Klag Bay Site

Sitka, Alaska

EPA Facility ID: AK0002364768

Basin: Baranof-Chichagof Islands

HUC: 19010203

Executive Summary

Klag Bay, on Chichagof Island, Southeast Alaska, is the location of the Chichagof Mine, a former gold and silver mine which operated from 1906 to 1942. The mine produced an estimated 600,000 tons of gold and silver, with about 500,000 tons of waste rock deposited directly to the nearshore of Klag Bay. Tailing and sediment samples collected in the bay contain trace elements at concentrations exceeding sediment-screening guidelines. Klag Bay contains NOAA trust marine species as well as two anadromous salmon streams that have runs of sockeye, coho, chum, and pink salmon. There are both subsistence and recreational fisheries in the bay.

Site Background

The Chichagof Mine is adjacent to Klag Bay, a small estuary on Chichagof Island, Southeast Alaska, about 80 km (50 mi) northwest of Sitka (Figure 1). The mine operated as a silver and gold mine from 1906 to 1942. Although there has been no actual mining since 1942, people have explored the property, particularly since the early 1980s. Now, old ruins are the only remnants of historical mining operations (Ecology and Environment 1999).

Ore was originally processed using mercury amalgamation. This process consisted of passing crushed ore in a water slurry over amalgamation tables coated with mercury. The larger particles of gold would adhere to the tables while the remaining slurry was drained onto drying pans. The remaining waste rock, called tailings, were placed in waste piles. A process method using cyanide, in which ores are finely crushed and treated with a cyanide compound to dissolve the gold, may or may not have been used at the mine. A cyanide plant was constructed between 1923 and 1931 but there are conflicting reports regarding whether it was used. The floatation process was used after 1932 in which about 0.5 kg (1 lb) of oil combined with four tons of water and one ton of superfine ore were agitated to form an oily froth that picked up the gold particles (Ecology and Environment 1999).

The total production for the mine was on the order of 600,000 tons. No metals other than silver and gold were recovered from the ore. Therefore, the tailings likely contain metals and metalloids from the ore host rock and may be concentrated by the milling and gold recovery process. Arsenic, lead, and zinc are trace elements commonly associated with sulfide ore gold deposits. In addition, the tailings may contain mercury from the amalgamation process (Ecology and Environment 1999).

The direct disposal of mine tailings to Klag Bay has provided the primary pathway for the transport of contaminants to NOAA trust resources. The bulk of tailings were discharged directly into the intertidal and subtidal zones of the bay (Figure 1). An estimated 500,000 tons were deposited on reportedly a substantial portion of the present beach. A smaller amount of tailings was disposed

Figure 1. Location of the Klag Bay Site, Sitka, Alaska.

of in an upland tailings pile above the beach. Information on other potential surface or groundwater pathways was not reported (Ecology and Environment 1999).

A combined Preliminary Assessment/Site Inspection Report was prepared for the U.S. EPA in March 1999, which continues to evaluate the site. The site has not yet been proposed for listing on the National Priorities List (Ecology and Environment 1999).

NOAA Trust Resources

The NOAA trust habitat of concern is Klag Bay, a small estuarine embayment in Southeast Alaska. Very little information on the physical characteristics of this relatively remote bay was available. Previous studies sampled depths of up to 20.1 m (66 ft) and sediments ranged from gravelly sands to clayey silts (Ecology and Environment 1999). Two anadromous salmon streams, Chichagof Creek and Fish Camp Creek, empty into Klag Bay (Ecology and Environment 1999). Chichagof Creek flows to the bay approximately 0.8 km (0.5 mi) northwest of the mine and Fish Camp Creek flows to the bay approximately 3 km (1.9 mi) southeast of the mine (Figure 1). Although there is no evidence yet that the two natal streams were impacted by the mine, their presence makes the bay a valuable nursery and migratory corridor for anadromous salmon. NOAA trust species use Klag Bay and selected important species are presented in Table 1.

Chichagof Creek has spawning runs of pink, chum, and coho salmon, while Fish Camp Creek has spawning runs of sockeye and coho salmon. Adults migrate past the former mine during the spring and summer each year to reach Chichagof Creek. Juvenile salmon use nearshore areas of the bay as a juvenile nursery for up to several months before outmigrating to the Pacific Ocean (Ecology and Environment 1999). The anadromous Dolly Varden char has also been observed in Klag Bay, but it is not known whether the species uses Chichagof or Fish Camp creeks for spawning (Powell 2000).

Although comprehensive fish surveys have not been conducted in Klag Bay, species commonly observed in the marine waters of Southeast Alaska would likely reside in the bay (Davidson 2000). All of the marine fish in Table 1 are commonly found in Southeast Alaska and most are coastal-shelf species that occupy bays, estuaries, and coastal waters for all of their life stages. Most of these fish do not make large migratory movements, although seasonal movements in relation to food availability, temperature, and spawning may occur (ADFG 2000a).

Several invertebrate species are common in Southeast Alaska and likely inhabit Klag Bay, including Dungeness crab, red king, tanner, and snow crabs, and pinto abalone (ADFG 2000b). Blue mussels have been observed in the intertidal and nearshore subtidal areas of the bay (Davidson 2000).

Native Alaskans have established, substantial subsistence fisheries on Fish Camp Creek for sockeye salmon from late July through early August. There are also subsistence fisheries on Chichagof Creek, although not to the same degree as the sockeye fishery on Fish Camp Creek. There is recreational fishing on both streams and in Klag Bay. Klag Bay is closed to commercial fishing, largely to protect the sockeye run at Fish Camp Creek, although commercial harvests take place outside of the bay (Ecology and Environment 1999).

Two marine mammals common to the area are listed under the Endangered Species Act of 1972. The threatened Steller sea lion and endangered humpback whale are commonly observed, and range freely throughout Southeast Alaska. The nearest documented haulout area for Steller sea lions is about 10 km (6 mi) west of Klag Bay. It is not known whether humpback whales enter Klag Bay (Ecology and Environment 1999).

Table 1. NOAA trust resources common to Southeast Alaska and Klag Bay (ADFG 2000a; ADFG 2000b; Davidson 2000).

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Area	Nursery Ground	Adult Forage	Subsistence	Recreational
ANADROMOUS FISH						
Chum salmon	*Oncorhynchus keta*	◆[a]	◆	◆	◆	
Coho salmon	*Oncorhynchus kisutch*	◆[a]	◆	◆	◆	◆
Dolly Varden char	*Salvelinus malma*		◆	◆		
Pink salmon	*Oncorhynchus gorbuscha*	◆[a]	◆	◆	◆	◆
Sockeye salmon	*Oncorhynchus nerka*	◆[a]	◆	◆	◆	◆
MARINE FISH						
Black rockfish	*Sebastes melanops*		◆	◆		◆
C-O sole	*Pleuronichthys coenosus*		◆	◆		
Copper rockfish	*Sebastes caurinus*		◆	◆		◆
Dusky rockfish	*Sebastes ciliatus*		◆	◆		◆
Flathead sole	*Hippoglossoides elassodon*		◆	◆		
Great sculpin	*Myoxocephalus polyacanthocephalus*		◆	◆		
Kelp greenling	*Hexagrammos decagrammus*	◆	◆	◆		
Lingcod	*Ophiodon elongatus*		◆	◆		
Pacific halibut	*Hippoglossus stenolepis*		◆	◆		◆
Pacific herring	*Clupea pallasi*		◆	◆		
Pacific cod	*Gadus macrocephalus*		◆	◆		◆
Pacific tomcod	*Microgadus proximus*	◆	◆	◆		
Quillback rockfish	*Sebastes maliger*		◆	◆		◆
Red Irish lord	*Hemilepidotus hemilepidotus*	◆	◆	◆		
Sablefish	*Anoplopoma fimbria*		◆	◆		
Sand sole	*Psettichthys melanostictus*		◆	◆		
Silvergray rockfish	*Sebastes brevispinis*		◆	◆		◆
Speckled sanddab	*Citharichthys stigmaeus*		◆	◆		
Starry flounder	*Platichthys stellatus*	◆	◆	◆		
Walleye pollock	*Theragra chalcogramma*		◆	◆		
Yelloweye rockfish	*Sebastes ruberrimus*		◆	◆		◆
Yellowfin sole	*Pleuronectes asper*	◆	◆	◆		
Yellowtail rockfish	*Sebastes flavidus*		◆	◆		◆
INVERTEBRATES						
Blue mussel	*Mytilus edulis*	◆	◆	◆		
Dungeness crab	*Cancer magister*	◆	◆	◆		
Pinto abalone	*Haliotis kamtschatkana*	◆	◆	◆		
Red king crab	*Paralithodes camtschaticus*			◆		
Snow crab	*Chionoecetes opilio*			◆		
Tanner crab	*Chionoecetes bairdi*			◆		

a spawning areas for Pacific salmon are in Fish Camp or Chichagof creeks.

Site-Related Contamination

Environmental investigations adjacent to the former mine and within Klag Bay have found source and sediment contamination at concentrations that exceed screening guidelines. The Preliminary Assessment/Site Inspection collected seven tailing samples and 12 sediment samples in Klag Bay. Tailing samples were collected in the intertidal zone along the western shore of the bay while sediment samples were collected in both the intertidal and nearshore subtidal zones. All samples were analyzed for trace elements (Ecology and Environment 1999).

Concentrations of arsenic, cadmium, copper, lead, mercury, nickel, silver, and zinc in both tailing and sediment samples exceed sediment-screening guidelines in Klag Bay (Table 2). Elevated concentrations were widespread in both media; concentrations of at least one trace element exceeded sediment-screening guidelines in every sample collected.

In general, the greatest concentrations were observed in tailing samples where arsenic concentrations exceeded sediment screening guidelines by at least an order of magnitude. Concentrations ranged from 140 to 840 mg/kg in the seven tailing samples collected. Concentrations of lead, mercury, and silver in tailing samples approached an order of magnitude above guidelines (Table 2).

Elevated concentrations of trace elements were also widespread in sediment samples collected in the bay. Concentrations of mercury exceeded guidelines by an order of magnitude (Table 2). Mercury concentrations ranged from 0.5 to 4.5 mg/kg in sediment samples collected in the bay. Although generally not as elevated as in tailing samples, concentrations of arsenic, cadmium, lead, nickel, and silver also exceeded screening guidelines in most samples collected in the bay (Table 2). Elevated concentrations appear to be distributed throughout the inner bay and into the outer bay. Fewer trace elements exceeded screening guidelines in samples collected in the outer bay, but the extent of contamination in the outer bay is not known.

Table 2. Maximum concentrations of contaminants of concern to NOAA in tailings and sediment samples collected in Klag Bay (Ecology and Environment 1999).

	Sediment (mg/kg)		
Contaminant	Tailings Samples	Sediment Samples	ERL[a]
Arsenic	840	250	8.2
Cadmium	0.83	2.7	1.2
Chromium	35	32	81
Copper	98	50	34
Lead	350	80	46.7
Mercury	1.1	4.5	0.15
Nickel	53	37	20.9
Silver	7.4	2.5	1.0
Zinc	360	140	150

a Effects Range-Low (ERL) represents the tenth percentile for the dataset in which effects were observed or predicted in studies compiled by Long et al. (1995; 1998).

References

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