

# STATE OF ALASKA

## DEPARTMENT OF NATURAL RESOURCES

DIVISION OF MINING, LAND AND WATER

DAM SAFETY AND CONSTRUCTION UNIT

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## FIELD INSPECTION REPORT GREENS CREEK MINE

**Inspection Date:** June 27, 2005  
**Report Date:** July 21, 2005  
**Weather:** Fair. Temperatures around 60°F.  
**Inspection Objectives:** Observation of tailings water storage facilities  
**Operator Contact:** Eric Sundberg, Kennecott Greens Creek Mining Co. (KGCMC)  
**State Personnel:** Ed Emswiler, DEC; Charlie Cobb, DNR,  
**Other Personnel:** Tom Zimmer, KGCMC; Keith Everard, Klohn-Crippen  
**Documentation:** Photos were taken and are available for inspection at DNR in Anchorage and DEC in Juneau.

Note: This is a joint report by ADNR and ADEC.

### Notes

On June 27, 2005, the above listed personnel participated in a site visit at the Greens Creek facility on Admiralty Island. The purpose of the visit was to discuss geotechnical stability of the tailings disposal facility and to visit various disposal sites and impoundment structures. After the meeting, Eric Sundberg of KGCMC gave the site tour. The tour covered the following areas:

1. Tailings disposal facility
2. Pond 6 and Pond 7
2. Pit 5 water treatment plant
3. Site D waste rock disposal facility including Pond 23 and Pond D
4. Pond A

We arrived at Greens Creek at approximately 10:30am. Notes from the meeting and the site tour follow.

### Project Meeting

The purpose of the meeting was to follow up on an October 25, 2004 memorandum by Mr. Cobb, which discussed specific geotechnical concerns at the tailings disposal site. This memo was in response to an ADEC request for ADNR to review the stability of the tailings storage facility for the Stage 2 expansion. As the 2005 construction season was under way, the state wanted the stability concerns addressed before tailings were disposed into the expansion area. It is important from a stability standpoint that the facility be designed and constructed properly from the foundation up. Appropriate factors of safety should drive the use of liners and operational techniques. Mr. Everard provided an update of the engineering response on each point raised in the memorandum. Mr. Everard indicated that additional site investigations and tests have been conducted recently and a comprehensive report would be forthcoming by the end of July, 2005 that specifically addresses the concerns raised by the state.



**Figure 1. Tailings Disposal Site – Southeast Expansion Area 2 (looking northeast from Pond 6)**

### **Tailings Disposal Facility**

At approximately 12:30pm we visited the tailings disposal facility. Details with regard to the work scheduled to be done at the tailings facility during the 2005 construction season can be found in a letter from Klohn Crippen to KGCMC Tom Zimmer dated February 4, 2005 entitled “Stage 2 Tailings Facility Expansion 2005 Work Summary”. At the time of this visit the work being conducted included the preparation of the Southeast Expansion Area 2 to install a liner system, and foundation work for the new Pond 7. Pond 7 will replace Pond 6 to receive stormwater and drainage water from the overall tailings facility (inclusive of the Stage 2 expansion).

At the Southeast Expansion Area 2, Tank No. 6 and the truck wash had been removed and the area had been prepared with a sand bedding layer and monitoring equipment (lysimeters and/or piezometers). The work appeared to be contiguous with the specifications in the 2005 work summary. The sand bedding layer was installed and the contractor was beginning to install a geotextile cushion and the 80 mil thick textured (both sides) HDPE geomembrane.

### **Pond 6 and Pond 7**

Pond 6 was observed including the Upper Cannery Tailings Dam (National Inventory of Dams number AK00203) which is under jurisdiction of the Alaska Dam Safety Program, as seen in Figures 2 and 3. The water level in the pond was low, and water was observed entering the system from the tailings pile underdrains. The dam and spillway appeared to be in good condition. Pond 6 is scheduled to be removed from service and used for tailings storage as part of the Stage 2 expansion.



**Figure 2. Upper Cannery Tailings Dam.**



**Figure 3. Pond 6**



**Figure 4. Pond 7 Dam Excavation and Fill**



**Figure 5. Oversized rock in fill at Pond 7 Dam**

We then proceeded to the Pond 7 area that was being excavated and prepared as a stormwater retention pond according to the 2005 work summary. We observed the HDPE components and foundation for a wet well that will be installed in Pond 7, and the portions of exposed foundation and fill placement for the Pond 7 Dam (National Inventory of Dams number AK00307). This dam will be under the jurisdiction of the Alaska Dam Safety Program and a *Certificate of Approval to Construct a Dam* has been issued by ADNR. The area of the spillway was also observed, but a substantial amount of excavation still needed to occur. Some oversized rock was observed in an area of fill. The foundation excavation and construction of the dam and liner system for Pond 7 will be completed over the 2005 construction season. Pond 6 will continue to operate until Pond 7 is commissioned, and will be used for additional operational storage until it is to be used for tailings disposal.



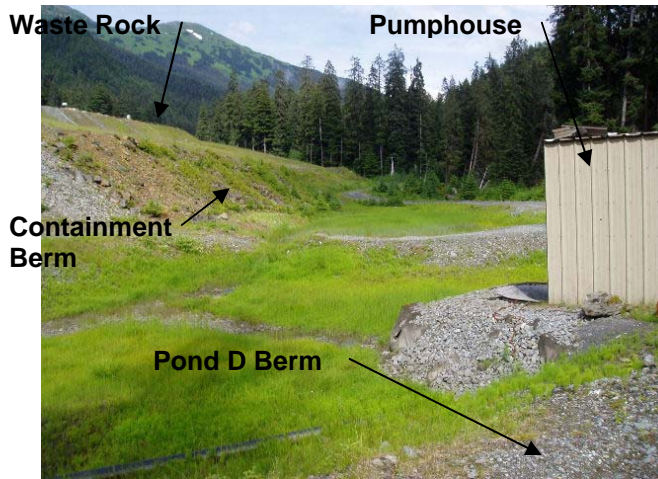
**Figure 6. Pond 7 Wet Well**



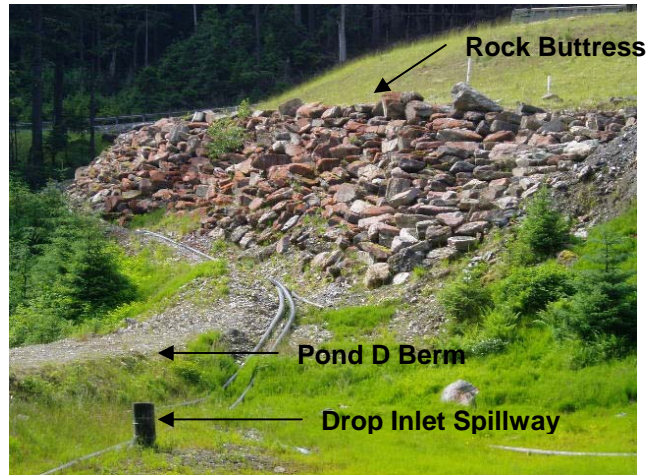
**Figure 7. Pond 7 Wet Well Excavation**

### **Pit 5 Water Treatment Facility**

We were given a tour through the Pit 5 water treatment facility. The facility is designed to operate at 800 to 1,200 gallons per minute. This plant may be relocated in close proximity to Pond 7 after it is completed, which will eliminate the plumbing and need to pump to the existing plant location at the northwestern end of the tailings site. Relocation of this plant will also enable tailings placement in Pit 5, and the overall expansion of the pile.



**Figure 8. Site D and Pond D**



**Figure 9. Site D Buttress and Pond D Berm**

### Site D

At approximately 2:30pm we stopped at Site D where Mr. Sundberg explained the water drainage and capture features of the site. Pond 23 was in service. An experimental cap section at Site 23 was observed from the road, and the grass cover appeared to be in good condition.

At Site D, placement of native glacial till excavated from the mill during site development is overlain by waste rock, as seen in Figure 8. Recent investigative field work and data analysis associated with hydrology, geochemistry and geotechnical stability suggest that there may be long term advantages to relocating the production rock placed at Site D. Field work and data analysis is continuing to identify potential risks and benefits with either leaving the site at the current location or moving the material elsewhere. We observed red staining of the rock in the outer buttress that is most likely due to lichen growth, as seen in Figure 9.



**Figure 10. Pond D Spillway Outlet**



**Figure 11. Pond D Outlet. Note orange color of water.**

An orange colored precipitate/staining was observed in the water below the Pond D berm at the discharge of the drop inlet spillway, as seen in Figure 10 and 11. The berm at the lower aspect of Site D was constructed to contain the surface and groundwater runoff from Site 23/D and to provide sedimentation control. The berm contains some pyritic quarry rock from the development Pit 405 in 1988. The water was clear. The orange color appeared to result from the sediment and biological growth that settled on the bottom of the pool. Efforts are taken to drain down Pond D to the maximum extent possible. At this visit a minimal amount of water storage was observed in the upper compartment. At the time of this site visit there was no apparent evidence of seeps through the berm, as active pumping maintains the pond empty or very low other than during major storm events.

KGCMC measured field parameters of the pool outside of the Pond D berm (Figure 10) in June 2002. This monitoring produced a pH of 6.9 and conductivity of 620 uS/cm. This represents a low to moderate soluble load and low acidity. A likely explanation for this is that oxidation of pyrite rock in the berm produces soluble iron that precipitates upon reaction with the atmosphere as the water daylights from the toe of the berm. Iron oxidizing bacteria usually promote these reactions. It is also common in disturbed areas to have changes in the water table, or redox-boundary, mobilizing iron and manganese from the original, undisturbed soil. This may contribute to the staining observed at the base of the site. Examples of such natural redox reactions exist at several sites beyond the KGCMC facilities. Water flows intermittently from the Pond D berm into a vegetated boggy area (Figure 10; upper-left) prior to reaching Greens Creek.

The remediation plan for the Pond D berm will result in its being removed within a few years, following completion of other priorities, such as a pumped water return system from Pond C. Plans include reconstructing the berm with inert material; a possible source is material recovered from the continuing development of the upslope of Site 23.



**Figure 12. Pond A. Note proximity to bridge over Greens Creek to portal.**

#### **Pond A**

At about 3:30pm we visited Pond A at the mill area. Pond A is part of the “closed” system that captures waters which contain sediments from the mill area. Runon into Pond A is limited by diversion ditches above the mill. Water captured in Pond A is transmitted to treatment at Pit 5. When sediments build within the pond and other containment structures in this area they are collected and taken back to the mill or taken to the tailings disposal site. Pond A is formed by an embankment adjacent to Greens Creek, as seen in Figure 12.



**Figure 13. Liner installation at Southeast Expansion Area #2 of Tailings Storage Facility**

### Conclusion

At approximately 4:30pm we traveled back to the cannery area where we turned in our protective gear and caught transportation back to Juneau. On the way we stopped at the tailings site where we observed the geosynthetic liner system being installed at the southeast expansion area 2, as seen in Figure 13.

## **Action Items**

The supplemental geotechnical stability report for the Stage 2 expansion is pending. No additional tailings should be placed above the level of the service layer in the southeast expansion area without ADEC approval. Demonstration of the stability of this critical cross section should be submitted as soon as possible.

Oversized rock in fill at Pond 7 Dam should be removed and replaced with fill that meets project specifications.

A review should be conducted of Pond A to determine if the embankment meets the statutory definition of a dam under AS 46.17.900(3). If so, it would be under the jurisdiction of the Alaska Dam Safety Program. A Hazard Potential Classification and Jurisdictional Review form (available from the Dam Safety and Construction Unit) should be completed by an engineer qualified under 11 AAC 93.193.

\* \* \* *End of Report* \* \* \*

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