ECONOMIC DEPOSITS AT BLUE HILL

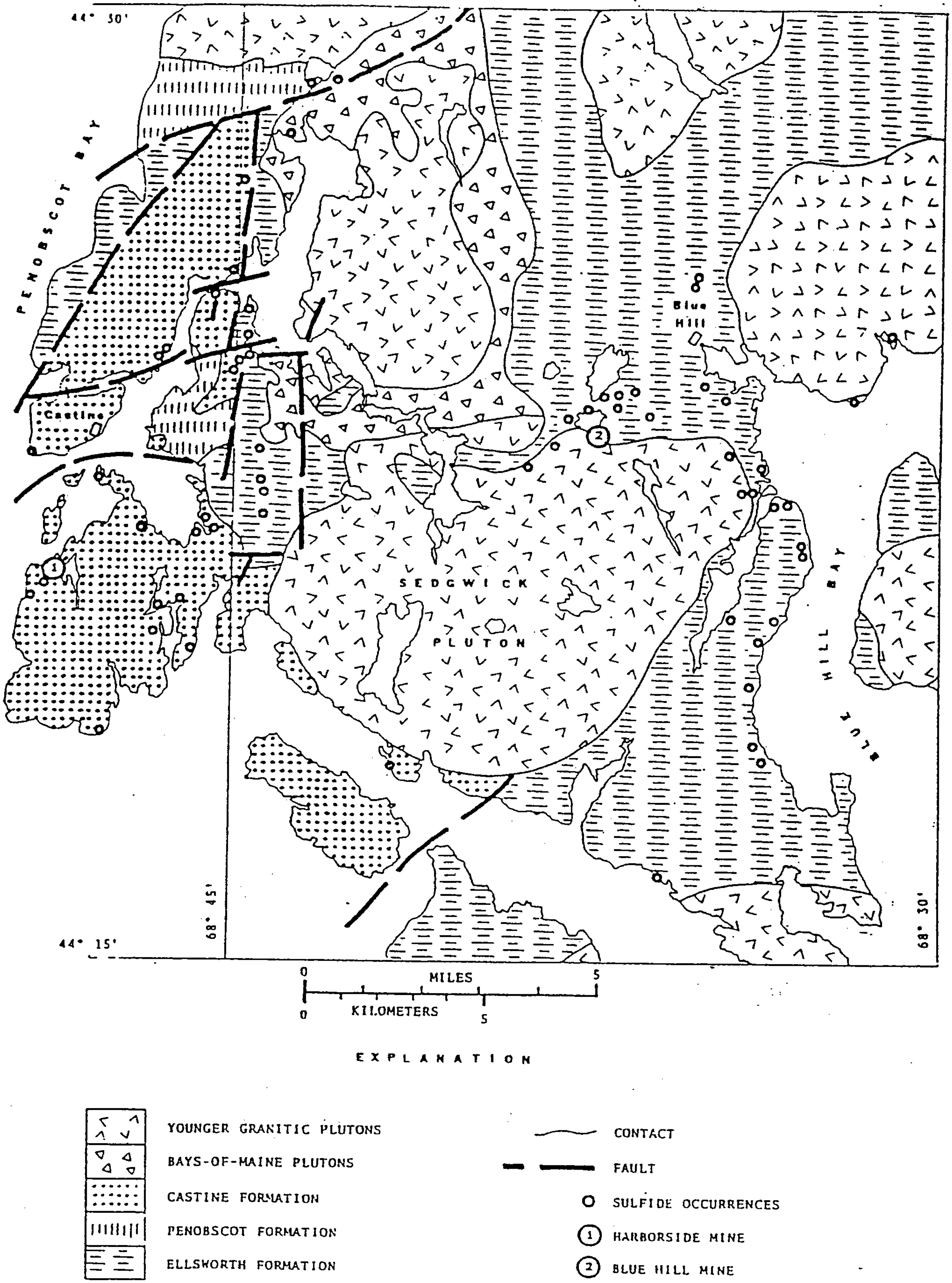
Frank H. Howd and David P. Drake
University of Maine, Orono and Kerramerican, Inc.

Introduction

The Penobscot peninsula, which lies between Penobscot Bay and Blue Hill Bay, is underlain by schists, volcanic rocks and intrusive rocks (see fig. 1). The Ellsworth Formation, which is dominant in the eastern part of the area, is a heterogeneous sequence of interlayered pyroclastic rocks, flows and clastic sedimentary rocks which have been highly deformed and metamorphosed to chlorite or biotite grade. At some localities original bedding features have been preserved, but more commonly the primary characteristics have been obliterated. Typically the rocks of the Ellsworth Formation contain abundant oriented chlorite or biotite resulting in a strong foliation. Colors range from light gray or greenish gray to almost black, depending on the relative abundance of quartz and feldspar as compared to the abundant chlorite and biotite. Segregations of quartz-rich zones are commonly present parallel to the foliation resulting in banded structures. Interbedded with the highly contorted schistose rocks are quartzite units as much as 300 feet thick which have reacted competently to the deformation.

The Castine Formation which dominates the western part of the area is composed of volcanic rocks including pillow basalts, felsic to intermediate tuffs and rhyolitic breccias, and less commonly slates and phyllites. The great variation in lithology has made stratigraphic correlation, even on a local scale very difficult, and as a result the total thickness and regional stratigraphy have been difficult to assess. The rocks have been subjected to chlorite grade metamorphism, but characteristically the original textures, especially of the coarser pyroclastic rocks have been preserved. Brookins et al. (1973) have established the age of the Castine volcanic rocks as 390 $\pm$ 5 million years.

The intrusive rocks of the area include gabbro and diorite of the Bays-of-Maine complex (Emmons, 1910; Chapman, 1962; Cheney, 1969), and the younger plutons most recently described by Chapman (1968) and Wones (1974). The younger plutons which show a close spatial relationship to many sulfide occurrences are characteristically granite or quartz-monzonite which vary in texture from coarsely porphyritic to fine-grained equigranular. They exhibit sharp discordant contacts not only with the Ellsworth and Castine Formations, but also intrude the rocks of the Bays-of-Maine complex. Commonly the intruded rocks have been brecciated, and the dislocated blocks have been engulfed and assimilated to varying degrees by the felsic plutons. Where the younger plutons invade the Ellsworth Formation, extensive metamorphic aureoles have resulted. The most common effect of metamorphism is the formation of hornfels containing biotite and cordierite as the characteristic minerals. Faul (1963) has determined the younger plutons to be early Late



Geology Modified from Brookins et al. (1973), Chapman (1968) and Cheney (1969)

FIGURE 1. GENERALIZED GEOLOGIC MAP OF THE BLUE HILL - CASTINE AREA

Devonian in age. Brookins (1968) determined the Sedgwick pluton, one of the younger intrusives, to be 395 ± 15 million years, and also points out that it intrudes the Castine Formation.

Sulfide Occurrences

Those sulfide occurrences located in the western part of the map area are concentrated in the Castine volcanic rocks; those in the Blue Hill area are concentrated at or near the contact between the Sedgwick pluton and the Ellsworth Formation (see fig. 1). This suggests several possibilities regarding the origin of the sulfide deposits, two of which will be pursued briefly.

1. – A single period of sulfide mineralization which post-dated the younger plutons and which produced hydrothermal replacement deposits over a large area in receptive host rocks.

2. – Two periods of sulfide mineralization, each of which affected a somewhat restricted geologic environment.

At this point, some of the characteristics of the ore deposits should be examined to provide evidence of their origin.

The Harborside deposit, which was the site of an open pit mine operated by the Callahan Mining Company from 1968 to 1972, is the largest known occurrence of those associated with the Castine Formation. Sphalerite and chalcopyrite are the dominant ore minerals, accompanied by abundant pyrite d lesser amounts of pyrrhotite. The host rocks are relatively undeformed, ightly metamorphosed (chlorite grade) or hydrothermally altered (chloritic) pyroclastics. At that deposit there are many textural and mineralogical characteristics which indicate that fluids of very low viscosity permeated the host rock and allowed deposition of sulfide minerals by a process commonly referred to as hydrothermal replacement. Some of the more common and, at the same time, spectacular developments are:

1. – Presence of unmineralized rock fragments which differ in composition from the mineralized matrix of the pyroclastic host rocks.

2. – Selective sulfide mineralization of certain minerals and grains in the matrix of the pyroclastic rocks.

3. – Preservation of pyroclastic and metamorphic textures and structures within the sulfidized zones.

4. – Presence of sulfide metacrysts transecting original pyroclastic textures.

5. – Presence of doubly terminated sulfide crystals in pyroclastic rocks.

6. - Presence of gradational sulfide mineralization fronts.

No one of these features by itself is conclusive evidence of hydrothermal replacement, but the combination of them in a single deposit is compelling evidence that the sulfide mineralization took place after the pyroclastic rocks were at least partially solidified. Most of the characteristics indicate that the rock was completely solid and had already been subjected to its slight metamorphism (or alteration) prior to the sulfide mineralization. These conclusions do not preclude the possibility that the ore-depositing solutions were derived from the same source as the volcanic material and represent a late stage of the volcanogenic cycle.

The largest and most intensively studied of the sulfide occurrences near the contact of the Sedgwick pluton and the Ellsworth Formation is the Blue Hill ore deposit, which is being mined by Kerramerican, Inc. by underground methods. Sphalerite and chalcopyrite are the dominant ore minerals; galena is rare and of no economic importance, and pyrite and pyrrhotite are common gangue minerals. The most important host rocks are slightly deformed quartzite units of the Ellsworth Formation. Locally within the mine area thin (25 to 50 feet) off-shoots of the Sedgwick pluton contain significant sulfide mineralization.

There are several metamorphic and hydrothermal minerals which are important in determining the sequence of events in the Blue Hill deposit. Contact metamorphism of the chlorite rich metasedimentary rocks has produced biotite-cordierite rocks whose textural variations allow them to be classed as either hornfels, schist or gneiss. These contact metamorphosed rocks have in turn been replaced by sulfide minerals; replacement textures are well shown by biotite-sulfide relationships. In addition, dravite (brown tourmaline) is present in veins and irregular masses which cross-cut both the contact metamorphosed Ellsworth rocks and the Sedgwick pluton. The tourmaline in turn is replaced by sulfide minerals, most commonly chalcopyrite and pyrrhotite. These relationships clearly indicate that the sulfides were transported in the ionic state and are of post-intrusive age. The close spatial relationship between the sulfides and the pluton indicates the probability of either a collinear or cognate genetic association between the intrusive and sulfide mineralization. Ching (1942) has outlined a sequence of events indicating a collinear relationship, but the sequential associations outlined above for the Blue Hill deposit are equally indicative of a cognate relationship as described by Burnham (1967).

History of the Blue Hill Mine

The discovery of copper mineralization in 1876 on the north shore of Second Pond led to the development of the Douglas mine and smelter which produced 2,000,000 pounds of copper from 1880 to 1884. Following an extended period of dormancy, the mine was reactivated for a few months during

World War I, but could not survive the low market price of copper. Another period of quiescence preceded an attempt by the U.S. Bureau of Mines to delineate an eastward extension of mineralization in 1948 by drilling seven exploratory holes. Lack of sulfide intercepts discouraged further work at that time.

Recent exploration began in 1957 when Texas Gulf Sulphur instigated a drilling program which resulted in the discovery of significant copper and zinc mineralization directly beneath Second Pond and slightly to the southwest. Black Hawk Mining Company, a subsidiary of Denison Mines, Ltd. then entered the scene and pursued those discoveries with additional drilling through the early 1960's. Encouraged by the results of their drilling project, Black Hawk expanded their efforts by sinking a shaft in 1964 and 1965. The three-compartment shaft reached a depth of 698 feet, with development levels at 380, 480 and 580 feet. Black Hawk completed approximately 10,000 feet of lateral development on those three levels and in addition drilled 31,750 feet of core from the underground workings. The company experienced difficulty in holding experienced miners with the project and as a result also found it difficult to keep the development with the ore. Early in 1967 Black Hawk Mining Co. suspended operations and permitted the underground workings to become flooded.

In 1970 Keradamex, Inc., a wholly-owned American subsidiary of Kerr Addison Mines, Ltd., entered into an option agreement with Black Hawk Mining Co. for the development of and production from the Black Hawk mine. After completing a drilling program to test a geologic theory of continuity of ore mineralization, Kerradamex exercised the option in mid-1971. By agreement, Kerramerican, Inc. (another subsidiory of Kerr Addison established to mine this property) was to acquire a 60% interest in the property after producing 500 tons of ore per day by September 1, 1973. Construction and pre-development began in July 1971 and in September of that year a 15% decline ramp was started in order to provide trackless access from the surface to the ore horizons. Once the ore zones were reached, a trackless pilot and slash technique was used for mining. Two rubber-tired jumbos were used for drilling, and broken ore was loaded into dump trucks for transportation to the crusher or stockpile at the surface. Kerramerican met their production objective as outlined in the agreement with Black Hawk Mining Co., and now are completely responsible for the mining and milling operation.

Mine Geology

The Second Pond mineralized area is underlain by the Ellsworth Formation which has been intruded and contact metamorphosed by the Sedgwick pluton. That portion of the Ellsworth Formation which is present in the mine area can be subdivided into four lithologic units which are described briefly in Table 1.

TABLE 1. Subdivisions of the Ellsworth Formation in the Blue Hill Mine.

Unit	Thickness	Description
Allen quartzite	greater than 300 feet	Massive to banded, brownish-gray to purplish-gray biotite-cordierite quartzite; variation in color and foliation dependent on amounts of dark brown biotite and blue-gray cordierite each of which may range in content from near zero to 40%; gradational into underlying schist with increase in biotite content. (Originally this quartzite was considered two units, Allen quartzite and Robbins quartzite, but is now treated by Kerramerican as a single unit).
Biotite schist	100 to 500 feet	Foliated, crenulated brownish-black to purplish-black biotite schist; biotite is dominant (up to 85%), blue-gray cordierite porphyroblasts are common in some areas, absent in others, quartzite content is variable and inversely related to the biotite content.
Pond quartzite	150 to 300 feet	Massive, gray quartzite with minor biotite and sericite; generally lacks prominent foliation and recognizable bedding; host for most of the known ore deposits.
Banded quartzite	150 to 250 feet	Upper portion dominated by alternating brownish-black biotite rich layers and dark green chloritic quartzites; quartzite dominates the lower portion and resembles the Allen quartzite, with the exception of the chlorite content.

The most common effect of metamorphism by the intrusive is the transformation of chlorite to biotite. In certain stratigraphic horizons where the mineralogy is suitable and where heat has been sufficient, cordierite porphyroblasts have developed and have produced a rock with a gneissic texture. Biotite and cordierite are not characteristic of the Ellsworth Formation except near the intrusive contacts.

In addition to the mineralogical change, a hybrid breccia zone has been formed irregularly at the contact. It is composed of partially assimilated blocks of Ellsworth Formation surrounded by granitic material. Both the mineralogical and intrusive breccia effects form zones as much as several hundred feet thick.

Although the Sedgwick pluton has a relatively narrow range in mineralogical composition (granite to quartz monzonite), the texture varies from fine-grained to coarse-grained and porphyritic, and the color varies from light gray to blue-gray, green and tan-orange. The color variations are primarily due to feldspar hue; although there is a wide range in the biotite content, its effect is to lighten or darken the colors. The pluton tends to be concordant and sill-like, generally located above the Pond quartzite. Within the mine area the thickness of the pluton is variable, attaining a maximum of 200 feet and increasing in thickness toward the south. There are many localities near the contact where the pluton has been partially to almost completely replaced by sulfide minerals. To complicate matters, there are also a few localities where unmineralized apophyses of the pluton cut across sulfide zones in the Ellsworth Formation.

A significant thickness of dark green, medium-grained gabbro is associated with the Sedgwick pluton southwest of the mine area. Within the mine, however, only minor (10 feet or less) gabbro or diabase dikes occur. All observed gabbro occurrences in the mine are pre-ore in age, and presumably part of the Bays-of-Maine igneous complex.

Ore deposits

The ore mineralization is related to the axis of an open syncline in the Ellsworth Formation striking N 30°W and plunging 30°SE. Mine development and geologic studies have disclosed a significant wrinkling in the axial plane of the syncline which may have resulted from drag folding or superimposition of a second generation fold. The Ellsworth Formation and banded ore deposits commonly contain folds with amplitudes of 10 to 20 feet. Several folds of large magnitude have been observed and interpreted to be distorted drag folds parallel to the major fold. Interpretation of surface drilling indicates a flattening of the major syncline down plunge, but data are sparse and details of the structural trends are not well known.

Several faults which are locally significant have been recognized on the mine property. The Mammoth fault was first detected by Black Hawk Mining Company as a result of surface drilling and has been further defined by Kerramerican drilling. Early in 1974 the fault was crossed by the Mammoth haulage drive, substantiating its projected position. New movement on the fault is estimated to be 100 to 200 feet in a reverse direction.

The Carleton fault was outlined by Kerramerican geologists on the basis of drill hole intersections which show planar continuity. The throw on the Carleton fault is estimated to be 100 feet or less in a reverse direction.

The Sedgwick and West faults, which are cross-faults between the Carleton and Mammoth faults, were first detected in drill hole intersections. The West fault has been substantiated by mine development, and the Sedgwick fault is now interpreted to be a locally sheared monoclinal fold.

The Dam fault is the only one of significance recognized in an ore body. It is present in the Second Pond "A" zinc zone where it has a displacement of about 30 feet, and is accompanied by marked thickening of massive sulfides on the hanging wall. The combined accumulation of sphalerite, pyrrhotite, pyrite and chalcopyrite approaching 30 feet is unique in the mine.

The most important ore mineralization at the Blue Hill mine consists of massive sphalerite occurring in at least four strata-bound horizons which are nearly continuous over most of the mine area. The horizon which currently accounts for the greatest production is the Second Pond "A" zinc zone which occurs near the upper contact of the Pond quartzite. The mineralization has local folds and disruptions of sufficient magnitude that in some areas the miners have difficulty staying on the ore. Massive sphalerite of the "A" zone ranges in thickness from less than an inch to over twenty feet, and averages about two and a half feet. The massive sphalerite of the "A" zone contains as much as 3% chalcopyrite and 25% combined pyrite and pyrrhotite; commonly the zone is dominated by gangue sulfides. Disseminated and veinlet sulfide minerals occur throughout the mine area, most commonly near the massive sulfide horizons. Sphalerite is typically coarse-grained, dark brown to almost black; rarely paler shades of brown and fine grained textures occur. Three additional zinc horizons similar to the "A" zone have been discovered by diamond drilling, but ore bodies have not yet been delineated.

Chalcopyrite mineralization is widespread in the mine area, commonly occurring as replacement at intergranular boundaries in quartzitic units. It also occurs in fracture fillings and by replacement in all rock units including the Sedgwick pluton. In spite of the widespread occurrence of chalcopyrite, only two zones are large enough and sufficiently mineralized to be considered orebodies. The Lower Second Pond (L.S.P.) orebody lies directly beneath the "A" zinc zone, at or near the base of the Pond quartzite. Thickness of the L.S.P. orebody ranges from a few feet to 30 feet. The Mammoth area, southwest of Second Pond contains two zones similar to the L.S.P. orebody, but on the basis of current information, only a portion of one of the zones in the lower-middle Pond quartzite can be considered an orebody.

Hydrothermal alteration of host rocks is common but not consistent throughout the mine. A systematic study concerning alteration has not yet been carried out, and at this time the spatial and paragenetic relationships between alteration products and sulfide minerals are not well known. Sericite, chlorite, biotite, amphiboles, tourmaline and green feldspar have been reported as alteration products, but analytical confirmation has been attempted for only a few specimens.

References

Brookins, D. G., 1968, Whole rock and mineral ages of granites and related rocks from the Castine-Blue Hill area, Maine (abs.): Am. Geophys. Union Trans., v. 49, p. 346.

______, et al., 1973, Isotopic and paleontologic evidence for correlating three volcanic sequences in the Maine coastal volcanic belt: Geol. Soc. America Bull., v. 84, p. 1619-1628.

Burnham, C. W., 1967, Hydrothermal fluids at the magmatic stage: Chap. 2 in Geochemistry of Hydrothermal Ore Deposits, ed. by H. L. Barnes. Holt, Rinehart and Winston, New York.

Chapman, C. A., 1962, Bays-of-Maine igneous complex: Geol. Soc. America Bull., v. 73, p. 883-888.

______, 1968, A comparison of the Maine coastal plutons and magmatic central complexes of New Hampshire: Chap. 29 in Studies of Appalachian Geology, Northern and Maritime, ed. by Zen, et al., Interscience, New York.

Cheney, E. S., 1969, Geology of the Blue Hill-Castine mining district, southwestern Hancock County, Maine: Second Ann. Rept. for Maine Geol. Survey, 148 p.

Ching, Y. L., 1942, Genesis of some ore deposits of southeastern Maine: Geol. Soc. America Bull., v. 53, p. 15-52.

Emmons, W. H., 1910, Some ore deposits in Maine and the Milan mine, New Hampshire: U. S. Geol. Surv. Bull. 432, 62 p.

Forsyth, W. T., 1953, Metamorphic facies of the Ellsworth schist in Blue Hill, Maine: Unpublished M. S. Thesis, Univ. of Maine, 52 p.

Hussey, A. M., II, and Austin, M. B., 1958, Maine metal mines and prospects: Maine Geol. Survey, Min. Res. Index No. 3, 53 p.

Wones, D. R., 1974, Igneous petrology of some plutons in the northern part of the Penobscot Bay area: in NEIGC 1974 Guidebook.

Young, R. S., 1962, Prospect evaluations, Hancock County, Maine: Maine Geol. Survey, Spec. Ec. Stud. Ses., No. 2, 113 p.

STATE OF MAINE

Reference 9

Department of Environmental Protection

MAIN OFFICE: RAY BUILDING, HOSPITAL STREET, AUGUSTA
MAIL ADDRESS: State House Station 17, Augusta, 04333

JOHN R. McKERNAN, JR.
GOVERNOR

MEMORANDUM

DEAN C. MARRIOTT
COMMISSIONER

TO: Susan Svirsky, EPA Region I

FROM: Gordon Fuller, OHMS I, MeDEP

DATE: May 28, 1987

RE: Site Inspection Report, Callahan Mine, Harborside, Maine
Site Number - MED980524128

** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** **

Introduction

The Callahan Mine Site, an approximately 100 acre site, located in Harborside, on Cape Rosier, has been the Site of intermittent efforts for the mining of zinc-cooper ore since 1880. In 1964 the Callahan Mining Corporation purchased the Site from the Penobscot Mining Company, and actively mined it from February 1968 to June 1972. At the cessation of mining, Callahan undertook several efforts to restore/reclaim the Site, including grading, hydroseeding, and planting trees and shrubs. These efforts were only partially successful as much of the Site is still barren of any vegetation.

The Site is presently owned by Mr. Robert Mant, who purchased the Site from Callahan in 1976. Mr. Mant attempted some aquacultural activity at the Site, including the raising of salmon, with some degree of success. The Site is presently inactive and apparently abandoned.

Topographic considerations indicate that the Site is adjacent to or over an area of groundwater discharge. Any leachate which may be produced by precipitation percolating through the ground surface at the Site, is assumed to discharge primarily into the Goose Pond Estuary after travelling a short distance as groundwater.

Past studies and investigations indicate that the Cape Rosier area, including Harborside and the Callahan Mine Site, is naturally metalliferous. Therefore, it would not be surprising to find that groundwater in this region might have a relatively high concentration of total metals due (at least in part) to natural geologic conditions in the area.

An attempt was made to examine the entire Site and particular attention was devoted to the Tailings Storage Pond Area, the Old Dump Area, the Buildings/Underground Fuel Storage Tanks Area, and the Settling Pond Area (Dyer Cove) (see attached Figure 1). A number of soil and water samples were collected from these areas (see attached Figures 1 and 1A). In addition, seven (7) drinking water samples were collected from local residences located around the general vicinity of the Site (see attached Figure 2), and an on site artesian well was sampled also. All samples were analyzed for the following metals which might be associated with the former mining operation at the Site: cadmium, lead, zinc, and copper. Cadmium and lead are listed by the Environmental Protection Agency (EPA) and Department of Human Services (DHS) as primary contaminants for drinking water supplies, capable of creating adverse health effects when found in drinking water at concentrations above standards established by the EPA and the DHS; while zinc and copper are considered to be secondary aesthetic contaminants, not generally associated with adverse health effects to users/consumers of water containing these metals.

NOTE: These metals often occur naturally in groundwater and when found in small quantities, at or below EPA/DHS drinking water standards or guidelines, are considered by EPA and DHS not to be harmful to humans. EPA/DHS Guidelines and Standards for these metals have been included in attached Table 1.

Investigation/Observations

Following a cursory examination of the surrounding vicinity and the Site itself, further investigative efforts were concentrated in the following areas:

Tailings Storage Pond Area

This area occupies approximately ten (10) acres of the Site and is surrounded by a rock berm estimated to be approximately 100' in height. The area is adjacent to the Goose Pond Estuary and was used to contain mine tailing wastes, generated during the mining operation, 1968 - 1972. These tailings wastes consist of fine sand and silt-sized particles which were generated during the milling process.

At the center of the former Tailings Storage Pond area is a wet area where cattails are thriving. Surface water from this area was sampled and analyzed at the DHS Public Health Lab. The results of these analyses indicate the presence of the four metals at concentrations below the levels considered unhealthful by the EPA or the DHS. The remaining surface area of this Tailings Storage Pond area was dry and sparsely vegetated by shrubs and grasses.

At the north end of the Tailings Storage Pond area there is a drainage ditch and rock spillway which drains off any excessive surface water from the center of the pond, created during periods of heavy rainfall, therefore decreasing the volume of water percolating down through the tailings wastes. Any water running off from this area into the drainage ditch and rock spillway, would eventually discharge to the Goose Pond Estuary. As would be expected, a composite soil/sediment sample collected from the Tailings Storage Pond ditch area contained high concentrations of total metals relative to historical background metals data for soil/sediment samples collected from this area (see enclosed Table 2 for a summary of soil/sediment samples collected at the Site and Table 2A for historical background information from this area and Table 2B for a range of concentrations in soils of inorganic elements which may occur as contaminants). High metal concentrations from the Tailings Storage Pond wastes and/or the lack of organic material present, may be responsible for the lack of plush vegetation here.

The base of the rock Tailings Storage Pond berm was investigated for possible water seeps from this area. Three seep areas were discovered and soil and water samples were collected from two of these areas. Seep Area #3 was not sampled due to inaccessibility to the water discharge area and a lack of flow. Cadmium levels in waters collected from the two observed and sampled seeps were slightly elevated over EPA/DHS drinking water standards and zinc concentrations were also elevated in Seep Area #2. Also, as expected, metal concentrations in the soil/sediment from the areas near these seeps, were higher than historical background metal levels from the Cape Rosier vicinity. In addition, these two seeps were sampled and analyzed for cyanide, volatile organics, and semi-volatile organics. (Samples were analyzed for cyanide in response to allegations that drums of cyanide waste may have been deposited into the Tailings Storage Pond .) No cyanide was detected in any of the samples. However, low concentrations of certain volatile organic compounds, 1,1,1-Trichloroethane - .017 milligrams per liter (mg/l); Toluene - .005 mg/l; Ethyl Benzene - .006 mg/l; and Xylene - .036 mg/l; were detected in the sample from Seep #2. In addition, one semi-volatile base neutral compound, Di-n-butylphlalate, was found in the sample from Seep #1. Two other compounds identified as 0,0 Diethyl S-Ethyl Phosphorothioate and 0,0 Diethyl S-Methyl Phosphorodithioate, were found in the Seep #1 sample at concentrations of approximately .008 mg/l and .010 mg/l respectively. Several other unidentified nonhalogenated compounds were also detected in this sample (at concentrations in the parts per billion range) as well. Neither of the seep samples contained contaminant concentrations exceeding established DHS/EPA standards for safe drinking water. (See Table 3 for EPA/DHS standards for volatile organic and semi-volatile organic compounds, and other compounds identified within.)

Although only three seep areas were discovered during the investigation, it is certainly possible and in fact likely, that others may exist. In all likelihood, water seeping from the tailings storage pond area discharges eventually to the Goose Pond Estuary. There were specific locations along the base of the berm wall that were barren from vegetation, however, most of this area between the base of the Tailings Storage Pond area and the estuary was covered with thriving vegetation.

Summary

The Tailings Storage Pond area designed to contain mine processing wastes is leaking slowly at the base in several observed locations. Water seeping from this area and discharging to the Goose Pond Estuary contains cadmium and zinc at concentrations above EPA/DHS drinking water standards. In addition, a number of other compounds, including volatile organics, semi-volatile organics, and other unidentified nonhalogenated compounds, were detected in the water samples collected from two of the seep areas at the base of the Tailings Storage Pond north eastern wall. The concentrations of the identified contaminants did not exceed those standards/guidelines established by the EPA/DHS for safe drinking water. Relatively high metal concentrations were found in the soil/sediment on the Tailings Storage Pond surface - compared to historical background data. These relatively high metal concentrations and the lack of organic material on the surface of this area, are probably responsible for the lack of thriving vegetation over the entire surface area.

Old Dump Area

The area depicted on Figure 1 as the Old Dump area by Callahan Mining is located several hundred yards northwest of the Tailings Storage Pond area and occupies the first terrace of "Callahan Mountain". This area is several acres in size and is bermed by a rock wall, 75-100' in height. It is my understanding that this area was used as a dump site for waste rock and marine clay that had filled the open pit mine following a mud slide. One estimate suggests that up to 200,000 tons of marine clay may be located in this dump area. Additional information indicates that Callahan undertook a revegetation project for this area as part of its Site restoration/reclamation effort following the closing of the mine in 1972. It is apparent that such a project was implemented as vegetation, including shrubs and grasses, is thriving here, covering the entire surface of this so-called dump area.

The base of the rock berm around this dump was also checked for seeps/leaks including the area at the head of the Settling Pond. The only seep discovered in the area was observed at the head of the Settling Pond.

Summary

The Old Dump site depicted on Figure 1 was used as a site for the dumping of waste rock and marine clay/mud. This area has been revegetated and trees, shrubs, and grasses are thriving. Water seeping through this area, may eventually discharge to the estuary at the head of the settling pond.

Settling Pond (Dyer Cove) and Goose Pond Estuary

The Settling Pond area (commonly referred to as Dyer Cove) was a fully enclosed area used to temporarily store water pumped from the open pit mine. Particulates were allowed to settle out prior to pumping the water from this pond out into Goose Cove. Today the Settling Pond is not fully enclosed and is a part of the Goose Pond Estuary. The cove appears to be supporting a large population of soft shell clams and marine worms. Several species of marsh grass were also observed growing here.

Water was observed seeping through the rocks into the Settling Pond at the head of the pond. The seep may originate from the Old Dump area or more likely from the Buildings area where four partially full underground fuel tanks are buried. A water sample and soil/sediment sample was collected from this seep area. The water sample contained concentrations of cadmium and zinc - above

EPA/DHS standards for drinking water. As expected the soil sediment sample collected from this seep area, showed relatively high metal concentrations. In addition, water samples were collected and analyzed for volatile and semi-volatile organics. None were detected, including gasoline and fuel oil.

The rocky shore of this pond/cove was walked and examined for additional seep areas. No evidence of seepage was observed. However, four unmarked/unlabeled drums were found, three of which contained some free flowing liquid waste material. I estimated that the drums contained twenty gallons total. The fourth drum was empty. The three drums were sampled and these samples were returned to Augusta for hazardous waste analyses. All drums were found to contain non hazardous rusty water.

In addition, it appeared that the rocky area, near the head of the Settling Pond had at one time been used as a general dumping area, as solid waste materials and other debris was observed in amongst the rocks along the shore, near the seep area.

Two water samples were collected from the Goose Pond Estuary, one along the western shore of the estuary, adjacent to the Tailings Storage Pond; and the second at the south end of the Weir Cove Ditch. Both samples were analyzed for total metals and found to contain concentrations below EPA/DHS Drinking Water Standards/Guidelines.

As was observed in the Settling Pond, soft shell clams and marine worms appear to be present in the estuary. Several species of marsh grass were also observed growing in parts of the estuary. In addition, blue mussels were observed thriving in the area near Goose Falls.

Summary

One water seep was observed slowly discharging to the Goose Pond Estuary at the head of the Settling Pond (Dyer Cove). The seep contains concentrations of cadmium and zinc exceeding EPA/DHS Drinking Water Standards/Guidelines. Four waste drums were found, sampled, and analyzed by the DEP. None were found to contain hazardous waste. These drums have been removed from the shore and are stored in the main building at the site.

Two water samples collected from the Goose Pond Estuary were found to contain acceptable metal concentrations - below EPA/DHS Standards/Guidelines. In addition, several species of marine biota were observed thriving in the estuary.

Buildings/Underground Tank Area

The Buildings area near the Settling Pond was investigated for the presence of drums, hazardous wastes, and underground fuel tanks.

The area is cluttered by general debris and trash, however, no drums containing liquid wastes were found. Several empty rusted drums were seen. Four partially covered underground fuel storage tanks were discovered in this area. Intake fill pipes were opened and the tanks were found to still contain varying quantities of liquid. It appeared that two of the tanks were gasoline/ diesel tanks, one was a fuel oil tank, and the fourth one was a waste oil tank. These tanks must be removed and properly abandoned in accordance with Maine law and regulation.

Summary

General debris and trash is cluttered about the Site in the area of the main buildings. In addition, four abandoned underground fuel tanks are present which must be properly taken care of (contents properly removed and tanks excavated). This area should be picked up and trash and debris hauled off site to an approved solid waste disposal facility.

Other Areas

It is my understanding that Callahan used an area south of the powder magazine on Callahan Mountain as the site of one of its company dump sites for trash. The area has apparently been covered over as no evidence of a dump was observed in this area.

Several other areas on the Site were found, where debris and other wastes had been dumped or deposited. Trash and several empty rusted drums were observed in these areas. There was no indication that any of this debris represented hazardous wastes. It appeared that these wastes had been in their present locations for many years, without apparent significant threat to public health, safety or the environment.

Drinking Water Sampling Program

In addition to the on-site investigation and sampling program which was carried out, an on site artesian well and seven off-site area resident drinking water supplies were sampled and analyzed for lead, cadmium, zinc, and copper.

Those residences sampled were: Roscoe Rankin, Perry Smith, Joseph Gray, Jack Robinson, Glendon Harding, and Malcolm Gray/Albert Sandecki. Two wells were sampled at Malcolm Gray/Albert Sandecki residences - an older dug well (infrequently used) and a newer drilled well (used for drinking water). All water samples, except the Gray/Sandecki dug well sample, met DHS Standards/ Guidelines for the metals, cadmium, lead, zinc, and copper. The dug well sample from the Gray/Sandecki residences contained concentrations of the secondary trace metal zinc at 10 mg/l, which exceeds the DHS Guideline of 5 mg/l. All residents have been informed of their well water sample results, and a copy of this information has been mailed to each resident.

An onsite drilled well was found, located in the woods just west of the Tailings Storage Pond. A second artesian well was found in the area just west of the main buildings. This artesian well was sampled and analyzed for volatile organic compounds, semi-volatile organic compounds, and total metals (Cd, Zn, Pb, and Cu). No volatile or semivolatile compounds were detected. The other onsite well had been capped or sealed and therefore could not be sampled.

Summary

Based on available historical information/data and a review of the recent sampling results for those residential wells around the vicinity of the Site, there is no indication that those wells are currently unsuitable for drinking water purposes. There has been no apparent increase in the concentrations of these metals in the local groundwater since prior groundwater study work was performed in 1968 - 1972 (see Enclosure A - Table VI from U.S. Department of Interior, Federal Water Quality Adminstration, Northeast Region, New England Basins Office, Needham Heights, MA, August 1970, "Effects of Strip Mine Discharges on the Marine Environment, Cape Rosier, Maine".).

Conclusions:

1. The Callahan Mine Site in Harborside, Maine is located on a groundwater discharge area adjacent to the Goose Pond Estuary. The Site occupies a large area and is characterized by huge piles of rock and rock debris, and sparse vegetation. There are several distinct areas at the Site which have been described above - Tailings Storage Pond Area, Old Dump Area, Settling Pond, and Main Buildings Area where four Underground Fuel Tanks are located.

2. There is unrestricted access to the Site at two locations. One particular hazard associated with this Site is the fact that access is not restricted. There are many areas at the Site where serious injury could occur by persons slipping, falling, or even driving a vehicle over the edge of one of the huge rock piles. There are access roads to the tops of these rock piles which enable anyone, whether familiar with the Site or not, to explore and travel the Site.

3. Three groundwater seeps were observed at the base of the Tailings Storage Pond area, and a fourth seep was observed at the head of the Settling Pond (Dyer Cove). These seeps eventually discharge to the Goose Pond Estuary. Although the concentrations of certain metals in these seep waters exceed EPA/DHS standards for drinking water and low concentrations of certain volatile and semi volatile compounds were detected in the water from two of the seep areas at the base of the Tailings Storage Pond, I cannot conclude that these seeps would have a significant adverse impact on the water quality of the Goose Pond Estuary, due to the large volume of water in the estuary and the very slow flow of each seep.

4. Past studies by the Department of Marine Resources and the U.S. Department of the Interior have shown that shellfish in the Goose Pond Estuary have concentrated metals to the point where these animals may not be suitable for human consumption. In addition, these studies have shown that the mud and sediment in the Goose Pond Estuary show elevated values for metals, as might be expected following a mining operation. The area is presently closed to the taking of shellfish by the Department of Marine Resources.

5. The four buried, partially full, underground fuel tanks represent a potential threat to the environment and public health of people living in the immediate vicinity of the Site. At this time it is not known whether any of these tanks have leaked, although it is known that there is some water in each of the four tanks.

Recommendations

1. The four abandoned underground fuel tanks must be properly pumped out and removed from the Site, together with any contaminated soil resulting from past spills or leaks.

2. The Goose Pond Estuary should remain closed to the taking of shellfish until such time that officials from the Department of Marine Resources and the Department of Human Services determine that metal concentrations in the shellfish decrease to a acceptable level safe for human consumption.

3. Prior to use of groundwater beneath the Site, such water should be resampled and tested for the metals of concern, volatile and semi volatile organic compounds (including gas and fuel oils), and those other identified compounds detected in the seep water from the Tailings Storage Pond area. The Bureau of Health should be consulted prior to the use of this groundwater for any purpose, following sampling and analyses. (This is especially true if the capped well near the Tailings Storage Pond is intended to be put back into service, or another well is installed in this area on the Site.)

4. Access to the Site should be restricted (e.g., gates erected across Site entry roads and no trespassing signs posted). Swimming in the estuary in the area adjacent to the Tailings Storage Pond and in Dyer Cover should be prevented or discouraged (post no swimming signs).

5. The Tailings Storage Pond Area should remain undisturbed. Construction or development activities or any groundwater withdrawal/use should not be conducted in this area without prior approval of at least the Town, only after it has determined by detailed assessment to be protective of public health, safety and the environment. To insure no development or groundwater withdrawal and use in this area, a restriction should be placed in the property deed by the Site owner or Town, prohibiting such activities.

6. Additional sampling of the groundwater seep areas around the base of the Tailings Storage Pond and at the head of Dyer Cove and periodic monitoring of selected downgradient household wells for metals, volatile organic compounds and semivolatile organic compounds may be warranted in the future in order to develop a better data base, and to further evaluate conditions at and around the Site.

GFCALLAHN

Table 1

State of Maine Rules Relating to Drinking Water - DHS

Primary Drinking Water Standards - Inorganic Chemicals

Contaminant	Maximum Contaminant Level (mg/l)*	Action Level
Cadmium (Cd)	0.010 mg/l	0.005 mg/l
Lead (Pb)	0.05 mg/l	0.025 mg/l

Secondary Drinking Water Standards - Esthetic Contaminant Levels

Contaminant	Recommended Maximum Contaminant Level
Copper	1.0 mg/l
Zinc	5.0 mg/l

Summary of Water Sample Analyses at Site

Location	Metals			
	Pb	Cd	Cu	Zn
Seep Area to Settling Pond	.003 mg/l	.06 mg/l	.05 mg/l	13.9 mg/l
Weir Cove Ditch	<.001 mg/l	<.001 mg/l	<.02 mg/l	<.02 mg/l
Tailings Pond Surface Water	<.003 mg/l	<.001 mg/l	<.02 mg/l	.39 mg/l
Goose Pond Estuary	.004 mg/l	.002 mg/l	.04 mg/l	.38 mg/l
Seep Area #1	<.003 mg/l	.011 mg/l	<.02 mg/l	3.62 mg/l
Seep Area #2	<.003 mg/l	.018 mg/l	<.02 mg/l	9.41 mg/l
Onsite Drilled Well	<.003 mg/l	<.001 mg/l	<.02 mg/l	.02 mg/l

* mg/l = ppm
(milligrams per liter = parts per million)

Table 2

Summary of Soils/Sediments Sampled at Callahan Mine Site

Locations	Metals (mg/kg)* Cd	Cu	Pb	Zn
Seep Area to Settling Pond	11 mg/kg	84 mg/kg	360 mg/kg	4200 mg/kg
Spillage from Tailings Pond	10 mg/kg	730 mg/kg	370 mg/kg	2800 mg/kg
Seep Area #1	110 mg/kg	1200 mg/kg	510 mg/kg	23000 mg/kg
Seep Area #2	21 mg/kg	890 mg/kg	1100 mg/kg	7600 mg/kg

** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** **

TABLE 2A

Background Soil/Sedment Stations #5, 6, 7, 8, 9, 11, 12, 13
See Enclosed Figure 3 from DMR Report

Metal	Range in ppm (mg/kg)	Mean Background
Pb	0 - 1.75	1.6
Cd	0 - .4	.1
Zn	8.79 - 13.76	11.01
Cu	.87 - 2.88	1.6

From 1972 Department of Marine Resources Report "Renewable Resource Problems of Heavy Metal Mining in Coastal Maine" by Robert Dow and John Hurst.

** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** ** *** **

TABLE 2B

Range of Concentrations in Soils of Inorganic
Elements which Sometimes Occur as Contaminants

Metal	Range in ppm (mg/kg)
Pb	2 - 200
Cd	0.1 - 7
Zn	10 - 300
Cu	2 - 100

From "The Nature and Properties of Soils", 8th Edition, by Nyle C. Brady.

*mg/kg = ppm
(milligrams per kilograms = parts per million)

Table 3

	EPA/DHS Maximum Exposure Guidelines	Action Level
<u>Volatile Organic Compounds</u>		
1,1,1-Trichloroethane	.330 mg/l	.170 mg/l
Toluene	.100 mg/l	.050 mg/l
Ethyl Benzene	---	---
Xylene	.620 mg/l	.310 mg/l
<u>Semi-volatile Organic Compounds</u>		
<u>Base Neutral Compounds</u>		
Di-n-butylphalate	---	---
<u>Other Compounds</u>		
0,0 Diethyl S-Ethyl Phosphorothioate	---	---
0,0 Diethy S-Methyl Phosphorodithioate	---	---

--- No established EPA/DHS Standard/Guideline

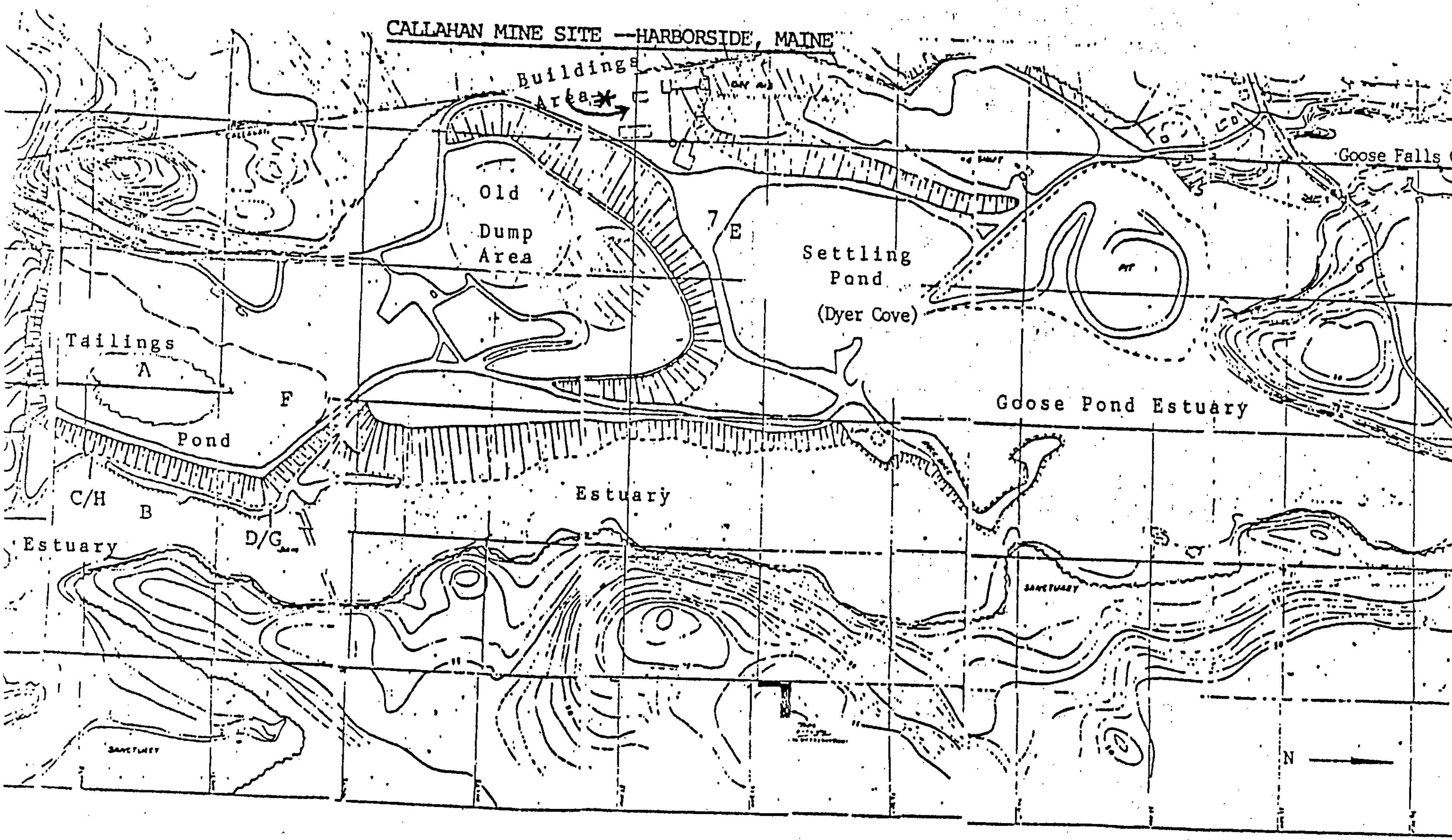
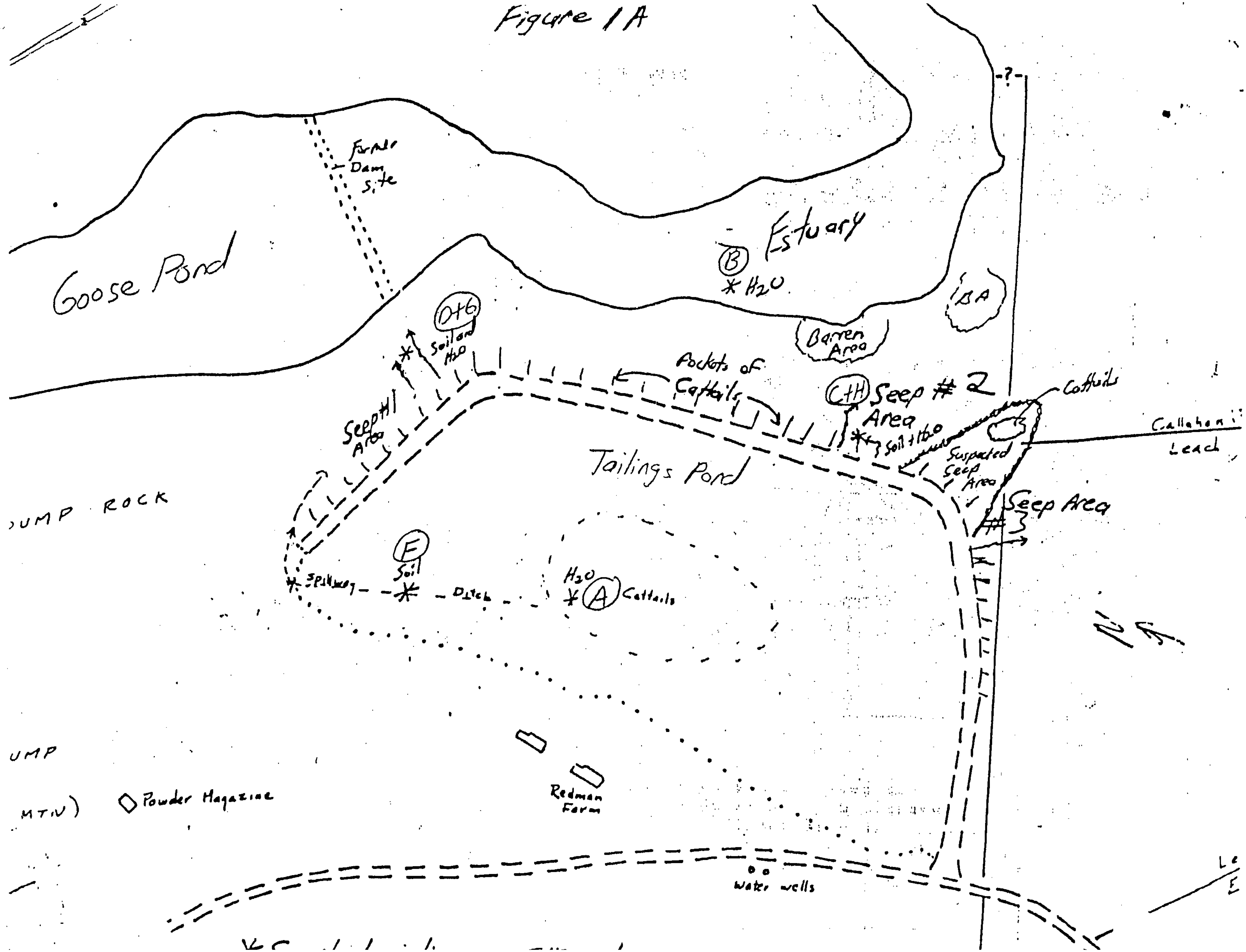


Figure 1

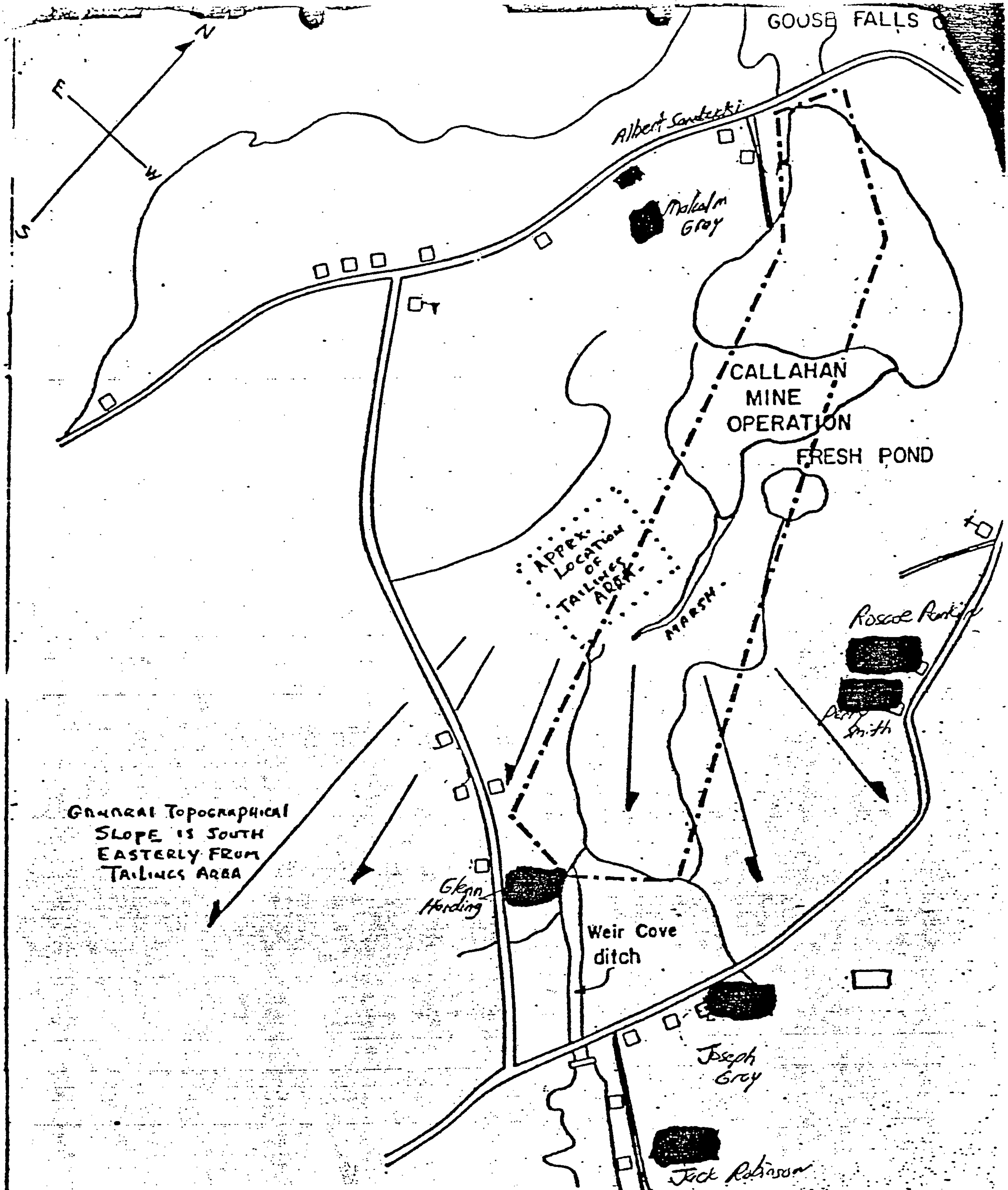
Key:

A -- Surface water from tailings pond area
F -- Soil/Sediment from tailings pond spillway
C -- Water from seep area #2
H -- Sediment from seep area #2
B -- Water from Goose Pond Estuary
D -- Water from seep area #1
G -- Sediment from seeparea #1
E -- Sediment from seep to Dyer Cove
7 -- Water from seep to Dyer Cove
* -- Water from onsite artesian well

Figure 1A



Goose Pond
Former Dam Site
Estuary
B
H2O
BA
Barren Area
D+G
Soil and H2O
Pockets of Cattails
C+H
Seep # 2 Area
Soil + H2O
Cattails
Callahan Lead
Seep #1 Area
Tailings Pond
Suspected Seep Area
Seep Area #3
DUMP ROCK
F
Soil
Spillway
Ditch
H2O
A
Cattails
DUMP
MTN)
Powder Magazine
Redman Farm
Water wells
N



WATER SUPPLY SAMPLING LOCATIONS
CAPE ROSIER, MAINE

Figure 2

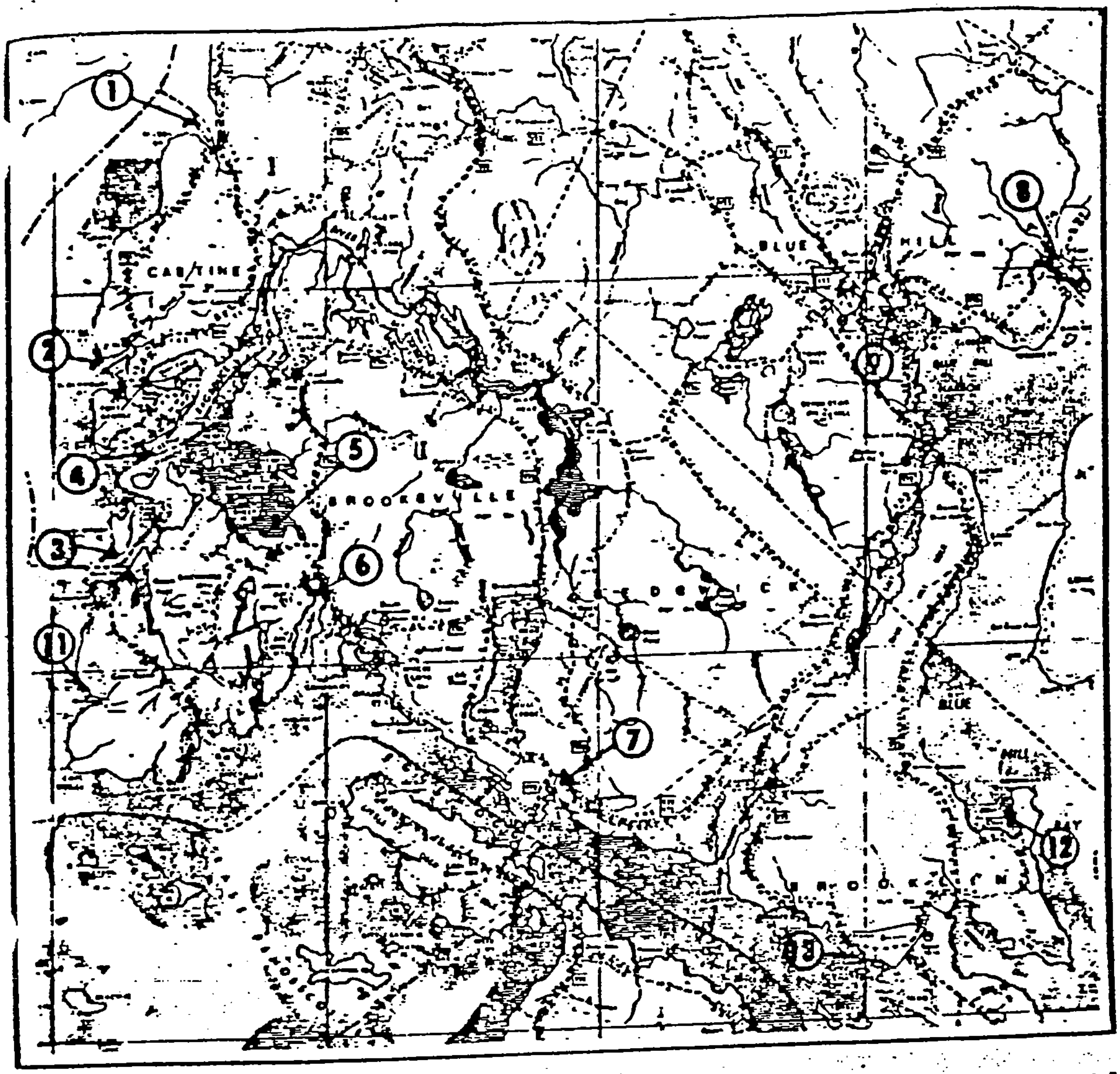


FIG.3 shows sample areas from unmined sections of Hancock which were used to compare normal metal concentrations in sea water and sediments with those in the mining area.

Background Stations #5, 6, 7, 8, 9, 11, 12, 13

Metal	Range (in ppm)	Inferred Background (mean)
Cu	.87-2.88	1.6
Zn	8.79-13.76	1 1.01
Cd	0-.4	.1
Pb	0-1.75	.84
Co	0-.38	.16
Fe	196.7-654.8	356.25
Cr	1.26-6.78	3.4
Mn	3.78-34.1	12.31
	.76-2.07	1.27
Ni	Mean	4 3.00

Figure 3

TABLE VI

Metals Concentration - mg/l in Well Water
Cape Rosier, Maine December, 1967 - September, 1968

Station	PHASE I Zn	Cd	Ni	Cu	Pb	PHASE II Zn	Cd	Ni	Cu	Pb
1F	1.5	0.0	0.02	0.5	0.0	< .01	< .01	< .01	0.4	< .01
2F	1.6	0.001	0.02	0.01	0.0	1.3	< .01	0.02	0.1	< .01
3F	0.1	0.0	0.02	0.05	0.02	0.4	< .01	0.02	0.1	< .01
4F	0.1	0.002	0.03	0.03	0.0	< .01	< .01	0.01	0.07	< .01
5F	1.6	0.001	0.03	0.06	0.0	0.8	< .01	0.02	0.2	< .01
6F	0.1	0.0	0.0	0.2	0.01	-	-	-	-	-
7F	0.02	0.001	0.01	0.005	0.0	< .01	< .01	< .01	0.03	< .01
8F	1.6	0.0	0.05	0.02	0.01	< .01	< .01	0.15	0.04	< .01
9F	0.03	0.0	0.04	0.02	0.01	< .01	< .01	< .01	0.04	< .01
10F	0.07	0.0	0.05	0.02	0.02	< .01	< .01	< .01	0.06	< .01
11F	1.6	0.001	0.03	0.03	0.09	-	-	-	-	-
12F	0.04	0.0	0.03	0.01	0.0	< .01	< .01	< .01	0.04	< .01
13F	0.05	0.001	0.03	0.14	0.01	< .01	< .01	< .01	0.08	< .01
14F	0.05	0.0	.04	0.05	0.08	< .01	< .01	< .01	0.09	< .01
Goose Pond At Weir Cove	0.03	0.0	.03	0.02	0.0	< .01	< .01	< .01	0.04	< .01

Phase I - December, 1967

Phase II - May, 1968

Enclosure A

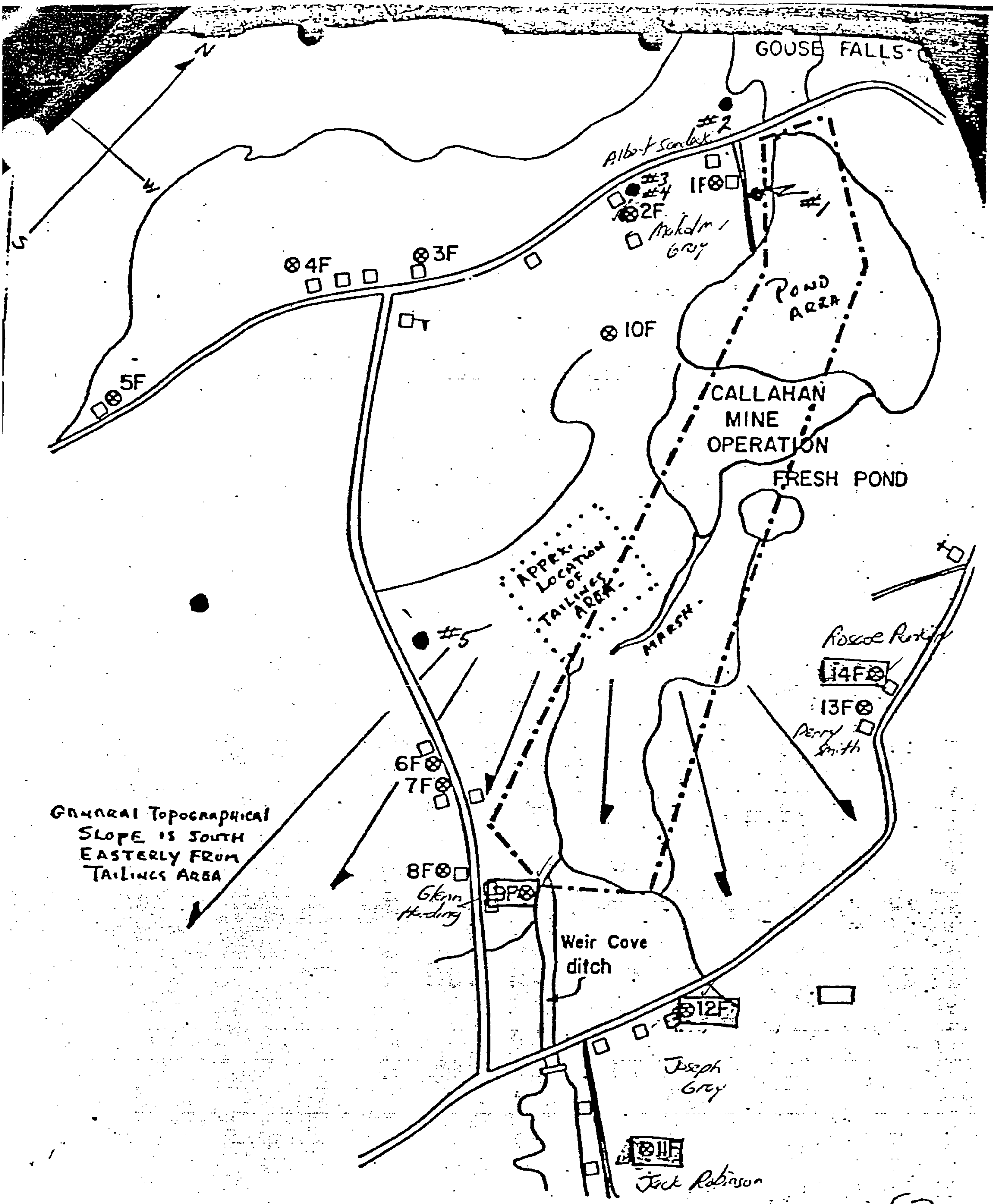
TABLE VI (Cont.)

Metals Concentration - mg/l in Well Water
Cape Rosier, Maine December, 1967 - September, 1968

	PHASE III					PHASE IV				
Station	Zn	Cd	Ni	Cu	Pb	Zn	Cd	Ni	Cu	Pb
1F	-	-	-	0.03	-	0.0	< .004	< .01	< .005	< .03
2F	1.07	0.01	<.01	0.05	< .03	0.68	< .004	< .01	0.03	< .03
3F	0.11	< .004	<.01	0.25	< .03	0.08	< .004	< .01	< .01	< .03
4F	0.04	< .004	<.01	0.04	< .03	0.08	< .004	< .01	< .005	< .03
5F	0.47	< .004	<.01	0.15	< .03	0.45	< .004	< .01	0.120	< .03
6F	-	-	-	-	-	0.09	-	-	-	-
7F	0.03	< .004	<.01	0.04	< .03	< 0.01	< .004	< .01	< .005	< .03
8F	0.72	< .004	<.01	0.04	< .03	-	-	-	-	-
9F	0 07	< .004	<.01	0.0	0.05	0.01	< .004	< .01	< .005	< .03
10F	0 04	< .004	<.01	0.03	< .03	0.02	< .004	< .01	< .005	< .03
11F	-	-	-	-	-	-	-	-	-	-
12F	0.02	< .004	<.01	0.02	0.05	-	-	-	-	-
13F	0.03	0.008	<.01	-	< .03	0.01	< .004	< .01	0.03	< .03
14F	0.04	< .004	<.01	0.11	0.1	0.05	< .004	< .01	0.25	< .03
Goose Pond at Weir Cove	-	-	-	-	-	-	-	-	-	-

Phase III - July, 1968

Phase IV - September, 1968



WATER SUPPLY SAMPLING LOCATIONS
CAPE ROSIER, MAINE
DECEMBER, 1967 - DECEMBER, 1968

(2)

01000-S

"Rite in the Rain"®
ALL-WEATHER WRITING PAPER

LEVEL

All-Weather Notebook
No. 311

CALLAHAN MINE
BROOKSVILLE, MAINE
TDD NO: 00-05-0080
MED980524128

4 5/8" x 7" - 48 Numbered Pages

Reference 10

"Rite in the Rain"®
ALL-WEATHER WRITING PAPER

Name Tom Campbell

Roy F. Weston, Inc.

Address 217 Middlesex Turnpike

Burlington, MA 01803

Phone 781-229-6430

Project Callahan Mine

Yellow Polyethylene Protective Slipcovers (Item #31) are available for this style of notebook. Helps protect your notebook from wear & tear. Contact your dealer or the J. L. Darling Corporation.

INCHES

CONTENTS

PAGE	REFERENCE	DATE

1 June 2000 Callahan Mine

0745 At Maine Department of Environmental Protection. START Personnel are Tom Campbell - Site Leader, Joe Schmidt - Project Leader, Joanne Savitski - Site Leader. We drop Joanne Savitski at the MEDEP offices after meeting Jean Firth of MEDEP. She provides us with some background information to read on the way to the site, and some copies of the most up-to-date site map (October 1999) to annotate.

0800 We meet other members of the MEDEP Wetlands survey team who are assembling gear. MEDEP team includes Camille Parrish, Brian Beneski, Erica Lloyd, Tracey Weston.

0820 We depart MEDEP and travel to site w/ MEDEP personnel. MEDEP has invited us to visit the site under their access agreement.

1100 We arrive at Site w/ MEDEP personnel. There is no gate on Old Mine Road, and no barriers to vehicular or pedestrian

Tim A. Campbell

1 June 2000 Callahan Mine

access. There are not even any signs restricting trespassing. According to Jean Firth, she has regularly observed trespassers on the property.

1115 ME DEP wetlands survey team prepares canoes for survey - GPS and photos. Vehicles are parked on Waste Pile 2 - no observed engineered cover, sparsely vegetated with grasses and saplings.

No visible dust noted by SHSC Campbell.

START photodocuments Dyer Cove and Goose Pond to document the coves opening to the pond. 4 photos taken from south to east. Waste Pile 1 is in background to south.

START photodocuments SW edge of Dyer Cove.

Photodocument embankment with discoloration indicating leaching metals facing west.

Tim A. Campbell

1 June 2000 Callahan Mine

1125 START and ME DEP proceed north along access road towards north end of area designated mine entrance. The ground material in this area is identical to Waste Pile 2 with broken rock fragments (non engineered cover).
View location of soil samples 99-SS-04. All soil samples collected by MEDEP during 1999 sample event were surficial (0-6") depth.

1130 Photodocument historic mine location (open pit mine) looking NE
START and ME DEP proceed north on access road and view nearest residences.
First house is yellow west of access road (Old Mine Lane Road).
Mr. Sandecki is owner and year-round resident. START had brief conversation w/ Mr. Sandecki regarding his residency. A grey garage is located north of the yellow house.

Tim D. Canfield

1 June 2000 Callahan Mine

Next homes encountered are white house on east side and another white house on west side of access road proceeding north.
Signs prohibiting shellfish harvesting are observed on road
START and ME DEP turn NE on Goose Falls Rd. A small unnamed stream noted crossing road (underneath - culvert) into Penobscot Bay.
Lobster pot buoyes and sail boats are noted in Penobscot Bay indicating fishery (lobster) and recreation area.
Marine flora noted included rock weed, kelp, and eel grass.

1145 Photodocument lobster buoyes and house with lobster traps.

START and ME DEP return to Old Mine Lane Road and proceed south. Waste rock material extends to Goose Pond.

1150 Photodocument yellow house w/ perm. resident

Tim D. Canfield

1 June 2000 Callahan Mine

1153 Photodocument extent of waste rock along access road. Waste rock extends down into Goose Pond w/ no barriers to runoff. START and MEDEP view background soil sample location (99-BKSS-01, -02, -03) west of access road up slope in an area that appeared to contain native soils ~ heavily vegetated with firs and bushes.

Investigate abandoned building beneath background soil location. Building was empty w/ concrete floor and metal siding. A former AST concrete platform w/ no staining was observed adjacent to building.

Proceed along access road that leads to Waste Pile 2 ore storage area. Deer tracks noted on access road.

Ore storage area built on

Tim A. Cr[illegible]

1 June 2000 Callahan Mine

waste rock material. Large variety of rocks noted - some containing Cu oxides. Numerous areas of staining noted of Fe and Cu derivation (origin).

1210 Photodocument ore storage area

1212 Photodocument areas of green and brown staining

Tire tracks were evident in ore storage area noting the area is used by the public and access is not restricted. Numerous broken shotgun targets (clay pidgeons) were noted w/ spent shotgun cartridges.

START and ME DEP proceed SE towards mine operations area. Rebar and concrete foundations were observed throughout this area. The ground cover continued to consist of broken/weathered waste rock material.

Tim A. Cr[illegible]

1 June 2000 Callahan Mine

A large diameter rock core is observed left from mine operations / exploration period.

Proceed south along access road into Waste Pile area. Observe blasting material building. Building is empty with no noted hazardous materials. Building is constructed of cinderblocks.

Photodocument waste rock pile. The pile has no engineered cover and is composed of the same rock material observed up to this point in the northern portion of the site. Occasional clumps of grass and young trees are observed growing on the waste rock pile. There are no barriers to prevent surface water runoff from entering Goose Pond.

Panoramic photographs are taken

T. A. Gall

1 June 2000 Callahan Mine

of (from top) waste rock pile looking north to south.

Proceed south off of ~~waste~~ rock pile along access road. Pass location of Redman Farm a non operational farm.

Rock along this portion of access road appear smooth and typical of river/stream bed rock.

Observe tailings pond. Wetland vegetation is observed in the central portion of pond. Very little standing water is observed in pond, the majority of the pond is made up of a silty powder which was deposited during mining operations after the extraction of ore from floatation ponds.

The tailings pond directly abbuts Goose Pond. A breach

T. A. Gall

1 June 2000 Callahan Mine

area was observed at the north end of the pond, allowing surface water runoff from the pond to directly enter Goose Pond.

ME DEP personnel noted that during Geo probe operations in the tailings pond, ~~4~~ the 47 ft of continous silt material was encountered.

A discharge over flow drain was noted protruding from northwest edge of tailings pond.

A dumping area was observed south of the access road (south of tailings pond). This area contained used tires and discarded household goods and general debris.

This is the Tailings Pile source area: To the south, east, and north of the tailings pond, a waste rock embankment was present. This embankment extended down to

Tm A. Gill

1 June 2000 Callahan Mine

the water's edge of Goose Pond.

The most upstream ~~potentia~~ one probable point of entry (PPE) was noted at the southeast corner of the tailings pond.

Note: the most downstream PPE was noted as located north of the former location of the mine directly east of the yellow house (nearest residence).

Multiple PPEs were noted extending from upstream PPE to downstream PPE. No barriers to surface water runoff were noted along this segment.

In addition, the waste rock embankment also extended along this segment.

A phragmites wetland was observed along the southeast toe of the tailings pond embankment. A cattails wetlands

Tm A. Gill

was observed along the northeast toe of the tailings pond embankment.

Proceed north along access road which extends along outer perimeter of tailings pond adjacent to Goose Pond. Waste rock material makes up embankment which leads down to Goose Pond. Embankment was estimated to be approximately 80 ft in height.

Proceed to breach area in north end of tailings pond. The breach area through the waste rock embankment is approximately 50-75 ft across. Run off wash out follows the embankment southeast towards Goose Pond. The area was dry at the time of the reconnaissance but was noted

Tim A. [signature]

by ME DEP personnel to contain running water earlier.

Proceed north on access road along eastern edge of waste pile. The ground is composed of waste rock which extends down into Goose Pond. No barriers to surface water runoff or any type of engineered ground cover were noted by START personnel. Multiple PPEs were noted along this segment.

Proceed west along access road south of Dyer Cove (former settling pond). The dam / access road that once existed along north end of cove has been removed. The cove is now open to Goose Pond. The ground cover in this area (south of cove) consisted of the same type of waste rock material which extends

Tim A. [signature]

1 June 2000 Callahan Mine

down to the water of Dyer Cove. No barriers to surface water runoff or engineered ground cover were noted by START personnel.

Proceed north on access road west of Dyer Cove back to parking area.

Signs are observed by START personnel prohibiting the harvesting of shellfish in Goose Pond due to contamination with heavy metals. These signs are observed west of former mine location adjacent to access road.

Photodocumentation:

- Panoramic photo series taken from atop Waste Rock Pile looking towards Dyer Cove (N) to Goose Pond (South).
- Panoramic photo series taken in Tailings Pond looking SW to E

Tim A. Campbell

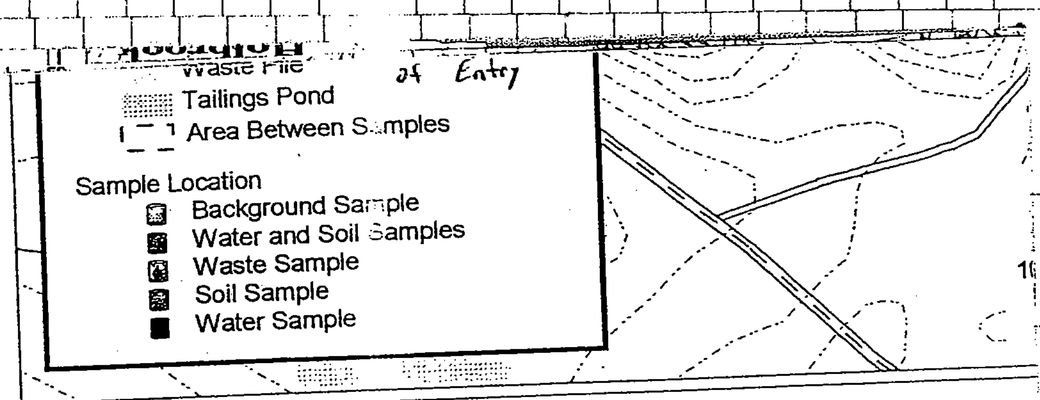
1 June 2000 Callahan Mine

with Breach area and Callahan Mountain (Waste Rock Pile) in backgrounds. (1304 hrs)

- Photo of waste rock pile showing coloring from leaching of minerals, south end (1315 hrs).
- photo of breach area showing no flow, the location of ME DEP sample location 99-TPR-50 surface water sample.
- photo of breach area looking south.

At the completion of the reconnaissance by START personnel, ME DEP conducted pH sampling in the tailings pond. A pH of ~7 was obtained from standing water in the center of the pond.

Tim A. Campbell



Callahan Mine

Brooksville, ME

SITE TYPE: Uncontrolled Site	MINOR CIVIL DIVISION: Brooksville	
GWID: 1788	DATE: November 1999	PRODUCED BY THE MAINE

Memo

To: Jean Firth

From: Erika K. Lloyd, Maine DEP GIS Unit

CC:

Date: 06/28/00

Re: Area Calculations for Callahan Mine Site, Brooksville, Maine

---

Method used to Determine Locations and Areas

All polygon, line, and point features displayed on the attached site map, produced by the Maine Department of Environmental Protection, were gathered using one Trimble Pro-XR TDC1 Global Positioning System (GPS) and one Trimble Pro-XR TSC1. Both GPS units were configured to Trimble's recommended default settings and all data was post-processed to achieve sub-meter accuracy. Correction files for post-processing were obtained from the University of Maine at Orono base station, located approximately 32 miles North of the site. All data was projected in the North American Datum of 1927, with x,y coordinates displayed in meters.

The limits of the Tailings Pond, Tailings Pile, and the Waste Rock Piles 1 and 2 were determined by walking their apparent boundaries while carrying the GPS unit and logging positions. The collected GPS data was exported into an ESRI Geographical Information System (GIS) using the Shapefile format. Areas for both the pond and the piles were determined by using an ESRI tool that calculates area from polygon themes based on the data's spatial location and projected units.

The Mine Entrance Sampling Area and the Mine Operations Sampling Area were created using the GIS system. GPS positions of sample points within each of the areas above were exported into the GIS system. Lines were then drawn between each sample point forming enclosed polygon areas. The areas were then converted into Shapefile features, where the area of each was calculated using the ESRI calculation tool mentioned above.

The detailed contour elevations of the Waste Rock Pile were determined by walking around the pile at a constant elevation while carrying the GPS unit and logging positions. The collected GPS data was exported into the GIS system using the Shapefile format and then combined with the state contour layer.

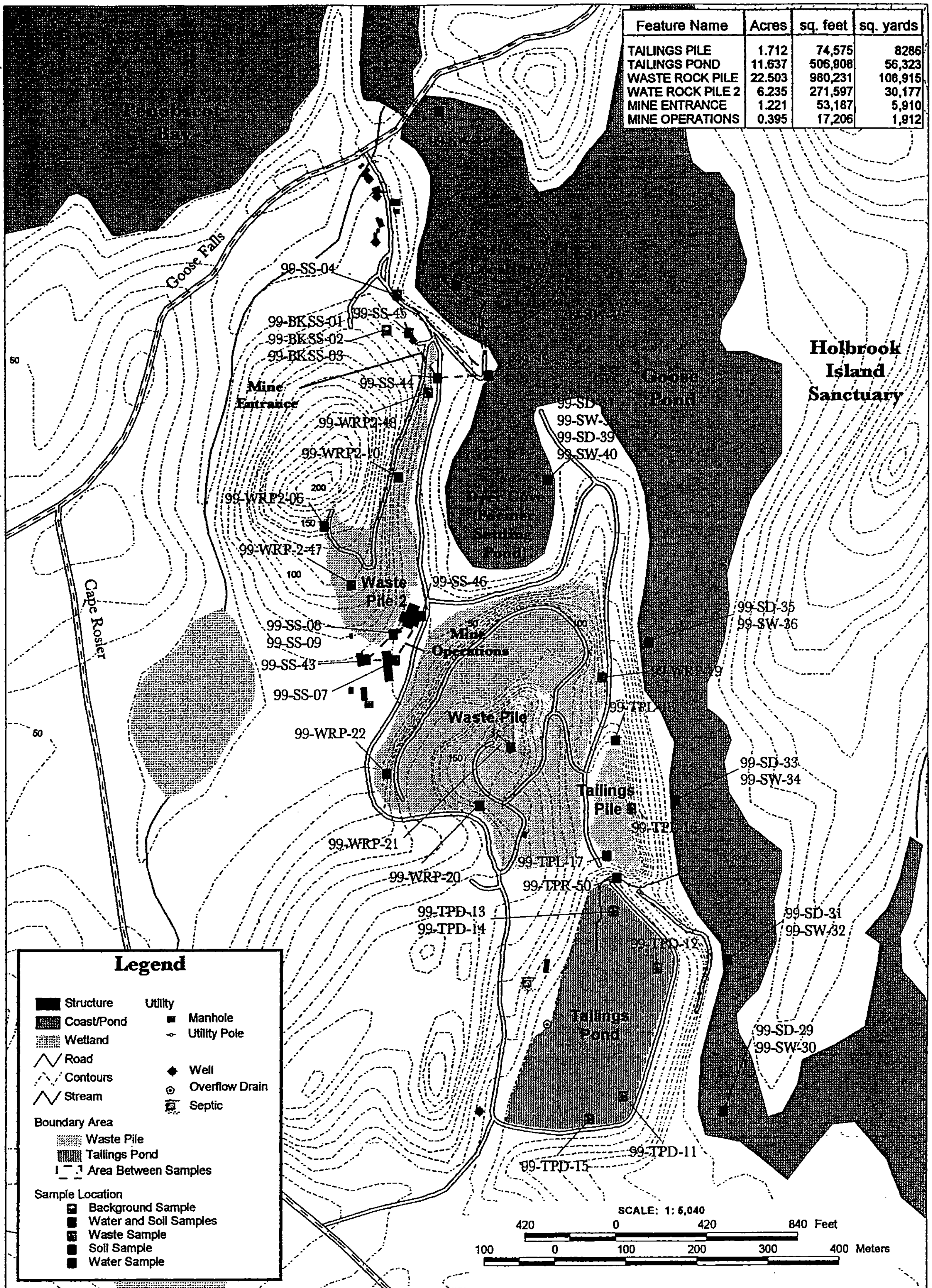
Further questions and comments on the area calculation process can be addressed to Erika K. Lloyd at (207) 287–2117, erika.k.lloyd@state.me.us.

Sincerely,

Erika K. Lloyd

Erika K. Lloyd

GIS Analyst
Maine DEP GIS Unit



STATE OF MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

Callahan Mine

Brooksville, ME

N W E S

NOTES:
1. Stream, Pond, and Contour Data were gathered from the Maine OGIS 24K Data Layers.
2. All other features were surveyed using a Trimble ProXR GPS Unit.
3. Wells have an accuracy <1 meter; all other features +/- 3 meters.
4. This map is to be used for reference purposes only.

SITE TYPE: Uncontrolled Site	MINOR CIVIL DIVISION: Brooksville	PROJECT MANAGER: Jean Firth	HOSS #: B-241-87
GWID: 1788	DATE: November 1999	PRODUCED BY THE MAINE DEP GIS UNIT; Erika K. Lloyd	path name: d:\Mines\Callahan Mine\Callahan Mine.apr