

# Northern Latitudes Mining Reclamation Workshop

## Field Trip Guide



**Historic Gold Dredge #2 – Lower Fairbanks Creek**

Fairbanks, Alaska

June 6, 2003

**State of Alaska  
Department of Natural Resources  
Division of Mining, Land and Water  
Abandoned Mine Lands Program**



## **NORTHERN LATITUDES MINING RECLAMATION WORKSHOP**

**FIELD TRIP – FRIDAY, JUNE 6<sup>TH</sup>, 2003**

**Fairbanks Creek – Fort Knox Tour**

### **FAIRBANKS CREEK TOUR:**

Depart River's Edge at 8:00 sharp (school bus)

Arrival time: 9:15 AM (total tour time 2 hours and 30 minutes) STRICT!

Tour Schedule:

45 min. Hi Yu Mine	(9:15 – 10:00)
30 min. Travel time/ shuttle to Upper Fairbanks Creek	(10:00 – 10:30)
30 min. Presentation on Stream Restoration Project	(10:30 – 11:00)
15 min. Walking Tour/Travel time	(11:00 – 11:15)
20 min. Reclaimed Placer Mine - Too Much Gold Creek	(11:15 – 11:35)

- Load bus and meet at Fort Knox overlook at 12:00 noon for LUNCH.
- After lunch, load into Fort Knox Bus (motor coach).

### **FORT KNOX TOUR:**

Depart Fort Knox overlook at 12:20 PM.

Arrival time: 12:30 PM (total tour time 2 hours and 30 min.) STRICT!

Tour Schedule:

20 min. Orientation Movie and Restrooms	(12:30 – 12:50)
15 min. Gold Bar with Photos	(12:50 – 1:05)
20 min. Tour Fort Knox open pit	(1:05 – 1:25)
1 ½ hr. Comprehensive tour of Tailing Storage Facility, Reclaimed Wetlands and Fresh Water Reservoir – Focus on Reclamation, prior and planned. Return to office/restrooms.	(1:25 – 2:55)

- Load bus and depart for River's Edge at 3:00 PM.
- Arrive River's Edge at 4:00 PM.





## NORTHERN LATITUDES MINING RECLAMATION WORKSHOP

FIELD TRIP – FRIDAY, JUNE 6<sup>TH</sup>, 2003

Fort Knox – Fairbanks Creek Tour

### FORT KNOX TOUR:

Depart River's Edge at 8:00 sharp (motor coach)

Arrival time: 9:00 AM (total tour time 2 hours and 30 minutes) STRICT!

Tour Schedule:

20 min.	Orientation Movie and Restrooms	(9:00 - 9:20)
15 min.	Gold Bar with Photos	(9:20 - 9:35)
20 min.	Tour Fort Knox open pit	(9:35 - 9:55)
1 ½ hr.	Comprehensive tour of Tailing Storage Facility, Reclaimed Wetlands and Fresh Water Reservoir – Focus on Reclamation, prior and planned. Return to office/restrooms.	(9:55 – 11:25)

- Load bus and drive to Fort Knox overlook at 11:40 for LUNCH.
- After lunch, load into Fairbanks Creek Bus (school bus).

### FAIRBANKS CREEK TOUR:

Depart Fort Knox overlook at 12:00 noon.

Arrival time: 12:30 PM (total tour time 2 hours and 30 min.) STRICT!

Tour Schedule:

45 min.	Hi-Yu Mine	(12:30 – 1:15)
30 min.	Travel time/ shuttle to Upper Fairbanks Creek	(1:15 – 1:45)
30 min.	Presentation on Stream Restoration Project	(1:45 – 2:15)
15 min.	Walking Tour/Travel time	(2:15 – 2:30)
20 min.	Reclaimed Placer Mine - Too Much Gold Creek	(2:30 – 2:50)

- Load bus and depart for River's Edge at 3:00 PM.
- Arrive River's Edge at 4:00 PM.



## Fort Knox Mine

The Fort Knox Mine is an open-pit gold mine located in the Fish Creek drainage, 15 air miles northeast of Fairbanks, Alaska. The gold deposit is hosted in a granitic intrusive complex with gold occurring in and along margins of stockwork veins and veinlets, quartz-filled shear zones, and fractures within the granite. The ore deposit itself has dimensions of 4,000 feet by 2,000 feet and extends to depths over 1,000 feet.

When the mine was permitted in 1994, Fort Knox contained proven and probable gold reserves of 4.1 million ounces (161.8 million tons of ore at an average grade of 0.025 ounces per ton). Construction began in 1995 and the first gold pour occurred in 1996. The mine was designed for a milling rate of 35,000 to 50,000 tons per day. The True North Mine is a satellite-pit that commenced operation in January 2001 with the ore being trucked to the Fort Knox Mill. Total combined gold production from Fort Knox and True North mines during calendar year 2002 was 410,520 ounces.



**Figure 1. Fort Knox pit in August 2001.**

The gold ore is crushed, then ground, and processed as slurry in a mill adjacent to the mine. The gold is extracted in tanks containing a cyanide solution that dissolves the gold. The gold is captured by activated carbon, then stripped from the carbon and recovered by electrolysis. The cyanide in the remaining slurry is detoxified in tanks before the tailings are deposited in the tailings storage facility.

Extensive placer mining occurred in the Fort Knox Project area since 1917 and disturbed a significant portion of the valley bottom along most of the length of Fish Creek. Prior to construction of the Fort Knox Mine facilities, placer or other mining activity had disturbed approximately 904 acres within the Millsite Permit Area. Of this, approximately 367 acres would be classified as historically disturbed (characterized by some revegetation) and 511 acres as recently disturbed (characterized by a lack of vegetation). An additional 26 acres of the project area contained large sediment settling ponds.

Fish studies began in 1992 as part of the baseline investigations for the permitting of the Fort Knox Project. Arctic Grayling and burbot were discovered in the creeks and abandoned placer mining settling ponds within the project area. The Alaska Department of Fish & Game (ADF&G) predicted, prior to the construction of the Fresh Water Supply Reservoir Dam, that opportunities existed to enhance the fisheries resources in the Fish Creek valley. During construction of the Fresh Water Supply Reservoir Dam, Fairbanks Gold Mining, Inc. (FGMI) worked with ADF&G to protect the existing fisheries resources and to optimize habitat diversity within the area to be flooded.



**Figure 2. Overview of reconstructed wetlands, looking downstream from tailings dam.**

Work began in 1996 to construct wetlands in the previously disturbed area between the Fresh Water Supply Reservoir and the tailings impoundment. Construction of a channel, connecting the wetlands with the Fresh Water Supply Reservoir, provided spawning and rearing habitat for Arctic Grayling in spring 1999.



**Figure 3. ADF&G staff conducting studies on Fresh Water Supply Reservoir.**

The work to improve habitat diversity and productivity is an on-going process in cooperation between ADF&G, FGMI, ADNR, and federal agencies.



**Figure 4. Reclaimed placer mining settling pond.**

## Historic Hi-Yu Mine

The Hi-Yu Mine is an abandoned underground gold mine located along Moose Creek, a tributary to Fairbanks Creek. The Hi-Yu Mine was one of the major historic producing lode mines in the Fairbanks Mining District prior to World War II. The ore body consisted of many quartz veins, some along faults, and most offset by faults, containing free-milling gold and sulfides including stibnite, argentiferous galena, arsenopyrite, pyrite, and sphalerite.

Before 1913, the Hi-Yu shear was traced over 900 strike feet over a vertical range of 625 feet before an adit was developed on the right limit of Moose Creek. By 1913, the main adit was 450 feet long and a lower adit was started. A twenty-three ton lot of ore from the first 150 feet of the main adit yielded 6.29 ounces of gold per ton.

By 1916, the lower adit had been abandoned and a new adit (the Hi-Yu adit) was established approximately 500 feet above the level of Moose Creek. The Hi-Yu adit was driven 1,300 feet by 1922. The average recovered grade of the ore in 1922 was 1.21 to 1.45 ounces of gold per ton. Production records indicate that by 1933, the Hi-Yu Mine had produced 13,560 troy ounces of gold from 8,200 tons of ore with an average grade of 1.65 ounces of gold per ton. In 1933, a rich ore shoot was discovered in the upper adit and produced 3,010 ounces of gold from material grading 2.1 ounces per ton over the next 11 months. The Hi-Yu Mine remained the second largest producer in the Fairbanks Mining District during 1936, 1937, and 1938. The mine also recorded continuous production in 1939 and 1940.



Figure 5. Historic Hi-YU mill building.

The Hi-Yu Mine was shut down in 1942 by the War Production Board Order L208, and like most other lode mines in the district, the Hi-Yu did not reopen after World War II. Existing records indicate that the Hi-Yu Mine produced approximately 22,160 ounces of gold between 1933 and 1941. In 1988, Tri-Con Mining reportedly mined 14,600 tons of material from the Hi-Yu stamp mill sand tailings dump and one of the mine waste rock dumps.

Northern Latitudes Mining Reclamation Workshop, June 4-6, 2003 Abstract: Chemical variations in the waters draining the HI-YU Mine, Fairbanks Mining District, Alaska, by John M. Clark.

Mining and milling of gold bearing ore release metals into the environment when sulfides contained in the ore and mine tailings are exposed to water and oxygen. There are two sources of contamination at the Hi-Yu mine: the 'mill seep' and the mine tailings. The 'mill seep' has an acid pH (4.8) containing ~21 parts per billion (ppb) Cd and ~2400 ppb Zn.



**Figure 6. Seep in front of historic Hi-Yu mill building.**



Water draining the mine tailings contains ~284 ppb As and 27 ppb Sb. These concentrations are above the EPA and Alaska State Maximum Contaminant Levels (MCL). The source of As and Sb in water draining the tailings is weathering arsenopyrite and stibnite in the tailings. The 'mill seep' water flows through a portion of the tailings, keeping the pH near 4, picking up more metals before mixing with Moose Creek. Once the mill seep mixes with Moose Creek, the pH increases, leading to the precipitation of iron and manganese hydroxides with associated As, Cd, Sb, and, Zn. Samples of the iron precipitate contain > 10,000 parts per million (ppm) As, 19 ppm Cd, 240 ppm Sb, and 2600 ppm Zn. Precipitation of metals along with interaction of organic material and dilution brings the metal contaminant levels down to below MCL levels within 0.8 km from the mixing point.

Although technically a point source of pollution, the seep and tailings cause no significant increase in the metal content of Fairbanks Creek 1.2 km downstream of the Hi-Yu mine. In fact, Fairbanks Creek, which drains several other mines, has higher As and Sb concentrations than does Moose Creek. The relatively low sulfide content of the ore, the presence of secondary carbonates within the ore, and the adsorption of metals onto Fe and Mn oxide and hydroxide phases make the discharge relatively benign, despite the unsightly iron hydroxide precipitate locally present.



**Figure 7. Iron hydroxide precipitate from seep adjacent to Hi-Yu mine tailings.**

## History of Early Placer Mining on Fairbanks Creek, 1903 - 1918

Fairbanks Creek flows in an easterly and southeasterly direction from a divide east of Cleary Summit for approximately 9 miles to Fish Creek. The creek is small and originally flowed through a willow covered flat 100 to 300 feet in width, with a gradient of about 100 feet to the mile. For the last several miles, it meandered across a broad flat to Fish Creek.

In 1903, prospecting had been done and pay had been found over several miles of the creek's course. The bedrock is mica-schist, quartzite-schist, and gneiss. These are covered with a thickness of 14 to over 40 feet of muck (organic rich soil – typically frozen) and gravel. The pay dirt was reported to run from 2 to 7 feet in thickness. The ground was deep and frozen and prospecting was a time consuming task of sinking holes by the use of wood fires at first, and later by the use of boilers and steam thaw points.

“With the advent of the boiler, work can be done more easily and quickly, and a brief description of the method may not be out of place. Boilers at present in use on the creeks vary from 2 to 6 horsepower, and are capable of supplying steam to 4 or 5 points. Steam is generated by the boiler, passes through an ordinary steam point, and is delivered to the points. These points are pipes from 4 to 5 feet in length, attachable at one end to the steam pipe and the other end provided with a small opening through which the steam rushes with greatly increased penetrative force. They correspond to the nozzle attached to fire hose, and the whole system is similar, with the exception that the thawing machine is adapted to the transmission of steam rather than of water. The blunt ends of the points are placed in position against the frozen surface and the steam is turned on. Shafts may rapidly be sunk to bedrock by this method and the ground then drifted out laterally. Care must be exercised to prevent the too extensive thawing of the ground and consequent “sloughing” or falling in of material from the walls.” – U.S.G.S. Bulletin No. 225, 1904.

Between 1904 and 1910, Fairbanks Creek, though not a large producer, yielded a steadier annual output than any other creek in the Fairbanks Mining District. Mining by both open-cut and drifting methods was carried on from claim “No. 10 above” to “No. 11 below” (claim names relate to the claim location in terms of the number of claims above or below the claim on which the initial discovery was made). During 1910, six or seven open-cut mines were in operation, most of which employed bottomless scrapers for stripping the ground and steam hoists for carrying the pay gravel to the sluice boxes.

In 1911, Fairbanks Creek continued to be one of the important producers for the district; from 1904 through 1910, \$5,250,000 worth of gold was produced (approximately 256,000 ounces). From 10 to 15 mines were working between “No. 10 above” to “No. 11 below”, and about 150 men were employed. During this year, a new discovery appeared to have been made on “No. 2 below”; the gold was so different in appearance from any that had been produced on the creek that the operators believed that they had found an entirely new paystreak. The paystreak was over 200 feet in width and the gold was very

coarse, with some of the ground containing as much as \$2 to \$3 to the gold pan (this would be the equivalent of getting \$36 to \$50 of gold per pan at today's gold price).

In 1911, Fairbanks Creek saw the introduction of a bucket line gold dredge on "No. 8 above" by the Alaska Exploration Company. The dredge had operated on the Stewart River in the Yukon Territory. It was taken by river to Chena, where it was dismantled into parts that could be handled and was shipped by train to Gilmore, where it was hauled on wagons over the divide and into the Fairbanks Creek valley and reconstructed and put into operation. The cost of moving, dismantling, and reconstructing the dredge was reported to have been \$30,000.

In 1912 there were 135 men employed at 35 winter mining operations on Fairbanks Creek. In the spring, as soon as sluicing water became available and seasonal factors would allow open-cut mining, the number of mining operations decreased to about 25, but the number of men employed increased to approximately 225. Mining occurred from claim "No. 17 above" to "No. 10 below". The dredge that was constructed on "No. 8 above" in 1911 commenced operations about June 1<sup>st</sup>. At the time of a U.S.G.S visit on August 7, 1912, the dredge had mined a total distance of 1,320 feet upstream, through an average depth of 20 feet and a width of 100 to 110 feet. The dredge operated two 11-1/2 hour shifts per day with five men per shift. The cost of wood for fuel was so great that the operation considered the installation of oil boilers and the obtaining of crude oil from California. In March 1912, pay gravel was first located on the right limit of the creek, being found on the first tier bench on claim "No. 1 below". The pay streak was 100 feet in width and in July some exceptionally rich ground was found on claim "No. 3 below" with pans of \$10 being frequently found (this would be the equivalent of \$178 per pan at today's gold prices).

In 1914, summer mining operations on Fairbanks Creek were carried on from "No. 16 above" to "No. 15 below". Eighteen mining plants worked on thirteen separate claims and employed up to 180 men. The depth to bedrock on Fairbanks Creek ranged from a few feet near its head to 120 feet on "No. 15 below". In the upper section of the valley, the mines were open-cut and were operated largely by manual methods, though a few were equipped with steam scrapers. In the lower valley, the operations were underground drift mines. The only bucket line dredge in the Fairbanks Mining District continued to be that of the Alaska Exploration Company on claim "No. 8 above".

In 1918, the Alaska Exploration Company dredge was operated on claim "No. 6 above" and the company installed a second dredge on claim "No. 1 below". The new dredge was a Bucyrus dredge with a capacity of 3,000 cubic yards per day and was powered by two – 120 horsepower diesel engines. From 1904 through 1918, approximately \$7,500,000 worth of gold was produced from Fairbanks Creek and its tributaries.

## Recent Placer Mining on Upper Fairbanks Creek, 1950's – 1997

During the 1950's, open-cut mechanized mining occurred on Fairbanks Creek just downstream from Too Much Gold Creek (Area "A" on map). The mining equipment used consisted of dozers, draglines, front-end-loaders, sluice boxes, and various pumps. This basic spread of mining equipment was utilized for all of the mining that occurred in the upper portion of Fairbanks Creek and the lower portion of Too Much Gold Creek. During the 50's, 60's and 70's, there were no requirements at this time for the use of settling ponds to control the impacts to the downstream water quality or reclamation requirements. No reclamation occurred in this area during this time frame.

Settling ponds were established in Area "A" during the late 1970's and the early 1980's when open-cut mining occurred in Area "B" and Area "C". There was some reclamation work that occurred in this area in an attempt to stabilize the settling ponds in order to prevent the contained sediments from being washed into the creek. The miner who mined at this location reported "It became evident that the creek was going to re-establish itself where it wanted to go, regardless of the attempts to control it". The conditions observed in Area "A" represents to a large degree, natural reinvasion of native plant species and the creek channel stabilizing over time.



**Figure 8.** Looking across Fairbanks Creek valley (Area "A") from lower Too Much Gold Creek.

As open-cut mechanized mining proceeded upstream, mining occurred in Area "B" during the 1978 to 1981 mining seasons. No reclamation work was required during this time frame on federal claims. The miner did complete some reclamation in this area; however, he described it as "minimal". There was very limited recontouring of the edges of the open cut and the creek was left on bedrock in the center of the cut. The fines that collected as the result of the sluicing operations were "spread out". The conditions observed in Area "B" represent to a large degree, natural reinvasion of native plant species and the creek channel stabilizing over time.



**Figure 9. Looking downstream on Fairbanks Creek over Area "B".**

Open-cut mechanized mining occurred in Area "C" during 1981 through 1997. During this period the ground was staked as federal mining claims. Changes had occurred to the regulations that controlled mining on federal lands and reclamation was now a requirement. In order to meet federal Environmental Protection Agency (EPA) and Alaska Department of Environmental Conservation (ADEC) regulations, most miners had to use settling ponds and water recycle systems to control impacts to the downstream water quality. The location of settling ponds within the narrow confines of the head of Fairbanks Creek created challenges during reclamation of the site in order to leave the ponds in a stable condition.



**Figure 10. Looking upstream during mining on upper Fairbanks Creek in 1994.**

EPA grants were available for demonstration projects to study methods of reducing non-point source pollution. An oversight committee consisting of representatives from the US Bureau of Land Management, US Fish & Wildlife Service, Alaska Department of Fish & Game, Alaska Department of Natural Resources, US Army Corps of Engineers, the Alaska Miner's Association, and individual placer miners worked to select three placer mines to study stream channel restoration. The placer mine in Area "C" of upper Fairbanks Creek was selected as one of these sites. Dr. Robert Carlson of the University of Alaska Fairbanks, was the principal investigator responsible for the design, implementation and monitoring of the stream channel restoration. The stream channel restoration work was completed during the fall of 1997.



**Figure 11. Looking downstream at flood plain during construction of stream channel.**



**Figure 12. Looking downstream at flood plain and stream channel - May 2003.**

## Recent Placer Mining on Too Much Gold Creek, 1987 - 1989

Open-cut mechanized mining occurred on Lower Too Much Gold Creek during 1987, 1988, and 1989. During this period the ground was staked as state mining claims. Reclamation was a requirement of the Miscellaneous Land Use Permit issued by the Department of Natural Resources. The edges of the cuts were recontoured to blend with the surrounding hillsides. Available topsoil was spread to promote the reinvasion of native species. The spillway of the upper settling pond was stabilized and the stream channel was reconstructed on the right limit of the narrow valley to avoid the lower settling pond.



**Figure 13. Looking upstream at reclaimed slopes; note reinvasion of trees since 1989.**



**Figure 14. Revegetation surrounding upper pond.**

Pond embankment and spillway have remained stable since 1989. Miner typically placed coarse tailings from the sluicing operation to armor the spillways of all reclaimed settling ponds.



**Figure 15. Re-established wetlands on lower pond.**



Too Much Gold Creek: Placer mined 1987 - 1989.

Historic Hi - Yu mine.

Fairbanks Creek - Area "A": Placer mined in 1950's.

Fairbanks Creek - Area "C": Placer mined 1981 - 1995.

Fairbanks Creek - Area "B": Placer mined 1978 - 1981.

Ft. Knox overlook.

Ft. Knox mill and office complex.

Tailings storage facility.

Fresh Water Reservoir

Reconstructed wetlands.

Approximate location of open-pit.

