Report on Visit to Greens Creek Mine, May 23-26, 1994 – John Forth

c. Groundwater Hydrology and Quality – January 1983 Greens Creek Environmental Impact Statement

V. November 15, 1994 – Jim Clark to ADEC Requesting Change To Include Underground Disposal

W. November 18, 1994 – Inspection of Mine by ADEC Team

X. November 21, 1994 – Inspection Report from November 18, 1994 inspection

Y. November 22, 1994 – Approval to Temporarily Store Various Wastes During Application Process – ADEC to KGCMC

Z. December 5, 1994 – Information Requested in Future Permit Application – ADEC to KGCMC

2. Hanging File Folder – Greens Creek – June 1995 Application

A. June 30, 1995 – Application for Solid Waste Disposal Permit for Greens Creek Above Ground and Below Ground Disposal Facilities

1) Above Ground Tailings Disposal Facility

a. Cover Letter – June 30, 1995

b. Solid Waste Disposal Permit Application

i. Surface Location Information Document and Operational Plan

ii. Reclamation Performance Bond

iii. Figure A: Tailings Facility Site Plan – June 10, 1995

iv. Figure B: Tailings Pile Typical Cross-Section – June 10, 1995

v. Attachment 1: Tailings Solid Waste Disposal Facility Legal Description

vi. Attachment 2: Hydrology overview - Tailings Dam/Dry Tailings Area - by Andrews/Pappalardo – March 22, 1995

vii. Attachment 3: Tailings Site Well Monitoring Summary – December 29, 1994

viii. Attachment 4: Tailings Site Seepage Control Structure Monitoring Summary – December 29, 1994

ix. Attachment 5: U.S. Forest Service Land Use Lease Document – December 2, 1980

c. Tailings Characterization Study – March 1995 by Condon

2) Below Ground Disposal Facility

a. Cover Letter – June 30, 1995

b. Solid Waste Disposal Permit Application

i. Underground Location Information Document and Operational Plan

ii. Reclamation Performance Bond

iii. Figure A: Underground Mine Workings – March 18, 1993

iv. Attachment 1: Hydrology overview – Mine Area - by Andrews/Pappalardo – March 22, 1995

v. Attachment 2: Results - Mill Water Treatment Plant Fines Analysis, Toxic Characteristic Leaching Procedure Test – November 3, 1994

c. Production Rock Characterization Study – March 1995 by Condon

B. October 9, 1995 – Request for Approval to Dispose Various Inert Wastes from Mill Reconditioning at Underground Locations

Areas approved for temporary disposal in the November 22, 1994 letter from ADEC are now full. KGCMC wishes to place non re-useable metal and HDPE pipe material into back-fill areas within the underground workings of the mine.

C. November 15, 1995 – Approval for Temporary Solid Waste Disposal at Underground Locations

Approval given to dispose the inert materials mentioned in the October 9, 1995 KGCMC letter. This approval replaces the November 22, 1994 letter.

3. Hanging File Folder – Greens Creek, February 1996, Geotechnical Review and Analysis of the Greens Creek Tailings Pile

4. Hanging File Folder – Greens Creek, May 1996 Supplemental Application Information

A. May 15, 1996 – Supplemental Information, KGCMC Tailings Solid Waste Permit Application

1) May 15, 1996 - Cover Letter

2) March 1, 1996 - Preliminary Numerical Modeling Results and Conceptual Soil Cover Design – Unsaturated Soils Group

3) February 1995 - Upper Cannery Tailings Impoundment Site Review and Reclamation Planning Work Program - Draft

B. June 25, 1996 – KGCMC to USFS, General Plan of Operations, Appendix 3, Tailings Impoundment Submittal

5. Hanging File Folder – Greens Creek, February 1997, Supplemental Application Information

A. February 1997 – Supplemental Information, KGCMC Tailings Solid Waste Permit Application

1) Groundwater Flow Model Tailings Disposal Area, Kennecott Greens Creek Mining Company – Environmental Design Engineering

6. Hanging File Folder – Greens Creek, November 1998, Supplemental Application For Above & Below Ground Tailings Disposal Facilities

A. November 3, 1998 – Supplemental Application for Above Ground and Below Ground Tailings Disposal Facility

1) Above Ground Tailings Disposal Facility

a. November 3, 1998 - Cover Letter

b. November 3, 1998 - Solid Waste Permit Application For Monofill Disposal of Inert Waste: 18 AAC 60.460

i. Updated Surface Location Information Document and Operational Plan

ii. Seismic Hazard Assessment -Final Report – August 21, 1998

<u>To be Brought Forward from the June 1995 Permet Applications</u>

iii. Figure A: Tailings Facility Site Plan – June 10, 1995

iv. Figure B: Tailings Pile Typical Cross-Section – June 10, 1995

v. Attachment 1: Tailings Solid Waste Disposal Facility Legal Description

vi. Attachment 2: Hydrology overview - Tailings Dam/Dry Tailings Area - by Andrews/Pappalardo – March 22, 1995

vii. Attachment 3: Tailings Site Well Monitoring Summary – December 29, 1994

viii. Attachment 4: Tailings Site Seepage Control Structure Monitoring Summary – December 29, 1994

ix. Attachment 5: U.S. Forest Service Land Use Lease Document – December 2, 1980

<u>To be Brought Forward from a May 1996 KGCMC Letter Submittal to ADEC</u>

x. Preliminary Numerical Modeling Results and Conceptual Soil Cover Design – Unsaturated Soils Group – March 1, 1996

xi. Upper Cannery Tailings Impoundment Site Review and Reclamation Planning Work Program - Draft – February 1995

2) Below Ground Tailings Disposal Facility

a. November 3, 1998 - Cover Letter

b. November 3, 1998 - Solid Waste Permit Application For Monofill Disposal of Inert Waste: 18 AAC 60.460

i. Update Underground Location Information Document & Operating Plan – November 1998 Seismic Hazard Assessment -Final Report – August 21, 1998

<u>To be Brought Forward from the June 1995 Permet Applications</u>

ii. Figure A: Underground Mine Workings – March 18, 1993

iii. Attachment 1: Hydrology Overview - Mine Area - Andrews/Pappalardo – March 22, 1995

iv. Attachment 2: Results - Mill Water Treatment Plant Fines Analysis, Toxic Characteristic Leaching Procedure Test – March 13, 1994

7. Hanging File Folder – Greens Creek, December 23, 1998 – Supplemental

Information, KGCMC Above Ground Facilities

A. December 23, 1998, Waste Rock Cover Design, KGCMC – Unsaturated Soils Engineering, Ltd.

8. Hanging File Folder - Greens Creek, July 26, 1999 – Decision to Regulate Production Rock Sites 23 & D and Request for Application Materials – ADEC to KGCMC

This letter stated concerns with fees for services and water quality at the production rock site. The issue of expanding the existing disposal facility would require a solid waste disposal permit. Please refer to item #27 below (Shepherd-Miller Technical Review ARD / Metals Leaching).

9. Hanging File Folder – Greens Creek, October 15, 1999 Cover Letter - Supplemental Information, KGCMC Tailings Solid Waste Permit Application

A. July 1999 - Evaluation of Tailings Pile Final Report – Klohn-Crippen

Note: This document is too large for this folder – it follows this folder

B. December 1999 - Tailings Pore Water Chemistry Results

10. Hanging File Folder – Greens Creek, December 23, 1999 Cover Letter – Supplemental Information, KGCMC Tailings Solid Waste Permit Application

A. December 12, 1999 - Tailings Disposal Area Groundwater Flow Model 1999 Update – EDE

Note: This document is too large to put in file drawer – it is filed in the storage tray in the second file drawer.

B. December 15, 1999 - Preliminary Design of East Expansion to Tailings Pile Final Report – Klohn-Crippen

Note: This document is too large for this folder – it follows this folder

11. Hanging File Folder – Greens Creek, January 20, 2000 – Legal analysis memorandum regarding issues impending the KGCMC interagency technical review. Robertson, Monagle & Eastaugh

A. Legal Analysis contains information regarding the following issues of conern:

1) When are NEPA reviews triggered
2) Standard for compliance with USFS regulation
3) Should the GPO be interpreted as BMP's
4) Does antidegradation standard apply
5) What is the process for amendment of the FWMP

12. Hanging File Folder – Greens Creek, February 18, 2000 – Shepherd Miller Report & SEACC Response

A. February 18, 2000 - Shepherd Miller, Inc. - Technical Review ARD/ Metals Leaching and FWMP

B. April 14, 2000 - SEACC to USFS (Fred Salinas), Letter on timing SEACC's concerns around around KGCMC operations in light of new information in the Shepherd-Miller report.

Contains CSP2 comments dated April 7, 2000 from David Chambers to Sarah Keeney on Technical Review ARD/ Metals Leaching and FWMP – February 18, 2000

13. Hanging File Folder – Greens Creek, August 9, 2000 – Compliance Order by Consent, ADEC and KGCMC

The "COBC" was intended to resolve potential issues concerning compliance with state law arising from continued development of the surface tailings pile without a disposal permit. Continued development included lifts placed into previously unused areas within the permitted tailings facility footprint with the condition that work to acquire a solid waste disposal permit

14. Hanging File Folder – Greens Creek, Application Material, Year 2000, for Permit #9911-BA001

A. September 7, 2000, Supplemental Information, Application Material for Production Rock Site 23 & D

1) September 7, 2000, Cover Letter & Following ADEC Application Format

a. Attachment – Site Location Map

b. USFS Lease 4050-03 Documents

c. Three Drill Logs – Sites 23 & D - June 5-6, 2000

Note: these were not included in this submittal. It was requested this information be submitted in the next submittal updates dated October 9, 2000.

d. Appendix 1, General Plan of Operations for Freshwater Monitoring Plan

e. Appendix 3, General Plan of Operations for Tailings Disposal Facility

f. *Appendix 11, General Plan of Operations for Production Rock Piles*

g. *Appendix 14, General Plan of Operations for Reclamation Plan*

B. October 9, 2000 – Supplemental Information, KGCMC Production Rock Disposal Sites 23 & D

1) Cover Letter – October 9, 2000

a. *Two drawing set showing recent plan and cross-sectional views of the Site 23 placement area.*

b. *Three Drill Logs – Sites 23 & D – June 5-6, 2000*

c. *Production Rock Site Characterization Study, Sites 23 & D – Peter Condon, March 1995 – (characterization of older rock sites at Greens Creek, Site D inclusive)*

d. *Technical Review ARD/Metals Leaching and Freshwater Monitoring Plan Greens Creek Mine – Shepherd Miller, Inc., February 18, 2000 – (excerpt of sections presenting characterization information for Site 23 & D)*

e. *Environmental Assessment for Additional Waste Rock Disposal Capacity at Greens Creek Mine Admiralty Island National Monument, Alaska – November 1992 – (discussion of mixing zone at site D)*

C. October 18, 2000 – Supplemental Information, KGCMC Solid Waste Disposal Permit Application

1) Cover Letter – October 18, 2000 – KGCMC Keith Marshall to ADEC Heather Stockard

a. *Updated Coastal Project Questionaire for Greens Creek's Solid Waste Permit Application*

b. *Tailings Disposal Facility As-Built – October 3, 2000*

c. *Production Rock Disposal Facility As-Built – October 2, 2000*

d. *Current Kennecott Greens Creek Permits – January 19, 1999*

D. October 24, 2000 – Supplemental Information, KGCMC Solid Waste Disposal Permit Application

E. September 7, 2000, Request for Partial Waiver of Groundwater Monitoring Requirements for the Site's 23 & D

To be considered together with the technical documents (e.g. Freshwater Monitoring Plan and Production Rock Piles appendices)

15. Hanging File Folder – Greens Creek, Year 2000 Permit Process, Permit #9911-BA006 and Post-Permit Process Adjudicatory Request

A. Permit Process - Folder

1) October 30,31 2000, Juneau Empire public notice for permit and public meeting

2) November 16, 2000, Public meeting held at Centenial Hall

   a. Tape transcript of meeting

   b. Log of attendees and log of people wanting permit and General Plan of Operations

3) Written Comments on Proposed Permit #9911-BA006

   a) Southeast Alaska Conservation Council dated December 11, 2000 with attachments
   b) Page Else email dated December 11, 2000
   c) CSP2, Amy Crook dated December 11, 2000
   d) US Fish & Wildlife Service, Theresa Woods, dated December 11, 2000
   e) USFS, Brad Flynn, dated December 11, 2000
   f) Kennecott Greens Creek Mining Company, Bill Oelklaus, dated December 7, 2000
   g) Ken Post, dated December 11, 2000
   h) Mary Richmond, dated December 11, 2000
   i) Robert Robinson, dated December 11, 2000

4) January 2001 – Record of Decision and Fact Sheet

5) January 29, 2001 – Waste Disposal Permit 9911-BA001 and Response to Comments

   Includes address list of people on the cc list of permit and response

B. Post Permit Issuance Adjudicatory Request - Folder

1) January 29, 2001, Waste Disposal Permit 9911-BA00

2) January 26, 2001, Two letters from the USFS to KGCMC regarding non-compliance with the GPO

   a. Excess sediment buildup on "B" road – GPO Appendix 8. Issue resolved

   b. Non-compliance with WQS – GPO Appendix 1. Issue resolved

3) February 28, 2001, SEACC to ADEC Commissioner Brown, 2001, request for an adjudicatory hearing.

   a. Bond inadequate

   b. Reclamation plan incomplete

   c. Lack of process for permit modifications

4) March 5, 2001, Robertson, Monagle & Eastaugh to ADEC Commissioner Brown, dated, opposition to SEACC's request for adjudicatory hearing on Greens Creek

permit decision.

5) ADEC policy by Michelle Brown regarding Public Notice requirements for solid waste permit renewals and modifications

6) Alaska 18 AAC 15.100(c) regarding permit limitations.

Any expansion, modification or change in a facility process or operation which might result in an increase in emissions or discharges, or might cause other detrimental environmental impacts from the permittee's facility, requires a new permit or variance.

7) March 12, 2001, SEACC to ADEC Commissioner Brown, dated, clearification of hearing request for adjudicatory hearing.

8) March 27, 2001, ADEC Commissioner Brown to SEACC, request to hold adjudicatory hearing request in abeyance is granted.

Abeyance based upon the permitted requirement that KGCMC submit a reclamation plan by July 31, 2001. This would give the company time to produce the closure plan. SEACC wrote a letter dated March 19th to the Commissioner stating they would be willing to hold the adjudication in abeyance.

16. Hanging File Folder – Greens Creek, Permit #9911-BA006

A. April 5th Bond by KGCMC (Firemans Fund for $6 million) and April 27, 2001 Letter by ADEC to KGCMC approving it.

B. May 14, 2001 - Bond and Audit Process MOU, Robertson, Monagle & Eastaugh

C. May 21, 2001 - ADEC to KGCMC Letter asking for information required in the permit under section 2.8.3.1. concerning submission of internal monitoring and under section 4.1.2.1. concerning historical water quality data associated with site D pump station

D. May 31, 2001 – KGCMC submits internal monitoring plan as per section 2.8.3.1 of the waste disposal permit for both Site 23/D and Tailings

E. July 19, 2001 – KGCMC submits historical water quality data from site D pump station under permit section 4.1.2.1

F. July 31, 2001 – Site visit to observe the "further seep" area

At the inspection was Bill Oelklaus, Steve McGroarty, Ed Emswiler, and Pete McGee. Report by ADNR McGroarty.

G. August 9, 2001 – Approval to Place 10,000 tons of Class 4 Production Rock Into the Surface Tailings Facility

1) August 17th and August 8th letters from USFS concerning this.

2) July 23rd letter from KGCMC to ADEC requesting the disposal

H. October 10, 2001 – Approval of Action Plan for Analysis of "Further Seep"

Action plan submitted by KGCMC attached to letter.

I. December 4, 2001 - Wide Corner Quarry Liner Design

Describes the layout and design for the Wide Corner area of the eastern aspect of the tailings disposal site. See binder that follows this folder as it is too big to put in this hanging file.

J. January 2002 – KGCMC Submits Update of Information and Action Plan on Seeps West of the Current Tailings Disposal Facility

K. January 15, 2002 – ADEC Approves Wide Corner Quarry Liner Design

1) January 4th letter from USFS reflecting the same approval

L. January 16, 2002 – ADEC Inspects Greens Creek Facilities Under Permit.

1) Letter of Inspection dated March 8, 2002

a. Includes items to be presented in the Annual Report

b. Includes items to be included in site specific reclamation plan

c. Includes ADEC Southeast Alaska Response Team Report

M. February 5, 2002 – Stage II Tailings Expansion Hydrological Analysis – EDE Consultants

179 pages. On Disk

N. April 2002 – KGCMC Submits 1st Annual Report (Year 2001)

See Annual report under Hanging File Folder #17

O. April 2, 2002 – ADEC Letter Approves Modification to Wide Corner Quarry Liner Design

1) Letter from KGCMC requesting the change dated February 28, 2002

2) Letter from Klohn Crippen dated February 14, 2002

P. May 15, 2002 – Public Meeting at ADEC to Discuss Annual Report

Q. May 23, 2002 – ADEC Inspects Installation of Wide Corner Liner at Tailings Site

1) Insepction report generated May 24, 2002

R. October 25, 2002 – Assessment of 1st Annual Report Under Waste Dispoal Permit #9911-BA006

17. Hanging File Folder – Greens Creek, Permit #9911-BA006, April 2002 – 1st Annual Report

A. April 2002, Annual report document submitted by the company

B. May 2002, Document submitted by ADF&G entitled "Aquatic Biomonitoring at Greens Creek Mine, 2001"

C. May 15, 2002, Meeting held at ADEC with the public, attendee list inside of annual report

D. October 25, 2002 – Assessment of 1st Annual Report Under Waste Disposal Permit #9911-BA006 (copy)

Note: See Also Hanging File Folder – Greens Creek, Permit #9911-BA006

18. Hanging File Folder – Greens Creek, Permit Process, Permit #0111-BA001 (Modification of Permit #9911-BA006) and Post Permit Process Adjudicatory Request

A. Permit Process - Folder

1) July 31, 2001 – KGCMC submits Appendix 14, Attachment A reclamation plan

a. July 31, 2001 cover letter to ADEC introducing the reclamation plan

Note: Actual reclamation plan is too large to put in file drawer – it is filed in the storage tray in the second file drawer. Note: This document was replaced with a November 2001 version.

b. July 31, 2001 - Meeting at ADEC to introduce the plan. At this meeting it was discussed there was a seepage condition called "further seep" at the facility that had anomolous results.

Includes list of attendees.

c. July 31, 2001 – Steve McGroarty, Pete McGee and Ed Emswiler perform a site visit to observe Further Seep. See Hanging Folder #16 above.

2) August 14, 2001, KGCMC submittal of inclusion of omissions in the Reclamation plan (August 27, 2001 email by Zimmer)

3) August 29, 2001 – Initiation of Review to Modify Permit #9911-BA001 to Include

Bond and Reclamation Plan

a. *Public Notice, Juneau Empire, dated August 28 & 29, 2001*

b. *Electronic version of Public Notice*

4) September 5, 2001 – Start of ACMP Review – Modification of Permit #9911-BA001 to Include Bond and Reclamation Plan

a. *ACMP deadlines*

1) Reviewer can request additional info on or before 9/23
2) Comments due to DEC by 9/28
3) Proposed consistency determination 10/12
4) Final consistency determination 10/18

5) September 18 through October 1 - Comments Received

A. CSP2 Amy Crook, dated October 1, 2001
B. SEACC Sarah Keeney, Buck Lindekugel, dated September 28, 2001
C. US Fish & Wildlife – Teresa Woods, dated September 28, 2001
D. CSP2 Dave Chambers - 9/18/01, dated September 18, 2001
E. KGCMC Tom Zimmer – 9/28/01 – Responses to comments from CSP2 letter dated 9/18/01 concerning the detailed reclamation plan
F. CSP2 – Dave Chambers - 10/19/01 – comments of response to KGCMC letter dated 9/28/01 that commented on 9/18/01 letter by CSP2

6) October 10, 2001 – ADEC to Oelklaus, Review Extension – Permit Modification to Approve Bond and Reclamation Plan #9911-BA006

Pete McGee suspended review because of unusually complex issues involved in the review. Review would start up again after bond was settled and was in place.

7) October 31, 2001 – DNR (Stan Foo) to KGCMC Asking For Clarification On Several Aspects Of The Bond

a. *Items included:*

a. Care, maintenance and monitoring costs for 1 yr prior to active reclamation
b. Funds for monitoring adequate?
c. Agency administration costs, estimate of 2% total direct cost
d. Indirect cost allowances
e. Allowance for contractor profit margin
f. Overtime wages
g. Adjustment for direct costs for inflation on an annual basis

8) November 1, 2001 – Meeting at DNR Juneau to Discuss Terms of the Bond

a. *List of attendees and agenda*

9) November 7, 2001 – USFS to Keith Marshall (KGCMC) Stating Clarification Needed in Bond Calculations and Echoing State Stance

10) December 4, 2001 – KGCMC Submits Updated Appendix 14, Attachment A of Reclamation Plan and Cost Estimates (dated 11/15/01)

    a. *December 4, 2001 cover letter to ADEC introducing the reclamation plan*

    Note: Actual reclamation plan is too large to put in file drawer – it is filed in the storage tray in the second file drawer. Note: This document replaced the July 31, 2001 version.

11) December 20, 2001 – SEACC (Sarah Keeney) to John Sisk (Governors Office) Registering Complaint Over Bond and Reclamation Plan

12) June 18, 2002 – Letter of Credit for $18,400,000 from Wachovia Bank

    a. *Cover letter from KGCMC to Pete Griffin, USFS, dated June 24, 2002*

    b. *Letter of credit from Wachovia Bank*

13) July 22, 2002 – Review Restart of Permit #9911-BA006, Now To Be Numbered As Permit #0111-BA001

    a. *Based upon acceptable reclamation plan and bond is in place*

14) July 31, 2002 – SEACC Submits Comments On The Review

    a. *Comment explains the following problems:*

    a. Permit is incomplete
    b. Permit violates the habitat standards
    c. Public Need

15) August 12, 2002 – Proposed Consistency Determination, with the following attachments:

    a. *Standards of the Alaska Coastal Management Program 6 AAC 80.140*

    b. *Draft Waste Disposal Permit #0111-BA001*

16) August 16, 2002 – Final Consistency Determination, Response To Comments and Final Modified Permit #0111-BA001

B. Post Permit Issuance Adjudicatory Request – Folder

1) September 16, 2002 – EarthJustice Request For Adjudicatory Hearing

    a. *Hearing request based on*

        i. Bond is not increased annually

        ii. Other sites at Greens Creek have serious potential to cause Acid Mine Drainage and should be included in the permit

2) September 23, 2002 – Preliminary Draft of the EIS (PDEIS) Submitted to Agencies by Michael Baker Inc.

   Note: This document is not available in the file

3) October 4, 2002 – ADEC Commsioner to EarthJustice
   a. *Hearing request didn't meet the requirements for the current law. Please submit electronically and estimate how long you think a hearing will take.*

4) October 18, 2002 – EarthJustice Resubmitting Request For Adjudicatory Hearing

5) October 21, 2002 – State's Comments On The PDEIS

   Note: See electronic file

6) November 29, 2002 – EarthJustice Letter Discussing Ways To Resolve Dispute Out Of Adjudicatory Process IF
   a. *Annual inflation in bond to be addressed in a future permit*
   b. *Enter Exhibit 1 into the August 16, 2002 response to comments concerning the incorporation of "other sites" into the permit*

7) November 29, 2002 – Robertson, Monagle & Eastaugh Objecting To SEACC and EarthJustice Resolution of Adjudicatory Process
   a. *Disagree with abeyance request*

8) December 4, 2002 – Robertson, Monagle & Eastaugh – 2 Letters of Objection To Hearing Request To ADEC Commissioner
   a. *One Letter Entitled "KGCMC Response to SEACC and NAEC Request For Adjudicatory Hearing"*
   b. *One Letter Entitled "KGCMC Opposition To Abeyance Request"*

9) December 5, 2002 – Fairbanks Gold Mining, Inc to Acting Commissioner Fredrickson – Adjudicatory Hearing Process Concerning Greens Creek Solid Waste Permit

   Faibanks Gold Mining, Inc, operator of the Fort Knox and True North mines near Fairbanks, Alaska is very concerned about the DEC working outside the established adjudicatory hearing process to enter an agreement with mining opposition groups Northern Alaska Environmental Center and SEACC on how bonding and waste rock management issues will be handled at mine projects in Alaska.

10) December 6, 2002 – ADEC Commissioner to EarthJustice Regarding Abeyance Request For Adjudicatory Hearing

Request to hold adjudicatory hearing request for the Greens Creek permit modification in abeyance is denied. I find no compelling reason to truncate the public process initied by your clients' request for an adjudicatory hearing.

11) December 9, 2002 – Tech Cominco to Acting Commissioner Fredrickson – Adjudicatory Hearing Request on Greens Creek Waste Disposal Permit

We believe that the request for an adjudicatory hearing on the Greens Creek Waste Disposal Permit should be denied because the issues raised in the request represent State policy issues with implications beyond the Greens Creek permit.

12) December 11, 2002 - Robertson, Monagle & Eastaugh to Tom Waldo of EarthJustice entitled "Your Request for Extension of Reply Deadline on Adjudicatory Hearing Request.

The discussion would not include DEC policy/regulatory changes concerning mine waste rock management or waste facility bonding, as those subjects are not appropriate for resolution through private negotiations.

13) December 13, 2002, ADEC Commissioner's Office to EarthJustice

a. *I have received your December 11th request to extend the time for you to file a reply. Your request to extend the time to file a reply until January 31, 2003 is granted under conditions:*

   i. You enter into the negotiations agreed to by KGCMC and AWQ staff.

   ii. The negotiations will be limited to discussions on the outstanding Site E monitoring issues.

   iii. There is no need to extend the discussions to the bond issue which they may address when a new permit is issued this year. The bond will not be a part of the discussions.

14) January 15, 2003 Meeting at ADEC to discuss Site E Monitoring

a. *December 23, 2002 - Letter by Cameron Leonard announcing January 15th meeting.*

b. *Present at meeting were representatives for SEACC/EarthJustice (Tom Waldo) and Greens Creek. List of attendees*

   i. Site E monitoring information

15) January 31, 2003 – Tom Waldo (EarthJustice) to Ernesta Ballard (ADEC), Request for Adjudicatory Hearing: Waste Disposal Permit No. 0111-BA001.

16) March 4, 2003 – SEACC to USFS Pete Griffin, Other Sites and Acid Rock Drainage Potential

New information was released from ADEC (reference site inspection report January 28, 2003) that clarifies the current risks to Admiralty Island National Monument from acid mine drainage by substatiating the existence of acid mine drainage.

17) May 12, 2003 – EarthJustice to ADEC Commissioner Ballard, Request for Adjudicatory Hearing, Waste Disposal Permit No. 0111-BA001

Pursuant to 18 AAC 15.220(a), Earthjustice submits this reply to ADEC Staff's response to SEACC's hearing request dated May 2, 2003.

18) May 14, 2003 – Memorandum from Pete McGee (ADEC) to ADEC Commissioner Ballard, Additional Information for Greens Creek Adjudication

Recently, Deputy Commissioner Fredrickson orally requested to acquire any other documents DEC staff relied upon concerning acid rock drainage potential of various sites at the Greens Creek mine….. This reply addresses that inquiry by providing copies of excerpted pages of a few documents, which are described below and attached.

19) May 22, 2003 – Public Notice, ADEC Commissioner Ballard

The Department has received and granted a request for a hearing for a contested Waste Disposal Permit. Any person who wants to participate in this proceeding may submit a request to intervene under 18 AAC 15.225.

20) June 3, 2003 – USFS Pete Griffin to SEACC Shoren Brown, Response to Request Under Freedom Of Information Act

This is response to your May 27th request for records under the FOIA for all records that relate to water quality issues at any of the sites at Greens Creek mine, dating from January 1, 2001 to present. Since any waiver or reduction in fees is an expenditure of public funds, please provide us with specific information and/or examples responsive to items 2,3 and 4 listed above. Under the provisions of the Forest Service Manual 6209, Section 14.9, fifty percent ($630) of the total fees ($1,360,00) must be paid prior to reproduction of the records.

21) June 6, 2003 – SEACC Shoren Brown to ADEC Tom Chappel, Alaska Public Records Act Request

Please provide us copies of all records from January 1, 2000 through the present, regardles of form or format, that relate to water quality issues at any of the sites at Greens Creek mine.

22) June 13, 2003 – Alaska Miners Association to Commissioner Ballard, Adjudicatory Hearing on Greens Solid Waste Permit

We believe that there are several issues in this matter that could have extremely adverse impacts on Greens Creek and on all other metal mines but also on sand, gravel, stone, armor rock, etc. mining in the state.

23) June 16, 2003 – Fairbanks Gold Mining to ADEC, Request to Intervene

Fairbanks Gold Mining moves to intervene in the adjudicatory hearing on the referenced matter granted by ADEC on May 21, 2003.

24) June 16, 2003 – Cam Leonard to Shoren Brown (SEACC), Request for Public Records, dated June 6, 2003

I write in response to your recent public records request, in which you ask for copies of records from January 1, 2000 to present, "that relate to water quality issues at any of the sites at Greens Creek Mine". Given the breadth of your request, our typical response would be to work with you to narrow the scope in order to minimize the administrative burden on ADEC and the potential expense to SEACC.

25) July 1, 2003 – Earth Justice to ADEC Commissioner Ballard, Notice of Dismissal of Adjudicatory Hearing: Waste Disposal Permit No. 0111-BA001

SEACC and Northern Alaska Environmental Center hereby provide notice that they dismiss their claims in the above-referenced adjudication. The reason for this dismissal is that the adjudication now appears likely to become moot before it can be decided.

26) State of Alaska Policy and Procedures

a. *18 AAC 15 Administrative Procedures*
b. *18 AAC 15.100*
c. *Policy Regarding Public Notice Requirements For Solid Waste Permit Renewals and Modifications – by Michelle Brown Commissioner*

19. Hanging File Folder – Greens Creek, Permit #0111-BA001

A. November 4, 2002 – Site Visit To Inspect All Other Areas On Mine Property That Received Waste Rock Or Of Other Potential Environmental Consequence

Report Written on January 28, 2003

B. November 14, 2002 – Klohn-Crippen to ADEC, "Southeast Expansion Construction Summary – Final Report"

Cover letter from KGCMC to ADEC dated December 10, 2002

Describes the overall as-built of the Wide Corner area of the eastern aspect of the tailings disposal site.

Note: This document is too large for this folder – it follows this folder

C. April 2003 - ADF&G document entitled "Aquatic Biomonitoring at Greens Creek Mine for the Annual Report, see Hanging File Folder #20 Annual Report

D. April 2, 2003 – Conversation With Dr. G. Ward Wilson by Ed Emswiler and Kenwyn George Regarding Monitoring of Oxygen, pH, and NNP Under Soil Cover System

G. Ward Wilson is the designer of the soil cover system proposed to be installed at closure at tailings and waste rock sites.

E. April 7, 2003 – Cassandra Hall, Klohn-Crippen Consultants Ltd. To Tom Zimmer KGCMC – Regarding change of ASTM methodology for Site 23 Production Rock Compaction

Currently, there is no ASTM standard procedure to determine the Proctor density for the material being stockpiled at Production Rock Site 23. The material is too coarse. Instead they propose to do the following:

1. Compact the waste material in accordance with a method specification
2. Place and spread to a maximum lift thickness of 24 inches and compact with one complete pass with a bulldozer.
3. Further compact the material with a minimum of 4 passes over each layer using a self propelled vibratory compactor.

F. May 6, 2003 – Stage II Tailings Facility Water Balance – EDE Consultants

222 pages – On Disk

G. June 10, 2003 – Site Visit and report by Kenwyn George

1) Report dated June 16, 2003

Site visit observed issues concerning Further Seep, Duck Blind Drain, and NPDES discharge line.

H. June 16, 2003 – Tailings and Production Rock Site 2002 – 2nd Annual Report submitted by the company

1) Includes Fresh Water Monitoring Plan Annual Report Water Year 2002

Note: This document is too large to put in file drawer – it is filed in the storage tray in the second file drawer.

I. August 5, 2003 - Dave Chambers CSP2 to ADEC Emswiler, Comments On the Greens Creek Tailings and Production Rock Site 2002 Annual Report,

J. August 12, 2003 – Dave Chambers (CSP2) to Jeff DeFreest (USFS), Issues of Concern For Ongoing Operations at Greens Creek Mine from Meeting With USFS On April 22, 2003.

1) Compiled by Dave Chambers and Amy Crook

K. August 2003 - Inactive Production Rock Sites and Quarries – 2002 Annual Report by

Pete Condon

L. August 20, 2003 – Public meeting held at ADEC, attendee list inside of annual report

M. August 21, 2003 – Dave Chambers CSP2 to ADEC Pete McGee, Concerns over proposed changes to Production Rock placement regime.

"While the changes that Pete Condon proposed may make sense, and may in fact be necessary if the amount of non-PAG waste is significantly less than had been assumed, it would none the less make the overall design of the Site 23 cover less conservative than it now is.

N. August 21, 2003 – Site visit to observe underground, mill, production rock, and tailings sites

1) Report issued on November 5, 2003

O. September 24, 2003 – Klohn-Crippen Submits to KGCMC "Existing Tailings Facility – Stability Assessment of South Slope"

Cover letter to ADEC dated October 23, 2003

P. September 26, 2003 – Klohn-Crippen Submits to KGCMC "Production Rock Site "E" Engineering Assessment"

Cover letter to ADEC dated October 23, 2003

Note: This document is too large for this folder – it follows this folder

Q. November 5, 2003 – ADEC to KGCMC – Assessment of Sites Not Related To Mine Tailings and 23/D Production Rock Covered Under Waste Management Permit #0111-BA001

The Department does not believe the waste management permit coverage should be expanded beyond that currently covered, the tailings site and site 23/D. The other inactive sites are not causing an environmental problem of sufficient magnitude towarrant a permit at this time. The Department believes other means are available to ensure continued compliance.

20. Hanging File Folder – Greens Creek, Permit #0111-BA001, June 16, 2003 – 2nd Annual Report

A. June 16, 2003 – Tailings and Production Rock Site 2002 2nd Annual Report submitted by KGCMC

1) Includes "Freshwater Monitoring Plan, Annual Report – Water Year 2002 (October 1, 2001 through September 30, 2002)

Note: This document is too large to put in file drawer – it is filed in the storage tray in the second file drawer

2) Includes Aquatic Biomonitoring at Greens Creek, By ADF&G, Technical Report No. 03-04.

B. April 2003, ADF&G document entitled "Aquatic Biomonitoring at Greens Creek Mine, for the annual report

C. August 20, 2003, Public meeting held at ADEC, attendee list inside of annual report

Site visit on August 21, 2003 arranged for those who wish to see the mine

D. August 2003 – Inactive Production Rock Sites and Quarries 2002 Annual Report

21. Hanging File Folder – Greens Creek, Permit Process, Permit #0211-BA001 and Post Permit Process Adjudicatory Request

A. Permit Process - Folder

1) November 3, 2001 – Robertson, Monagle & Eastaugh to Stan Foo (ADNR), MOU For Phase II NEPA/EIS Process

a. Sets the terms of cooperation between KGCMC and all participating agencies

2) February 12, 2003 – KGCMC to ADEC – Solid Waste Permit Application – Revised Reclamation Bonding For Stage 2 Tailings

a. Key issues/timing of major development components
b. Key issues of major reclamation bonding components
c. Total expected adjustment for current tailings expansion planning

3) March 3, 2003 – ADEC Ernesta Ballard to DOL Cameron Leonard, Earthjustice Adjudicatory Hearing Request for Waste Disposal Permit #0111-BA001

"Please provide me a brief explaination of the circumstances and authority that would cause the Division to change the permit before it expires."

4) March 13, 2003 - Cam Leonard to ADEC Commissioner Ballard "ADEC's Response to Commissioner's 3/3/03 Inquiry"

Based on the facts and law summarized above, ADEC permitting staff plan to authorize KGCMC's proposed tailings facility expansion through a new permit.

5) April 23, 2003 – Joint USDA Forest Service and ADEC Public Notice

a. Announcing Public Meeting at Centennial Hall on May 21st from 7:00 to 9:00pm

b. ADNR is coordinating the State review of the projec

c. *Deadline for comment for state permit is 5:00pm on June 9, 2003*

d. *Published in the Juneau Empire on 4/25/03 and 4/27/03*

e. *Published in the State of Alaska Online Public Notice Website*

f. *Published at the Alaska DGC and ADEC/SW website*

g. *Email from Brad Campbell to various people announcing the public comment period.*

6) April 28, 2003 – Memo Pete McGee (ADEC) to various state Commissioners and heads of programs, and USFS announcing the draft permit and asked for comments.

7) May 8, 2003 – Shoren Brown (SEACC) published article in My Turn, Juneau Empire and SEACC website

8) May 21, 2003 – Public Meeting at Centennial Hall

a. *30 people attended meeting – attendee list included*

b. *No one chose to record oral comments*

c. *One written comment that complimented the meeting format and the greater exposure to the experts*

9) June 2003 – CSP2 Sarah Zuzulock, MS website, "Greens Creek Mine Financial Assurance Review"

10) June 9, 2003 – Notice of Time Extension for Comments on Greens Creek Tailings Disposal Draft EIS and ADEC Draft Waste Management Permit

Contact list attached to notice

11) May 8 through June 30 - Comments Received

A. US Department of the Interior, Terence N. Martin, P.E., dated May 8, 2003
B. Joyce Levine, private citizen, dated June 29, 2003
C. CSP2, David Chambers and Amy Crook, dated June 30, 2003
D. SEACC, Kat Hall, dated June 30, 2003

Additional comments for USFS
A. EPA to USFS, Judith Leckrone Lee, Circa June 2003
B. CSP2, David Chambers to USFS, dated August 12, 2003
C. July 18, 2003 – SEACC Kat Hall to Joe Donohue (OPMP)

12) September 16, 2003 – ADNR Steve McGroarty to ADNR Stan Foo – Kennecott Greens Creek Closure Bond Review – DRAFT – Issues for Discussion

13) October 16, 2003 – ADNR Stan Foo & USFS Pete Griffin to KGCMC Bill Oelklaus, Greens Creek Revised Financial Assurance

14) October 24, 2003 – KGCMC Bill Oelklaus to ADNR Stan Foo & USFS Pete Griffin, Greens Creek Revised Financial Assurance

15) October 31, 2003 – OPMP Joe Donohue to KGCMC Bill Oelklaus, Proposed Consistency Determination – Concurrence

16) October 31, 2003 – USFS issues Record of Decision (ROD), See Final Environmental Impact Statement

    Note: This document is too large to put in file drawer – it is filed in the storage tray in the second file drawer.

17) November 7, 2003 – ADEC Issues Waste Management Permit #0211-BA001 with Response to Comments

    a. *Permit #0211-BA001*

    b. *Response to Comments*

18) November 14, 2003 – USFS Publishes Final Environmental Impact Statement In The Federal Register

    a. *Appendix E – Response to Comments is incorporated into the file folder*

    b. *Final Environmental Impact Statement Volume I and Volume II are too large to put in file drawer – it is filed in the storage tray in the second file drawer.*

19) March 19, 2004 – Dave Bruce (Rio Tinto Inc) to Ken Done (USFS), Document acknowledging the receipt of securities deposited with the Federal Reserve Bank on the behalf of KGCMC in the amount of $7,950,000. Reclamation performance bond.

B. Post Permit Issuance Adjudicatory Request – Folder

1) December 29, 2003 – Buck Lindekugel (SEACC) to Denny Bschor (USFS), Appeal of Greens Creek Tailings Disposal ROD and FEIS

   27 page appeal with 21 exhibits

2) January 12, 2004 – Ed Emswiler and Kenwyn George (ADEC) to Cherie Shelley (USFS) Appeal Reviewing Officer, Comment on Appeal – SEACC #04-10-00-0005 A215.

   4 page comment letter with attached November 5, 2003 letter from ADEC to KGCMC assessment of sites not related to mine tailings and 23/D production rock covered under waste management permit #0111-BA001

3) February 4, 2004 – Steven Brink (USFS) to Buck Lindekugel (SEACC), Decision to

deny request to appeal EIS and ROD.

22. Hanging File Folder – Greens Creek, Permit #0211-BA001

- FOLDER #1

A. December 12, 2003 – Bill Oelklaus (KGCMC) to Ed Emswiler (ADEC), request for extension of deadline to produce Site 23/D hydrological/geological report.

B. December 16, 2003 – Pete McGee (ADEC) to Bill Oelklaus (KGCMC), approval of request to extend deadline to produce Site 23/D hydrological/geological report

C. December 24, 2003 – Stan Foo (ADNR) and Pete Griffin (USFS) to Bill Oelklaus (KGCMC), Greens Creek Revised Financial Assurance

   The agencies have accepted the revised financial assurance estimate in the amount of $26,238,518

D. March 2, 2004 – Dave Chambers (CSP2) to Jeff DeFreest (USFS), Issues of Concern for Ongoing Operations At the Greens Creek Mine Based On Meeting Of April 22, 2003.

   "We met in your offices and a number of concerns were raised. As promised we sent you a list of the detailed technical issues on August 12, 2003, to more clearly define and document our concerns, and to ask again how you were addressing these issues." Since the April 2003 meeting we have had no response to the issues raised during that meeting, or to our letter of August 2003.

   a. *Included: August 12, 2003 – Dave Chambers (CSP2) to Jeff DeFreest (USFS), Issues of Concern For Ongoing Operations at Greens Creek Mine from Meeting With USFS On April 22, 2003.*

E. March 19, 2004 – Bill Oelklaus (KGCMC) to Jeff DeFreest (USFS) and Ed Emswiler (ADEC), Site 23/D Hydrology and Geochemistry Analysis, by EDE Consultants

   Note: This document is too large for this folder – it follows this folder

F. April 2, 2004 – Klohn Crippen to Tom Zimmer (KGCMC), Submission of KGCMC Stage 2 Tailings Facility Expansion Design Overview For Forest Service Submission. April 4, 2004 Cover Letter by Bill Oelklaus (KGCMC) to Jeff DeFreest (USFS) and Ed Emswiler (ADEC).

   Note: This document is too large for this folder – it follows this folder

G. April 23, 2004 – Pete McGee (ADEC) to Bill Oelklaus (KGCMC) and Jeff DeFreest (USFS), ADEC comments on the Stage 2 Tailings Facility Expansion Design Overview.

H. April 23, 2004 – Revision to Appendix 3 of the GPO, Tailings Impoundment

1) April 2, 2004, Original letter requesting approval of this revision by Bill Oelklaus (KGCMC) to Jeff DeFreest (USFS) and Ed Emswiler (ADEC).

Note: This document is too large for this folder – it follows this folder

I. May 7, 2004 – Pete McGee (ADEC) and Susan Marthaller (USFS) to Bill Oelklaus (KGCMC), Approval of changes in FWMP, Appendix 1 of GPO to discontinue sampling at Site 34, Remove Site 13 from April sample schedule, and suspend Microtox testing.

1) March 5th, 2004 request from Bill Oelklaus (KGCMC) to Jeff DeFreest (USFS) and Ed Emswiler (ADEC).

2) March 2, 2004 letter from Robert McLean (ADNR/OHMP) to Bill Oelklaus (KGCMC), on Mine Biomonitoring Program Update & Proposed Testing Changes.

3) Supporting material from the Water Year 2002 FWMP Annual Report requesting the changes to the Sites.

J. May 13, 2004 – Pete McGee (ADEC) and Susan Marthaller (USFS) to Bill Oelklaus (KGCMC), Site 23 Production Rock Placement Modifications Under Waste Management Permit #0211-BA001 and GPO, Appendix 11

1) Includes relevant portion of a Technical Review ARD/Metals Leaching and Freshwater Monitoring Plan for Greens Creek Mine by Shepherd Miller, Inc., dated February 200.

K. June 2004 – 2003 Acquatic Biomonitoring Annual Report

See Folder that follows that has all of the 2003 Annual Reports

L. June 18, 2004 – Pete McGee (ADEC) to Bill Oelklaus (KGCMC), Assessment of 2nd Annual Report Under Waste Management Permit 0111-BA001

M. June 28, 2004 – Ed Emswiler and Kenwyn George (ADEC) to LMPT Working Group, USFS Mining and Mineralogy and KGCMC, Kennecott Greens Creek Site Visit, May 26, 2004.

N. July 27, 2004 – Ed Emswiler (ADEC) to David Chambers (CSP2), Greens Creek Mine Information Request

Letter to give information to CSP2 and SEACC on transmittals and reports generated since approximately April 2003. Packet of information was approximately 3.5” thick. Included was a CD of various reports generated by the USFS and the mine since then.

O. October 26, 2004 – Ed Emswiler (ADEC) to Bill Oelklaus (KGCMC), Greens Creek Mine Geotechnical Concerns – Tailings Disposal Facility Under Waste Management Permit #0211-BA001

1) Includes October 25, 2004 - Greens Creek Mine Tailings Pile Stability Review by Charlie Cobb, State Dam Safety Engineer

2) Includes April 23, 2004 – Pete McGee (ADEC) to Bill Oelklaus (KGCMC) and Jeff DeFreest (USFS), ADEC comments on the Stage 2 Tailings Facility Expansion Design Overview.

P. November 23, 2004 – Kennecott Greens Creek Site Visit by Kenwyn George

Q. December 22, 2004 – KGCMC - Year 2003 Tailings and Production Rock Annual Report

See Folder that follows that has all of the 2003 Annual Reports

R. January 7, 2005 – Engineering Assessment of Production Rock Sites 23 and D – Klohn Crippen

See binder that follows: Note: Too large to fit into this folder

S. February 4, 2005 – Stage 2 Tailings Facility Expansion 2005 Work Summary – Klohn Crippen

Incorporates maps and a schedule for the 2005 work season:

A. Work Completed in 2004 included:

- Southeast Expansion (Area 1)
- Pond No. 7 – excavation started to provide rockfill
- New Truck Wash Facility; and,
- B-Road realignment adjacent to the new Truck Wash

B. Work to be Completed in 2005 Includes:

- Pond 7 completion
- Southeast Expansion (Area 2)

T. March 2005 – Stage 2 Expansion of Tailings Facility Contract P05001 – CWI Civil Works Drawings

U. April 8, 2005 – Year 2003 Inactive Rock Sites and Quarries Annual Report

See Folder that follows that has all of the 2003 Annual Reports

V. April 18, 2005 – Site Visit Report of April 14, 2005 by Kenwyn George and Ed Emswiler

Purpose of the visity was to introduce Patty McGrath USEPA to the Greens Creek facility. Attendees included: Patty McGrath, Pete McGee, Kenwyn George, Steve Hohensee, and Bill Oelklaus

W. April 18, 2005 – Pond D Hydrology Report – EDE Consultants

Report presents the criteria used in determining the inflow design flood at the proposed Pond 7, and provides a compilation of the hydrologic design data for the Pond 7 construction.

Binder too big for this folder. See folder that follows.

X. May 16, 2005 – Evaluation of Co-Disposal of Production Rock and Filter-Pressed Tailings, by Klohn Crippen.

In Separate Folder – Hard Copy Only

Placed a copy of the Summary of Codisposal Trial dated June 28, 2006 by Klohn Crippen in with this report as they are both related to the mixing of Site E waste rock in with tailings.

Y. May 20, 2005 – Final NPDES Permit No: AK-004320-6

Includes;

1. Cover letter from Michael Gearheard EPA to Rich Heigh KGCMC
2. NPDES Permit
3. Response to Comments
4. ADEC 401 Certification

Z. May 26, 2005 – Year 2003 – Freshwater Monitoring Program Annual Report

See Folder that follows that has all of the 2003 Annual Reports – Note: this file is approximately 550 pages, therefore it is on disk.

AA. July 6, 2005 – Contract for applying flat fees to work done by the Department.

Note: Flat fees will replace a previous RSA for work accomplished

BB. July 21, 2005 – Site Visit Report for field visit on June 27, 2005 by Charlie Cobb and Ed Emswiler

Attendees: Charlie Cobb ADNR, Ed Emswiler ADEC, and Eric Sundberg KGCMC. Purpose of visit was to discuss geotechnical stability of the tailings disposal facility and to visit various disposal sites and impoundment structures.

CC. August 5, 2005 – Stage 2 Tailings Facility Expansion Stability Update by Klohn Crippen

Letter provides an update to the stability analyses done for the Design overview for Forest Service Submission by KC in 2004

DD. August 9, 2005 - Ed Emswiler (ADEC) to David Chambers (CSP2), Greens Creek Mine Information Request

Letter to give information to CSP2 on transmittals and reports generated since July 27, 2004. Packet of information was approximately 1" thick.

- FOLDER #2 – 2003 ANNUAL REPORTS FOLDER

A. 2003 Aquatic Biomonitoring at Greens Creek Mine Annual Report
B. 2003 Freshwater Monitoring Program Annual Report – **On Bookshelf**
C. Year 2003 Inactive Rock Sites and Quarries Annual Report
D. Year 2003 Tailings and Production Rock Site Annual Report

- FOLDER #3 - OTHER REPORTS FOLDER

A. March 2004 - Site 23/D Hydrology and Geochemistry Analysis, by EDE Consultants

B. April 2, 2004 - Stage 2 Tailings Facility Expansion Design Overview For Forest Service Submission.

C. April 2, 2004 - Revision to Appendix 3 of the GPO, Tailings Impoundment

D. January 7, 2005 - Engineering Assessment of Production Rock Sites 23 and D – Klohn Crippen

E. April 18, 2005 – Pond D Hydrology Report – EDE Consultants

F. May 16, 2005 – Evaluation of Co-Disposal of Production Rock and Filter-Pressed Tailings, by Klohn Crippen.

23. Hanging File Folder – Greens Creek, Permit #0211-BA001

FOLDER #1

A. May 2005 – Aquatic Biomonitoring at Greens Creek Mine, 2004 report

See Folder that follows that has all of the 2004 Annual Reports. Also available electronically.

B. August 10, 2005 – Year 2004 Annual Reports

See Folder that follows that has all of the 2004 Annual Reports. Also available electronically.

These reports include:

1. Tailings and Production Rock Site 2004 Annual Report
2. Inactive Production Rock Sites and Quarries 2004 Annual Report
3. Freshwater Monitoring Program Annual Report – Water Year 2004 – **On Bookshelf**

C. August 24, 2005 – Annual Meeting

Sign-in sheet from the Annual Meeting

D. November 30, 2005 – Field Inspection Report for Greens Creek Mine – Report date, January 3, 2006 by Ed Emswiler and Charles Cobb..

Inspection performed 3 days after a rather large precipitation event between November 16-23, 2005. Bill Oelklaus, Tom Zimmer, Eric Sundberg and Steve Hohensee.

E. December 15, 2005 – KGCMC Internal Tailings Pile Rock Use Request, by KGCMC

Because of a shortage of competent rock for use as internal travel ways within the tailings pile, KGCMC wants to use Class 4 siliceous rock from inside the mine for this purpose.

F. January 11, 2006 – Fax from KGCMC of August 1996 version of Appendix 3, Section 5.0 Regarding Development Rock Characteristics

G. February 1, 2006 – ADEC Letter to KGCMC, Use of Class 4 Rock as Road Material at KGCMC Tailings Facility

Request for a detailed approvable plan to be submitted before Class 4 rock can be used at the tailings facility

H. March 15, 2006 – KGCMC 2006 Construction Plan Submittal – Stage 2 Tailings Facility Expansion,

March 28, 2006 Letter from KGCMC announcing the Construction Plan

I. March 21, 2006 – KGCMC – Submittal of 3 Klohn-Crippen Reports

Reports include:

a. Greens Creek Mine Pond 7 Construction Summary Report, December 2005
b. Tailings Disposal Facility 2004-2005 Southeast Tailings Expansion Construction Summary, February 2006
c. Stage 2 Tailings Expansion Overall Stability Update, March 2006

Note: This document is too large for this folder – it is located on the bookshelf
CD – Available in the 2004-2005 Southeast Tailings Expansion Construction Summary

J. May 10, 2006 – KGCMC Water Year 2005 Freshwater Monitoring Plan and 2005 Aquatic Biomonitoring Reports

See Folder that follows that has all of the 2005 Annual Reports. Also available electronically.

K. May 16, 2006 – KGCMC Site Visit by Kenwyn George

L. June 1, 2006 – Post Construction Submittals for Pond 7 Dam (AK00307) from ADNR, Dam Safety by Charles Cobb

Based on a review of your submittals, Dam Safety has several concerns that require additional attention as described in detail in Attachment A to this letter.

June 19, 2006 – Technical Review Comments on Post Construction Submittals for Pond 7 Dam by Northwest Linings & Geotextile Products Inc.

September 12, 2006 – Momorandum Eric Sundberg, P.E., KGCMC to Charles Cobb, P.E. ADNR. Gives response to Cobbs June 1, concerns over operation and maintenance and the June 19, 2006 letter by Northwest Linings above.

M. June 2006 – KGCMC 2005 Tailing and Production Site and 2005 Inactive Production Rock Sites and Quarries Annual Reports

See Folder that follows that has all of the 2005 Annual Reports. Also available electronically.

- FOLDER #2 – 2004 ANNUAL REPORTS FOLDER

A. 2004 Aquatic Biomonitoring at Greens Creek Mine Annual Report
B. 2004 Freshwater Monitoring Program Annual Report – **On Bookshelf**
C. Year 2004 Inactive Rock Sites and Quarries Annual Report
D. Year 2004 Tailings and Production Rock Site Annual Report

- FOLDER #3 – KGCMC 2006 Construction Plan Submittal – Stage 2 Tailings Facility Expansion

- FOLDER #4 – 2005 ANNUAL REPORTS FOLDER

A. 2005 Aquatic Biomonitoring at Greens Creek Mine Annual Report
B. 2005 Freshwater Monitoring Program Annual Report – **On Bookshelf**
C. Year 2005 Inactive Rock Sites and Quarries Annual Report
D. Year 2005 Tailings and Production Rock Site Annual Report
E. Sign in Sheet for Presentation on July 11, 2006

- ON BOOKSHELF

A. Greens Creek Mine Pond 7 Construction Summary Report, December 2005
B. Greens Creek Mine Pond 7 Construction Summary Report, December 2005
C. Stage 2 Tailings Expansion Overall Stability Update, March 2006

N. June 27, 2006 – ADEC to David Chambers (CSP2), Greens Creek Mine Information Request

Letter to give information to CSP2 on transmittals and reports generated since August 9, 2004.

O. June 28, 2006 – Summary of Codisposal Trial

On June 28, 2006 KGCMC completed a mixing trial for codisposal of "new" tailings and Site E waste rock. The trial was observed by Rick Friedel of Klohn Crippen Berger.

Placed a copy in with the May 16, 2005 Evaluation of Co-Disposal of Production Rock and Filter-Pressed Tailings

P. July 28, 2006 – Jurisdictional Review Pond/Dam A

Letter to ADNR Dam Safety – KGCMC Pond/Dam A does not meet the statutory requirements of a dam.

Q. August 25, 2006 – Pond/Dam 7 Construction Report Signature Pages

Attached please find 3 original-signed pages for the Pond/Dam 7 Construction Report

R. October 19, 2006 – Assessment of the 2005 annual report and presentation under Waste Management Permit #0211-BA001

Letter from ADEC to KGCMC

S. October 26, 2006 – Geotechnical Engineering Status Report, Greens Creek Mine Tailings Storage Facility, Charles Cobb

A summary of the responses of KGCMC to geotechnical concerns raised in a memorandum dated October 25, 2004.

T. October 20, 2006 – KGCMC to ADEC, 2006 SRMP Update

April 4, 2006 – Investigations into Tailings Pore-Water Remediation at the Greens Creek Mine, Alaska, USA, 2005 Progress Report – CONFIDENTIAL with September 2006 SRMP Update sent on October 20, 2006 from KGCMC with email request for agency review and comment

December 27, 2006 – EPA Comments to the April 4, 2006 report

U. January 19, 2007 – USFS to KGCMC – Reclamation Plan Cost Estimate Update

V. February 25, 2007 – KGCMC Response to Joint-Agency Bond Review Letter dated January 19, 2007

W. March 8, 2007 – Stage 2 Tailings Facility Expansion – Construction Plan Update for 2007, by KGCMC

FOLDER #5 – 2007 TAILINGS CONSTRUCTION PLAN UPDATE BY KLOHN CRIPPEN BERGER

February 12, 2007 Stage 2 Tailings Pile Expansion Northwest/Pit 5 and Northeast Expansion Area Design Overview.by Klohn Crippen Berger

Stage 2 Tailings Expansion 2007 Construction Drawings and Technical Sections (See Bookshelf For Full Size Drawings), dated February 9, 2007

June 6, 2007 – Klohn Crippen Berger report – Response to Issues Raised in ADNR Memo dated May 1, 2007 Regarding 2007 Construction at Greens Creek Mine

X. May 3, 2007 – Assessment of Stage 2 Tailings Facility Expansion-Construction Plan Update for 2007, by ADEC

Attached May 1, 2007 memo by Charles Cobb, ADNR Dam Safety – State II Expansion at Greens Creek Tailings Storage Facility, outlines items of concern needing to be addressed having to do with stability of the northwest expansion of the site.

Y. May 3, 2007 – Construction Plan Update for 2007 Supplement: Detail Design Layout of Pond 7 Water Treatment Plant. Included 3 drawings.

Z. May 23, 2007 – USDA Forest Service to ADEC – Executed copy of the Memorandum of Understanding (MOU)

AA. June 7, 2007 – 2006 Annual Reports

- FOLDER #6 – 2006 ANNUAL REPORTS FOLDER

A. 2006 Aquatic Biomonitoring at Greens Creek Mine Annual Report
B. 2006 Freshwater Monitoring Program Annual Report – **On Bookshelf**
C. Year 2006 Inactive Rock Sites and Quarries Annual Report
D. Year 2006 Tailings and Production Rock Site Annual Report
E. Sign in Sheet for Presentation on June 7, 2007

BB. June 6, 2007 – Klohn Crippen Berger report – Response to Issues Raised in ADNR Memo dated May 1, 2007 Regarding 2007 Construction at Greens Creek Mine.

CC. June 19, 2007 – ADEC to KGCMC – Construction Plan Update for 2007 Supplemental. Detail design layout of Pond 7 Water Treatment Plant.

Letter of non-objection to position a new water treatment plant at Pond 7. Letter required compliance with 18 AAC 60.225(B)(2) at Pond 7. It also mentioned to be aware of volume limitations imposed by their NPDES permit in planning.

Attached May 3, 2007 cover letter - Construction Plan Update for 2007 Supplement: Detail Design Layout of Pond 7 Water Treatment Plant

DD. June 22, 2007 – KGCMC letter to ADEC introducing the attached responses addressing issues raised in May 3, 2007 ADEC letter and May 1, 2007, October 26, 2006 ADNR Dam Safety InterOffice Memos concerning geotechnical stability and other issues regarding the Stage 2 Tailings Facility Expansion-Construction Plan Update for 2007.

Attached is the Klohn Crippen Berger Report, dated June 6, 2007 entitled "Response to Issues Raised in Alaska Department of Natural Resources (ADNR) Memo dated May 1, 2007 Regarding 2007 Construction at Greens Creek mine

Also attached is the June 21, 2007 Klohn Crippen Berger Report, entitled "Response to Issues Raised by Alaska Department of Natural Resources (ADNR) During a June 13, 2007 Conference Call".

EE. June 26, 2007 – ADNR Dam Safety – InterOffice Memo by C. Cobb to Ed Emswiler saying all concerns from InterOffice Memos dated October 26, 2006 and May 1, 2007 have been addressed.

FF. June 27, 2007 – ADEC to David Chambers (CSP2), Greens Creek Mine Information Request

Letter to give information to CSP2 on transmittals and reports generated since July 27, 2004.

GG. July 6, 2007 - KGCMC letter to ADEC requesting waiver to 18 AAC 60.410(a) based on Klohn Crippen Berger report addressing issues raised in May 3, 2007 ADEC letter and May 1, 2007, October 26, 2006 ADNR Dam Safety InterOffice Memos concerning geotechnical stability and other issues regarding the Stage 2 Tailings Facility Expansion-Construction Plan Update for 2007.

HH. July, 20, 2007 – ADEC to Eric Sundberg, KGCMC, Approval of Waiver to 18 AAC 60.410(a) and resolution of issues related to May 3, 2007 ADEC letter regarding Stage 2 Tailings Facility Expansion-Construction Plan Update for 2007.

II. August 7, 2007 – USDA Forest Service to KGCMC, Approving the increase of the reclamation bond amount from $26,238,518 to $29, 003,889. A suggested increase to

$32,000,000 will be dealt with at the time of the facility audit and renewal of the permit.

JJ. September 11, 2007 – KGCMC to USFS and ADEC, Submission of 2 enclosed reports.

1. Stage 2 Tailings Expansion Hydrologic Analysis Update from EDE (submitted in electronic and paper formats) an update to these author's 2002 Stage II Tailings Expansion Hydrologic Analysis Report. IN SEPARATE FOLDER (Too large for this folder)

2. The "Ground Response Analysis" from Klohn Crippen Berger, this report presents an update to a 1988 Seismic Hazard Assessment conducted by Klohn Crippen.

KK. November 20, 2007 – ADEC to KGCMC, Review of Stage 2 Tailings Facility Northwest/Pit 5 Expansion – geomembrane liner system installation construction quality assurance program results.

Letter denying approval of tailings placement as requested by KGCMC based on unsigned documents that were submitted and other concerns regarding a report submitted by Klohn Crippen Berger dated November 15, 2007.

Attached is the November 15, 2007 letter by Klohn Crippen Berger
Attached is the Final Report of Field Construction Quality Assurance Services by URS Corp.

LL. November 15, 2007 – KGCMC Tailings Storage Facility, Northwest/Pit 5 Expansion – Geomembrane Liner System Installation

"Based on observations made by KCBL the work was completed in a manner consistent with the intent of the design and the lined area is ready to receive tailings.

This letter had with it the following accompanying document:

1. Final Report – Field Construction Quality Assurance Services, KGCMC Stage 2 Tailings Expansion, by URS Corporation, dated November 2007

FOLDER #7 – FOR FINAL URS CQA REPORT

MM. October 26, 2006 (submitted to ADEC November 2007) – Hydrological Performance of Cover Systems at the Greens Creek Mine: A Combined Field-Modeling Analysis, A Proposal to KGCMC, by Oregon State University

The proposal regards the requirement in Section 2.4.8 of KGCMC WMP to submit information on Tree Blow-Down on the final cover. This proposal only includes the rooting depth of plant species relevant to the proposed Saturated Cover for isolation of sulfide waste materials for site closure at KGCMC.

NN. November 2007 – KGCMC Performance Monitoring Program for the Production Rock Site 23 Cover System, Monitoring Report for Years 5 & 6 (January 2005 – December 2006), by O'Kane Consultants Inc.

Results of cover system performance monitoring

OO. December 20, 2007 – KGCMC Klohn Crippen Berger, Periodic Safety Inspection – Containment Pond 7, National Inventory of Dams ID No. Ak00307 – Dam Safety Review

SEE FOLDER THAT FOLLOWS – Hard Copy Submitted Only

PP. December 20, 2007 – KGCMC Sulfate Reduction Monitoring Plan, 2007 Update

Includes the following (**Electronic Submission Only** 200+ pages – please see electronic files)

1. 2006 SRMP Progress Report, Investigations into Tailings Pore-Water Remediation at the Greens Creek Mine, Alaska, USA, dated November 19, 2007, prepared by Department of Earth and Environmental Sciences, University of Waterloo, Waterloo, Ontario, Canada
2. 2006 SRMP Progress Report, Appendices

QQ. December 28, 2007 – Field Inspection Report Greens Creek Mine, Inspection done on October 11, 2007

RR. January 10, 2008 – ADEC to KGCMC – Review of Stage 2 Tailings Storage Facility Northwest/Pit 5 Expansion – Geomembrane Liner System Installation – Field Construction Quality Assurance Services Final Report, dated November 2007

"This updated URS report addresses previous ADEC concerns and is sufficient to allow tailings placement to proceed"

Other Reports and Studies – Incorporated into the File

1. Noranda Greens Creek Project, Tailings Reservoir Groundwater Hydrology – Ott Water Engineers (Draft) – November 1981

2. Evaluation of the Acid Production Potentials and Heavy Metals Bioleaching Characteristics of Greens Creek Tailings Samples – by Division of Extractive Metallurgy, B.C. Research – February 1982

3. Column Leach Testing on Greens Creek Tailings – Division of Extractive Metallurgy – March 1985

4. Environmental Assessment for Proposed Changes to the General Plan of Operations for the Development and Operation of the Greens Creek Mine – USFS Interdisciplinary Team – March 1988

5. Potential for Acid Mine Drainage from Greens Creek Mine – R.J. Vos, Vancouver B.C. – June 1990

6. Review of Acid Generation Potential Testing of Greens Creek Tailings – B.C. Research Corporation – June 18, 1991

7. Kennecott Greens Creek Mining Company Report on Dry Tailings Water Discharge System, Report to EPA – KGCMC Author – October 11, 1991

8. Greens Creek Tailings Impoundment Characterization Study Operations Manual – James M. Montgomery – Circa 1991

9. Kennecott Greens Creek Mine Tailings Impoundment Characterization Study – Peter Condon – February 1995

10. Kennecott Greens Creek Mine Production Rock Site Characterization Study – Peter Condon – March 1995

11. Analysis of Fresh Water Quality Data In the Vicinity of the Greens Creek Mine, 1978 – 1994 – Rosemary S. Antel, Envirodata – March 27, 1995

12. Geotechnical Review and Analysis of the Greens Creek Tailings Pile – SRK (Steffen Robertson & kirsten) – February 1996

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Appendix D
Greens Creek Mine Surface Environmental Inspection

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GREENS CREEK MINE SURFACE ENVIRONMENTAL INSPECTION

Inspection of Surface Facilities

- Conducted on Monday May 4 and Thursday May 8, 2008

Inspection Conducted By

- Don Hovdebo (SRK)
- Kathleen Willman (SRK)
- William (Bill) Oelklaus (HGCMC)
- Photographic record of inspection retained by D, Hovdebo and Kathleen Willman.

Areas Requiring Immediate Action

(Areas requiring immediate action were identified to William Oelklaus. during inspection and were also identified during the May 10, 2009 site meeting held at ADEC office)

- Lined ditch immediately below equipment wash area at the mill – approximate 40 to 50% blockage of the ditch by gravel/sediments – the current condition significantly reduces the flows that the ditch could handle (Photo 23 and Photo 24).
    - **Recommendation – Remove blockage as soon as possible.**
- Area of construction for the temporary fresh water intake line (near the potable water treatment plant) – the area poses a high potential to impact the quality of Greens Creek due to the flushing of fines directly into the Creek upstream of the weir (Photo 25).
    - **Recommendation – The area should be stabilized as soon as possible to prevent the unnecessary deposition of silt into Greens Creek upstream of the intake weir.**
- Secondary containment on the transformer located behind the old water treatment plant at the TDF was found to be full of water eliminating the secondary containment capabilities of the facility (Photo 3) – should be addressed as soon as possible.
    - **Recommendation – Remove precipitation water from secondary containment as soon as possible.**
- Secondary containment for the tailings thickener (largest thickener closet to the tailings load-out area). As it is currently constructed, the newly install concrete containment would direct any unanticipated discharge from this thickener into the road area west of the thickener (Photo 26 and Photo 27). This is a risk area for a puncture of the thickener as indications on the side of the wall of the tank (small dents and scratches primarily) that it has been struck by equipment (presumably).
    - **Recommendation – Secondary containment of the tailings thickener in the vicinity of the tailing load out area should be improved as soon as possible to reduce the potential of discharge to the road area in the event of an unanticipated discharge from the tailings thickener.**

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Two 500 gal. diesel fuel tank behind mill ore storage area – one (FT51) for fueling equipment – one (FT10) supplying fuel to mill	FT10 does not have secondary containment on pipeline into the mill FT51 fueling area found well maintained with no evidence of spillage during refueling of equipment Good “crash barrier” protecting fuel tanks	Location of pipe at the bottom of the tank – risk that a breach would result in the entire tank being discharged to the environment.
Small lay-down area between the mill(flotation circuits) and the back slope	A steel retaining wall approximately 8 feet in length has been created by driving steel plates into the ground – the area in the vicinity has a small accumulation of steel debris (worn parts of the mill) no concerns were noted in the area	
Ore storage area	Area found wet but well maintained – steel from underground intermixed in the ore stockpile which is removed by magnet in the mill and returned to underground for disposal – Caution/ hazard tape near power pole with no clear indication of why or what it was for	
Fresh water interception and diversion above the mill	HDPE lined ditch well constructed and maintained Secondary freshwater diversion collection system above the main ditch constructed of short lengths lined with HDPE liner in areas of identifiable stream flow – these discharge to the interception and diversion ditch	
Lay down area by warehouse	Area found well maintained with transport containers used for storage of various materials. It was noted that some containers that appear to be permanent and used for storage on an ongoing basis had wooden floors and some had steel floors. – unloading of containers underway at the time of inspection as a barge had just delivered materials to site – generally individual chemicals segregated into different container with no evidence of mixing of different chemicals in the same container. – FT17 diesel tank supplying fuel to warehouse furnace by pumping off the top of the tank – no secondary containment of piping – could result in a limited volume discharge if breached Empty barrels laying on side not labeled	Warehouse personnel should ensure that liquid chemicals and other hazardous materials are always put in competent containers with steel floors as this type of container will provide an additional level of containment in the unlikely event of materials spilling within the container.

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Mill (internal)	An inspection of the mill was conducted. High level alarms installed on some but not all tanks within the mill. Containment of mill floors was found to be good to excellent with floor/wall sealant well maintained and pliable and only a small number of light cracks in the concrete floors. A number of holes were found near the base of some walls of the mill, however, in all instances the small in- flows observed were from the outside into the mill. William Oelklaus indicated that these were to allow flow from drains located around the perimeter of the mill to discharge into the mill. All doors to the outside that were inspected had sufficient slope to limit discharge of materials out of the mill. All tanks within the facility had secondary containment or were located on floors that were sloped to a sump. All sumps inspected contained functioning pumps although it was not possible to inspect the condition of sump concrete as fluid was found in all.	Regular inspection of mill floors and floor/wall sealant should be conducted by mill personnel on a regular basis (at least once per year) in order to insure that materials are not exiting the mill floor or floor/wall joints. This inspection should include all sumps and include draining the sumps for to ensure a detailed inspection can be completed.
Fire Control Station -076	Maintenance and inspection tags on fire extinguishers were not up to date however 3 extinguishers inspected were fully charged (similar at other location)	Maintain inspections and inspection tag records on extinguishers
Freshwater flow above warehouse area	Discoloration of the water noted during inspection (Cub Creek) however the water was flowing from an area well above upstream of any site activities therefore the flow was not coming from the site. William Oelklaus stated natural flow with no exploration drilling or other mine related activities taking place now or historically in the area upstream of the flow.	If no sample previously, it is recommended that a sample be collected for future reference - include field pH
Warehouse	Storage of chemicals in appropriate containers which included MSDS sheets. Fire proof container used for storage of flammable materials – 082.	
Culvert near potable water treatment	A number of culverts were noted to be silted up near the inflow side – this has the potential restricting the flow volume within the culvert and backup water behind the culvert.	Regular inspection and maintenance of culverts throughput the site to ensure no blockage and free flow of design volumes can take place.

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Greens Creek Bridge near adit	Aluminum cladding on bridge appeared to be effective in minimizing material transfer to creek bank or creek proper Detailed inspection under the bridge showed a small amount of fines near the bank/bridge juncture. Placement of bales and “silt fence” on one side of the bridge to mitigate fines transport to the creek appears to work well - no evidence of materials being washed into the creek on either side of the bridge. Piping transporting glycol, water etc, across the bridge does pose some level of risk if pipes were to break - relocation of the piping with improved secondary containment is being proposed. Small amount of dust on remaining snow below the gravel pile near the adit – likely residual from stockpiling the gravel – no immediate concern based on the light dusting observed.	Relocation of piping with improved secondary containment should be initiated as soon as possible and per plan
Temporary freshwater intake	In anticipation of conducting maintenance on the freshwater intake grate, an area between the potable water treatment facility and Greens Creek has been cleared and work begun on the construction of a temporary water line. The area, in its current condition (disturbed with vegetation removed), presents the potential of a significant increase in the sediment load to Greens Creek in the event of a sustained or heavy rainfall event (Photo 25).	Immediate action should be taken to stabilize the area in order to prevent an increase in the sediment load to Greens Creek from the area disturbed by in order to install the temporary freshwater intake line
Fresh water intake	Area was inspected and the area was found well maintained no concern were noted	
A Pond & DB-01 Settling pond	The A pond liner was inspected and no concerns were noted. The pond had a minimal amount of solids and adequate freeboard was being maintained. Volume of the pond was not readily available from site personnel nor were site personnel able to give confident statement regard average flow into pond under normal operating conditions. Pond materials are slurried back into the mill circuit. Settling pond had recently been cleaned out with solids being transported to the ore storage area for inclusion in ore feed. Sufficient freeboard of approximately 2.5 m was being maintained at the time of the inspections	Enhanced understanding of site wide flows and containment capacities is required. Recommendation that a detailed and accurate site wide water balance be developed and updated on a regular basis. The site water balance must, at a minimum include: all flows,(measured contaminated and fresh water withdrawals, estimates of all leachate and contact water flows, pumping & piping capacity, individual pond capacities (with consideration for adequate freeboard) capacities and reconciliation of all volumes at least on an annual basis.

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Piping	HDPE lined containment ditch below the well was inspected and found to be partially blocked (40-50%) with fines a gravel which appeared to be from snow removal. This concern was immediately voiced to William Oelklaus. The blockage significantly reduced the volume of water that the ditch could handle and therefore the effectiveness. The HDPE lined ditch did show evidence of wear and in some instances (near the equipment parking area) evidence of tears in the liner directing water from the area to the ditch were noted. The tears were significant enough to reduce the effectiveness of the liner to prevent infiltration of potentially contaminated water into the liner ditch.	The HDPE lined ditch immediately between the mill and Greens Creek should be cleaned immediately, a detailed inspection of the entire ditch completed and repairs made as required as soon as possible.
Sewage Sludge Tanks	Area was found well maintained with a HDPE liner directing unanticipated discharge to an in-ground holding tank. The in-ground tank was also inspected and found to be approximately ¼ full with water being discharged into the tank. No clear explanation was provided as to the source of water or of where the water is pumped to. Further review of maps indicate flows of gray water were retained within the pipes.	Confirmation of source, volume and quality of water into these three tanks should be maintained by site personnel.
Spent Acid return line between mill and Creek	William Oelklaus indicated that the spent acid return line currently not in use as the line froze during the winter in spite of heat tracing. The line was constructed in such a way as to prevent visual inspection for leaks.	Consideration should be given to enhancing the visual inspection of the acid line.

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Tailings thickener area	Secondary containment by constructing sloping concrete pads has recently been built around the tailings and lead thickeners with overflow/ unanticipated discharges from the thickeners intended to flow to drains located at low points in the pads which in turn report into the mill at sites with appropriate sumps. The area between the tailings thickener and the tailings load-out facility appeared to be sloped away from the thickener and as a result would discharge to the roadway between the mill and the Creek (Photo 26 and Photo 27). This effective eliminates the value of the secondary containment in the area. This concern was immediately voiced to William Oelklaus. The thickener also showed evidence of contact with equipment (likely tailings load out equipment) as there were a number of relatively small scratches and dents on the outer wall of the tailings thickener	Secondary containment of the tailings thickener in the vicinity of the tailing load out area should be improved as soon as possible to reduce the potential of discharge to the road area in the event of an unanticipated discharge from the tailings thickener.
Zinc thickener	Area has secondary containment in the form of a graded sloping concrete that reports to a grated drain which itself reports inside the mill building. In reviewing the potential for a spill from the facility, an access plate approximately 2/3 up the side of the thickener was identified. In the event that the plate were to fail it could not be confirmed that the secondary containment would contain the discharged material.	Review containment capabilities outside the zinc thickener using the assumption that the inspection plate on the side of the thickener tank would fail entirely.
Concentrate Load-out	The area was found well maintained at the time of the inspection and no concerns were noted. From an OH&S perspective the audible alarm on one of the filter dump warnings was not functioning properly at the time of the inspections however the visual alarm was functioning – this was identified to the Mill Supervisor	Audible alarm should be repaired as soon as possible.
Concentrate Load-out Truck Wash	The area of the truck wash was also inspected and found to be in good order. Splash was retained within the building and containment and collection of the wash water appeared adequate. No trucks were in the facility at the time of the inspection. (a post-wash inspection of two trucks at the concentrate load out facility was conducted on May 08, 2008) see below	

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Tailings storage at mill	The area was inspected and found generally to be well maintained. Some tailings were evident on the top of the wall between the facility and the area used to load tailings for underground and the short wall connected to it. William Oelklaus indicated that the area was used to temporarily stockpile tailings (to allow the mill to continue running) when access to the Tailings Disposal Facility (TDF) is temporarily suspended. The tailings on the top of the wall could potentially fall or be washed outside of the area, were it can be tracked or washed to other areas of the site.	Efforts should be maintained to not allow stockpiled tailings to exceed the height of the containment walls with in the tailings load-out facility. In the event that tailings do pile on the top of the walls they should be removed as soon as possible in order reduce the potential of them falling outside of the facility area.
Tailings load-out at mill and site transport	The loading and transport route of tailings from the load-out facility to the TDF was inspected and the process fully discussed. It was noted during the inspection that no truck wash takes place after the loading of tailings. Although significant care is taken, the area immediately outside of the tailings load-out building clearly showed that tailings were located on the ground and that some tailings will be retained on the transport truck when it departs the area (particularly on the tires and wheel cowlings/mud flaps). During the inspection it was noted that this material is being tracked around the first corner (of the mill) after a truck departs from the tailings load-out facility.	The tailings load out facility should have a truck wash capability and all trucks should be washed before exiting the immediate area of the tailing load-out. Until such a facility is constructed, increased house keeping in required of the transport route to minimize the amount of tailings immediately in front of the load-out and limit the transfer of tailings to the tires etc. of the transport truck.
Bulk fuel storage area	The bulk fuel storage area was inspected as was the secondary containment (Photo 29). The secondary containment was adequate in size and was found in good condition with no significant cracks or holes in either the concrete floor or walls. The area was dry with only very small amounts of ponded precipitation water. The secondary containment in the transformer substation immediately beside the mill bulk fuel reports to the bulk fuel containment area and the pipe between the two appeared to be unrestricted. A concrete wall has been constructed between the transformer station and the bulk fuel storage area as a safety precaution.	

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Collection ditch behind mill and bulk storage	A HDPE lined collection ditch is located behind the mill and bulk fuel storage area to collect discharges from the collector pipes located under the mill back slope. The liner was inspected and found in reasonable condition although a general clean-up and maintenance of the ditch should be undertaken. No immediate concern was noted at the time of the inspection.	A general clean-up and maintenance of the collection ditch and ditch liner should be undertaken.
Maintenance Shop	The maintenance shop was inspected and found clean and well maintained. All floors in the shop are sloped away from the outside walls and any spilled material should report to a central sump which itself was found dry at the time of the inspection.	
Maintenance Shop Fueling Station	Truck fueling stations behind the mill was inspected and found well maintained with no evidence of recent spills or clean up of spills. Fueling nozzles at the mill fueling station were located within drip catch facilities which were connected directly to the used oil container. Secondary containment of the main mill fuel station contained all fuel storage tanks, used oil tank, used filter and other oils contaminated materials. Secondary containment was of sufficient size for material stored within the facility.	
Spill Response Stations	Spill response materials were located within easy access throughout the site, were consistent throughout the site, were well labeled (in general although some labeling is fading) and were found to contain sufficient quantities and types of response materials (absorbents, cloth and particulate, booms, etc.). In addition disposal bins for oil contaminated material such as absorbent pads etc. were located in the same area as the spill response materials.	
Production rock Area 23	A general inspection of the area was conducted during the site tour on May. The area appeared well maintained although wet from recent precipitation. No significant concerns were identified at the time.	

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Water Lines	Water lines (8” & 10”) Water flow in these lines is by gravity (i.e. there is no pumping) and the lines are buried (shallow 6”or more) along the length of road between the mill and the water treatment facility. As a result the water lines cannot be visually inspected for leaks. The lines only “daylight” when crossing low areas or small water flows (creeks or seeps). At various intervals, valves have been installed which in the past have been damaged during road maintenance and snow removal. As a result, a location pole has been installed at each to identify to equipment operators the location of the valves.	
Geology/Safety/Lab Buildings (Site C)	Area around building was inspected and found well maintained. Bulk fuel storage (i.e. 500 gallon double wall tanks) found at various locations were well maintained.	
Settling pond C	Area was visited during May 04 site tour and an explanation of current operations provided. No visible discharge or ponded water was observed in the pond at the time.	
Settling Pond 23 & DB-03	Area was inspected and found well maintained with adequate freeboard being maintained on pond 23. No concerns were identified at the time of the inspection. Volume of material in DB-03 could not be ascertained because of water levels in the area.	
Pump building area (Pond 23)	Area was inspected and no concerns identified at the time of the inspection.	
Settling pond D	Area was inspected and a discussion of its current operations provided on May 04, 2008.	

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Tailings Disposal Facility	A general inspection of the TDF was conducted which focused on the delivery of tailings to the facility, truck washing before exiting the facility and the general facility layout. Document reviewed (2007 Annual Report) on TM indicate that dusting of the area in the immediate vicinity of the tailings is evident particularly in the winter, however no evidence was observed of dusting during the inspection. During a return to the facility on May 08, a number of migratory waterfowl (Canada Geese, deer and two bears were observed on the slope of the tailings pile which had been hydro seeded. The birds were observed feeding on the spring grass shoots – does any data exist on the concentration of COPC in the vegetation present on the tailings? Further investigation may be warranted on the uptake of COPC by wildlife on the re-vegetated tailings. A number of small ungulates were also observed throughout the site feeding on the new shoots.	Recommendation that a further special (short duration) study be undertaken of the significance of the fugitive dust from the tailings pile. This could include some appropriate HV sampling in strategic locations and a screening level ecological risk assessment using the results. As migratory waterfowl were observed feeding on the vegetation within the tailings areas, consideration should also be given to including some vegetation analysis and inclusions of the results in the risk assessment.
TDF truck wash	The area of the truck wash was also inspected and found to be in good order. Splash was retained within the building and containment and collection of the wash water appeared adequate. (a post-wash inspection of two trucks at the concentrate load out facility was conducted on May 08, 2008) see below	
Water Treatment Facility (Current)	The current water treatment facility was inspected and found well maintained and operating in spite of the fact that certain equipment has been removed for installation at the new facility including a number of facility doors. The equipment removal had resulted in a shift in operating procedure from the use of ferric chloride to caustic potash in the treatment process. The operator of the facility was knowledgeable about the water treatment facility, its capabilities and the general treatment process. Storage of treatment chemicals was appropriate with chemicals storage contained in appropriate secondary containment even during temporary storage.	

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Water Treatment Facility Transformer	The secondary containment at the transformer located at the rear of the water treatment facility was completely filled with rainwater effectively eliminating the containment capacity of the area (Photo 3). Treatment plant operator was immediately notified as was Jennifer Saran	The precipitation water in the transformer secondary containment at the water treatment facility should be emptied in the appropriate manner.
Water Treatment Facility (New Construct)	The new water treatment facility was under construction at the time of the inspection. No chemicals were stores at the site and the equipment construction was not completed and nothing in the facility has been commissioned.	
Pond 7	A visual inspection of the Pond 7 liner was conducted from the side and no concerns were noted. Sufficient freeboard was being maintained in the pond. The total volume of the pond was not known by site personnel present.	
Hawk Inlet Warehouse	Very few chemicals were stored at this facility Fire proof container used for storage of flammable materials Two new heated hazardous chemical storage buildings were located at this site and were scheduled for installation and hook up in the near future.	
Outside Storage of Materials	All containers were inspected. Some contain wooden floors and some contain steel floors. The area was found well maintained – unloading of containers underway as a barge had just delivered materials to site – generally individual chemicals segregated into different container with no evidence of mixing of different chemicals in the same container. One container contained bulk totes which were not labeled – upon further investigation the material was identified as shotcrete.	Warehouse (or other) personnel need to ensure that all materials stored are clearly labeled in manner that is easily visible. Warehouse personnel should ensure that only container with competent steel floors (as opposed to wooden floors) are use to store chemicals of any kind.
Container on Lined Pad	One container is located on a pad with a HDPE liner underneath. The container was inspected and appeared to contain partially burned materials from a fire fighting mock up. There was no evidence that the container had been used in the past year.	Consideration should be given to removing and appropriately disposing of the container and materials within and using the lined pad as a storage area.

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Ozone Treatment Building	This area was inspected and no concerns were identified at the time of the inspection.	
Hawk Inlet Core Shed/ Maintenance Shop	An inspection of the core shed/maintenance shop was completed. Fire proof container used for storage of flammable materials. Used oil is collected in the shop in an appropriate container however; the container is emptied by pumping it to a container located on the hill at the back of the facility using a temporary hose which at the time of the inspection was left in place.	Temporary hose used to pump out of the used oil tank in the maintenance shop should be removed, the outdoor tank capped and the hose stored appropriately once operation is complete.
Stationary Barge and Ramp	The stationary barge and ramp were inspected and found clean and well maintained. Spill response material was adequate, well maintained and easily accessible. Two used automotive/industrial batteries were noted and when questioned, site personnel indicated that during the scuba inspection conducted batteries are often recovered from the bottom in the area of the docks and stationary barge. The ramp appears to be constructed of creosote treated timbers – appropriate management of this material will likely be required at decommissioning.	Confirm State and federal requirements for the appropriate disposal of creosote treated material if present.
Concentrate Load-out Facility	The concentrate storage building was inspected as was the area immediately inform of the facility doors. The area in front of the building doors has concrete containment which extends to the truck wash station, the fuel loading stations in all areas slopes toward strategically located drains.	General housekeeping of the concrete area in front of the Concentrate Load-out building must be maintained in order to reduce the potential of tracking the material out of the building and potentially off of the concrete apron.
Concentrate Area Truck wash	The concentrate load-out area truck wash was inspected and found to be in good order. Splash was retained within the building and containment and collection of the wash water appeared adequate.	

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Hawk Inlet Bulk Fuel Unloading Dock	The bulk fuel unloading platform (steel construction) was inspected and found to be excellent. Secondary containment within the facility was excellent and although a barge had been unloaded of more than 100,000 US gal. of diesel within the previous 12 hours, there was no evidence of spillage as all surfaces were free of hydrocarbon and only a very slight hydrocarbon sheen on the ponds created by a recent rain.	
Fuel Unloading pipeline	The entire length of the fuel unloading pipeline was inspected and found well maintained. No evidence of past spillage was evident at any point in the pipeline.	
Generator Shed	Area was inspected and no concerns identified.	
Hawk Inlet Bulk Fuel Storage	The Hawk inlet bulk fuel storage area was inspected as was the secondary containment. The secondary containment appeared to be more than adequate in size and was found in good condition with no significant cracks or holes in the HDPE liner. The area was dry with only small ponding of precipitation water.	
Hawk Inlet Fueling Station	Fueling area found well maintained with no evidence of spillage during refueling of equipment. Nozzle drip containment reports to a trough which reports to tank secondary containment area The gasoline tank did not appear to have sufficient secondary containment (need to confirm).	
Hawk Inlet Truck Wash	Truck wash station at Hawk inlet was inspected and found well maintained with no concerns identified. A bulk fuel storage tank located at the back of the facility did not have a cap (bung) on the inspection hole for the outside containment.	Cap (bung) should be replaced to prevent precipitation from entering between tank and containment.
DB-04	Area was inspected and the HDPE liner found well maintained. Adequate freeboard was found within the pond at the time of the inspection.	

HGCMC Site Aspect	Inspection Observations	Comments/Recommendation
Transport truck Inspection (post Hawk Inlet wash station)	A detailed inspection of two trucks which had recently been through the truck wash station at Hawk inlet was conducted. The inspection included the visible surface areas of the truck as well as an inspection of the undercarriage of both the tractor unit and the trailer. Generally, all areas were found to be clean with little residual materials found on the majority of the truck and trailer surfaces. A small amount of residual material was found within small protected void spaces and on areas of high splash (mud flap tops, etc.) This material was located at the same height on each truck and was found to be wet to the touch and easily dislodged indicating that it may be the result of not allowing sufficient time to allow the truck wash to completely wash the truck. It was not clear during the inspection, how often the truck wash is inspected to ensure all nozzles and flows are performing properly or if individual drivers or environmental personnel at the site perform spot audits of the trucks themselves and of the truck washing facility performance.	
B-Road Culverts	Two culverts along the B road were randomly chosen for inspection. Both were located approximately 0.5 miles up from the Hawk inlet turn off. The first was a recently installed plastic culvert and the other was a three foot diameter steel culvert. Both were found in good repair with little to no silt accumulated on the upstream side and no evidence of siltation on the downstream side	
Powder Magazine (Area 7)	The explosive magazine were inspected and found to be in good order with appropriate separation of materials. All magazines were found dry and securely locked to prevent unauthorized access (Photo 30).	

Appendix E
Photographic Record

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Photo 1: Pedestrian walkway linking the crew boat docking facilities with the parking area at Young Bay

Photo 2: Used Oil Tank at Hawk Inlet Warehouse

Photo 3: Transformer Secondary Containment

Photo 4: Haul Truck dumping tailings at the Tailings Disposal Facility

Photo 5: After spreading, the tailings are compacted with a self propelled, vibratinng drum compactor

Photo 6: A revegetated slope, with a granular toe buttree, on the west side of the Tailings Disposal Facility

Photo 7: Side view of the cover (foreground) and wooden housing for seepage collection piping at Site 23; lined stormwater storage pond in background

Photo 8: Frontal view of the test cover and wooden housing for seepage collection at Site 23; Active disposal of production rock in background

Photo 9: Groomed final slope on the lower portion of Site 23

Photo 10: Side view, looking west, across Site D

Photo 11: Stormwater pond facilities at the toe of Site D; Greens Creek is visible at right, in background

Photo 12: Side view, looking west at mine buildings which have been constructed on fill within Site C, part of Site C has no production rock

Photo 13: Perimeter berm constructed of production rock at Site E

Photo 14: Part of Site E has been covered by a geomembrane to reduce infiltration in the short term

Photo 15: Access ramp across the front of the reclaimed and revegetated production rock at Pit 405

Photo 16: Frontal view of the reclaimed and revegetated production rock at Pit 405

Photo 17: Side view of the access ramp and reclaimed and revegetated production rock in Pit 6

Photo 18: Looking up the access ramp that overlies reclaimed and revegetated production rock in Pit 6

Photo 19: Looking down the access ramp that overlies reclaimed and revegetated production rock in Pit 174

Photo 20: Side view of the access ramp and reclaimed and revegetated production rock in Pit 174

Photo 21: Frontal view of the exposed bedrock backslope at Pit 7

Photo 22: At Pit 7 looking downslope over the saturated toe of what is primarily overburden hauled from the quarry at 1.5 km on the A road

Photo 23: Ditch at 920 Area Looking East

Photo 24: Ditch at 920 Area Looking West

Photo 25: Construction Area near Freshwater Intake

Photo 26: Tailings Thickener

Photo 27: Tailings Thickener Concrete Containment

Photo 28: Pipelines attached to the bridge that crosses Greens Creek at the 920 Area

Photo 29: Secondary Containment for Fuel Storage at 920 Area

Photo 30: Explosives Storage