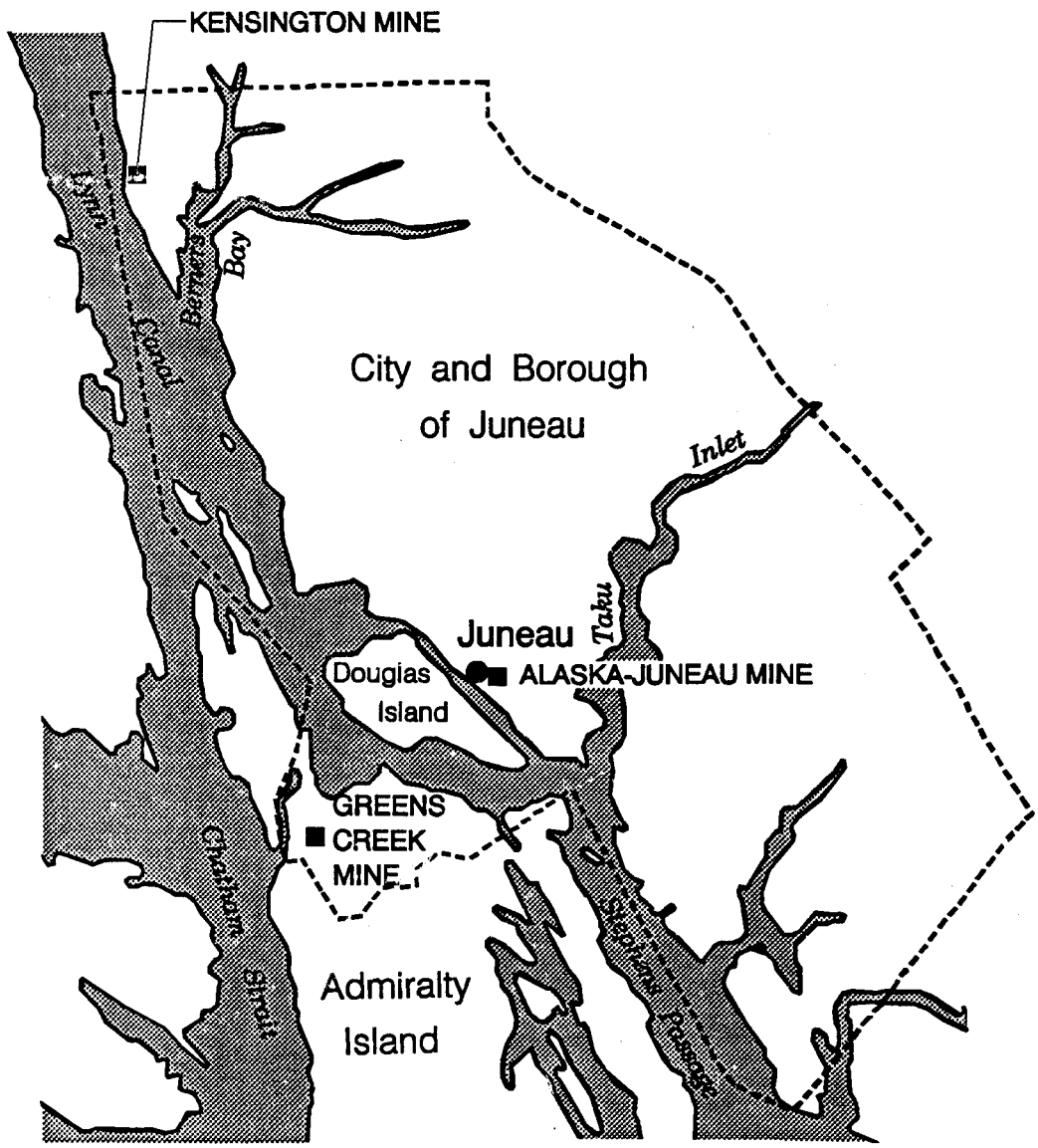
ENVIRONMENTAL REGULATION FOR MINES IN SOUTHEAST ALASKA

-And Its Effects On Projects Design, Timeframes, And Uncertainty, A Preliminary Review-



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ENVIRONMENTAL REGULATIONS FOR MINES IN SOUTHEAST ALASKA

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ABSTRACT

The environmental compliance process affects all aspects of hardrock-mining operations, from exploration through post-closure. The primary components of the environmental compliance process are requirements under the National Environmental Protection Act of 1969 (NEPA) and the permitting requirements associated with various other federal, state and local laws.

This study considers the Greens Creek Mine and the development of two other projects (Alaska-Juneau & Kensington). These mines were used as the foundation for a case study of the impacts of the environmental compliance process on hardrock-mining activity in Southeast Alaska.

The case study presents the institutional and legal requirements, followed by a discussion of the impact of this process on the production and timing of the three mines. The results of this preliminary study reveal some interesting findings, some expected and others unexpected, regarding the impact of the permitting process on the exploration, development and (proposed) operation of the three mining projects in the Juneau area.

Determining the cost of compliance with these requirements is an important step in evaluating the appropriate course of action to protecting the environment while providing the necessary raw materials needed for society. This preliminary study highlights the initial starting point for such an analysis.

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EXECUTIVE SUMMARY

Protection of the environment is an objective of most citizens and businesses. Realizing that society also needs the raw materials contained in the earth the question becomes what is the desired level of environmental protection. To answer this question it is important to consider what are the "tradeoffs" involved. A complete analysis of the tradeoffs would require determining the benefits and costs associated with each option. As an initial step to addressing this issue for the hardrock-mining industry the requirements for the environmental compliance process are identified and sources of cost changes are highlighted using southeastern Alaska as a case study.

The environmental compliance process affects all aspects of hardrock-mining operations, from exploration through post-closure. The primary components of the environmental compliance process are requirements under the National Environmental Protection Act of 1969 (NEPA) and the permitting requirements associated with various other federal, state and local laws. However, the firm must not only be able to satisfy the requirements of the governmental agencies involved, which often have differing objectives, it is also necessary to convince the local population of the desirability of the proposed project. The role of public citizens in the NEPA phase of compliance is critical to the success of a project.

Southeastern Alaska has a long history of mining activity that dates back at least a century. This activity, however, has declined dramatically between the end of World War II and the late 1980s. Recently, mining activity has been increasing with the opening of a mine (Greens Creek) and the development of two other projects (Alaska-Juneau & Kensington). These mines were used as the foundation for a case study of the impacts of the environmental compliance process on hardrock-mining activity in Southeast Alaska.

The case study has two important aspects. First, the institutional and legal requirements are presented. This is followed by a discussion of the impact of this process on the production and timing of the three mines mentioned above. Also of importance in this process is the uncertainty generated and how this uncertainty is incorporated into the project analysis.

The involvement in the regulatory process by the three levels of government demonstrates an increased willingness to participate in shaping the direction of development at all levels. Along with the increased involvement of the various levels of government, numerous private groups are also becoming more involved. With so many groups involved and each having differing objectives regarding the direction of development as well as how best to protect the environment, the process is becoming increasingly complex and time consuming. This was evident from the three mines studied for this report. The Final Environmental Impact Statement for the Greens Creek Mine required approximately one year to complete while those completed for both Kensington and Alaska-Juneau projects were in preparation for over two years.

The results of this preliminary study reveal some interesting findings, some expected and others unexpected, regarding the impact of the permitting process on the exploration, development and (proposed) operation of the three mining projects in the Juneau area. The most critical aspect of the mining operations that was impacted by the environmental compliance process was the disposal of tailings. This was evident for all three mines considered and began with Greens Creek Mine eventually needing to submit an Environmental Assessment, due to a change in the process, detailing their method of tailings disposal five years after the Final Environmental Impact Statement had been approved. Also, it was found that some milling/processing changes were required but the mining methods did not change for any of the mines from the initial plans. Future research should attempt to confirm this finding.

The overall impact of the environmental compliance process on the attractiveness of mining activities needs to be considered in much more detail. Issues that need to be addressed are interstate comparisons of the permitting process and an analysis of the efficiency of the various approaches. The issue of international competitiveness of domestic mining activities and the effect of environmental constraints is also an important issue and needs to be considered. Also of interest would be an analysis of interproduct comparisons. For example, the impacts of the environmental compliance process on precious metals versus base metals.

Over the last two decades, the time requirements for completing the environmental impact analysis of mining projects has increased dramatically. Determining the cost of compliance with these requirements is an important step in evaluating the appropriate course of action to protecting the environment while providing the necessary raw materials needed for society. This preliminary study highlights the initial starting point for such an analysis.

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1.0 INTRODUCTION

A major concern of those involved in mining activities is the increase in environmental regulation considered unnecessary and over restrictive and how it will affect present and future mining operations. Goals associated with mining activities and environmental regulations are often perceived as conflicting in nature and thus very difficult for the two activities to coexist. Many proponents of mining feel that the environmental requirements placed on the industry are excessive and threaten the success of many projects. Common arguments of these groups are that increased environmental regulation in the mining industry has decreased productivity and negatively affected international competitiveness. Opponents of the mining industry, on the other hand, believe that mine operators have not been sufficiently careful in their activities and must be regulated more extensively. A critical objective of regulators should be to develop environmental policies which effectively balance the goals of these two competing groups while providing the necessary mineral resources that society needs. To effectively develop this balance it is important to know the extent of the impact of the various regulation requirements.

Increased costs and time requirements needed to obtain compliance with environmental regulations can have dramatic effects on the economic feasibility of mining projects. This process may also affect project economics through changes in production technology. The purpose of this study is to take a first step in identifying the link between the environmental compliance process and mining activities in southeast Alaska. The results of this study can then be used as a foundation for further analysis to determine the effect of environmental regulations on the mining industry in general.

1.1 Mining Activities in Alaska

Recent events in the Alaskan mining industry indicate that the state may be bracing itself for a "mining boom in the 1990's" (E&MJ, 1991). These events include recent mine openings and increased development and exploration activities. Those closely associated with the mining industry see the trend as a positive improvement for the industry which has been depressed for much of the 1980's.

The hard-rock mining industry in Alaska has experienced a turn around from a downturn in the mid 1980's (E&MJ,1991). Activity in the Alaskan mining industry in the last three years include the opening of two large mines and the exploration/development of five others (Table 1).[2] Exploration expenditures exceeded $60 million in 1990, up dramatically from 1986 expenditures of only $9 million (E&MJ, 1991). Gold production recorded a 39-year high in 1989.

An area of the state experiencing a great increase in mining activity is southeast Alaska near Juneau. This area has had one mine begin production (Greens Creek) with two others currently completing the permitting and compliance requirements necessary to begin development (Alaska-Juneau and Kensington). The renewed mining activity and the fact that these mines are in various stages of production and development make this region attractive for a study of this nature.

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[2]An additional mine development project, Windy Craggy, located near the Alaskan border in northwest British Columbia, will also be important to the Alaskan mining industry (E&MJ, 1991).

1.2 Methodology

This study will examine the three mines in southeast Alaska to identify the steps in the environmental compliance process and the effects of this process on mining activities. The mines are at varying stages of development and operation which allows for evaluating mine specific as well as general impacts of the compliance process. The issues will be presented as follows: section 2.0 examines the compliance process for mining operations in southeast Alaska including the roles of the federal, state and local governments; section 3.0 describes the mines in the study area; section 4.0 examines the link between the compliance process and production technology; and section 5.0 provides conclusions.

Table 1. Recent Producing and Proposed Mines in Alaska

Mine and Location	Operator	Minerals	Status
Red Dog, Kotzebue	Cominco	Pb, Zn	Producing
Greens Creek, Admiralty Island	Kennecott	Ag, Au, Zn, Pb	Producing
Nixon Fork, McGrath	CAGG	Au, Cu	Development
Rainbow Hill,	Cantewell	Au	Exploration
Fort Knox, Fairbanks	AMAX Gold	Au	Exploration
Alaska-Juneau, Juneau	Echo-Bay	Au	Development
Kensington, SE Alaska	Echo-Bay	Au	Development
Jualin, SE Alaska	Placer Dome U.S., Inc.	Au	Exploration

Source: E&MJ November, 1991 and USFS, 1991

2.0 ENVIRONMENTAL COMPLIANCE REQUIREMENTS FOR MINES IN SOUTHEAST ALASKA

The environmental compliance requirements for mining operations is a lengthy, complicated process which involves all levels of government. The requirements have been complicated by the fact that the different agencies involved are trying to achieve goals which may be quite unique and conflicting. Thus, mine operators are subjected to a variety of environmental compliance requirements that must be considered. A close examination of the requirements associated with the compliance process is necessary to determine how this process may be affecting the mining industry. The following section discusses the role of different government agencies which are involved in the environmental compliance process and permitting requirements.

2.1 Federal Role in Environmental Compliance

Reacting to rising environmental concerns, the U.S. Congress passed the National Environmental Protection Act (NEPA) in 1969. The goal of NEPA was to provide a systematic framework to deal with increasing environmental problems located within the U.S. NEPA outlines procedural requirements which ensures federal agencies will consider the environmental consequences of

their activities. NEPA applies to any federal action which not only includes the operation of programs, construction of facilities, and the provision of funding to others but also, any federal agency's decision to grant permission for activities of others (Arbuckle, *et al.*, 1991). This includes any decision by a federal agency on the issuance of an environmental permit. An important aspect of NEPA is that it does not require agencies to promote preservation or protect the environment but only consider the consequences of their actions on the environment.

Section 102(2)(C) of NEPA requires "that an Environmental Impact Statement (EIS) be completed for every major federal action which significantly affects the quality of the human environment" (Arbuckle, *et al.*, 1991).[3] Fundamentally, the NEPA process creates a forum for government agencies, the public and the applicant to determine if a projects' development is compatible with present environmental guidelines. The process is evolutionary in nature and allows those involved to carefully examine relevant information from many different sources concerning environmental degradation resulting from the proposed action. The desired result of this independent input and review are changes and improvements in projects which will ensure that environmental degradation is minimized. While the EIS does not establish any requirements of the applicant, a permit's approval can be denied by a federal agency if the results indicate unacceptable risks to human health or environmental deterioration caused by the proposed action (Gana, 1991). As a result, this process is very important to issuance of environmental permits for mining projects.

2.1.1 Lead Agency(s) & Cooperating Agency(s)

NEPA requires that a "lead agency"[4] be designated to supervise the preparation of the EIS (Arbuckle, *et al.*, 1991). Due to the fact that more than one federal agency is often involved in "major actions", NEPA requires the designation of a lead agency to ensure that the EIS is prepared in the most efficient manner. The other agencies involved in the NEPA process are designated as cooperating agencies by the lead agency. The majority of mining projects participating in the NEPA process will have the Bureau of Land Management (BLM) or the United States Forest Service (USFS) designated as the lead agency responsible for preparing the EIS. This is mainly due to the unique opportunity made available to hard-rock mining claims on public lands established by the Mining Law of 1872.[5]

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[3]NEPA also requires the preparation of an Environmental Assessment (EA). The purpose of an EA is to provide the basis for determining whether an EIS is necessary. If the proposed action is perceived as having significant environmental impacts this stage of the NEPA process can be eliminated by going directly to the preparation of an EIS. Due to the fact that most mining projects have significant environmental effects, an EA is normally not prepared in the initial NEPA process, although it is commonly used to examine environmental effects of such things as changes in a production process of an approved project. An example of this is the Greens Creek Mine in southeast Alaska which submitted an EA in 1988 after the project was approved in 1984. The purpose of the EA was to describe the environmental impacts of a change in mining methods.

[4]A lead agency is determined by the five following factors listed in the order of importance: 1) magnitude of agency's involvement, 2) project approval/disapproval authority, 3) expertise concerning the action's environmental effects, 4) duration of agency's involvement and, 5) sequence of agency's involvement (Arbuckle, *et al.* 1991).

[5]The BLM and the U.S. Forest Service are responsible for the management of 70% of the public lands in the U.S (Gana, 1991).

Other agencies, such as the Environmental Protection Agency (EPA) and/or the Corp of Engineers (COE), will be designated as cooperating agencies and will be actively involved in the development of all relevant documents.[6] The cooperating agency can participate in the NEPA process by furnishing relevant information which lies within the agency's expertise during the scoping and EIS phases (Environmental Law Statutes, 1991). The cooperating agency may in turn use all appropriate material from all NEPA documents to aid in any decisions made on permits or other actions for which they are responsible. The extent of a cooperating agency's involvement is subject to the lead agency's approval.

Another important aspect of NEPA was the creation of the Council on Environmental Quality (CEQ). The CEQ then established guidelines for the NEPA process (43 FR 55990, 1978). Specifically, the CEQ describes the six general stages of the NEPA process as:

1) agency guidance and categorical exclusions;[7]
2) the environmental assessment;
3) the scoping process;
4) the draft environmental impact statement;
5) the final environmental impact statement and;
6) the agency decision and its accompanying Record of Decision (ROD) (Arbuckle, *et al.*,1991).

The lead and cooperating agency(s) must consider the information presented in the Final EIS and make a decision on the proposed action after steps 1-4 have been completed. The agency(s) must then write a "record of decision" which will include its choice of alternative and mitigation measures to be used to reduce environmental deterioration (Arbuckle, *et al.*, 1991).

The NEPA and environmental permitting processes are closely related but distinct. Encompassed in the EIS is a description of the environmental impacts and all mitigation measures used to reduce such effects. The permitting process allows individual government agencies to determine requirements and conditions necessary to reduce, to an acceptable level, the environmental impacts identified in the EIS. The NEPA process thus plays a major role in the determination of other relevant environmental requirements. Due to the fact that the NEPA process is so important to officials when determining permit requirements, it is generally the most time consuming component of the environmental compliance procedure.

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[6]Though NEPA's principal jurisdiction involves the actions of federal agencies, there are instances where state and local governments may become involved in the process. A state or local agency which has jurisdiction by law or special expertise with respect to any environmental impact of the proposed action can also be designated a cooperating agency. This is dependent on the lead agency's approval (40 C.F.R. 1508.5). An example is the City and Borough of Juneau which is cooperating in the preparation of the EIS for the Alaska-Juneau mine located within the city's jurisdiction.

[7]A project can be given a categorical exclusion if the agency determines, by way of a regulation, that neither an EA nor an EIS is necessary.

2.1.2 Federal Agencies

Agencies which also play a major role in the environmental compliance process are those responsible for issuance of environmental permits required for a mining operation. The most important of these are the agencies responsible for permits pertaining to the Clean Air Act (CAA),[8] Clean Water Act (CWA),[9] and Resource Conservation and Recovery Act (RCRA).[10] There are also other agencies involved which will have additional environmental compliance and permit requirements but these are not as significant to the applicant and will not be considered in detail. The following sections will discuss the responsibilities of the federal agencies responsible for environmental compliance by mining operations including the Environmental Protection Agency (EPA), Army Corp of Engineers (COE), Bureau of Land Management (BLM), U.S. Forest Service (USFS) and the U.S. Fish and Wildlife Service (USFWS).

2.1.2.1 Environmental Protection Agency

The EPA is involved in four areas of the environmental compliance process. These include responsibilities under CWA, CAA, RCRA, and NEPA compliance. The involvement of the EPA in each of these areas varies in importance but is necessary for compliance. Programs established by the CWA applying to mining operations in Alaska involving the EPA include:

* Section 402 National Pollution Discharge Elimination System (NPDES) Permit program,

* Section 404 Permit program dealing with the discharge of dredge and fill material, and

* Section 311 program regulating spills of oil and hazardous waste substances.

The NPDES permit, as established in Section 402 of the CWA, requires any person responsible for discharging pollutant(s) into any waters of the United States from a point source to apply and obtain a permit (Arbuckle, *et al.*, 1991). The purpose of this permit program is to require dischargers to disclose the nature and volume of their discharges (Arbuckle *et al.*, 1991). This allows the EPA to determine industry-by-industry standards with which dischargers must comply. The NPDES permit system also requires dischargers to notify the regulating agency of any violations of the standards. These national effluent limitations for each industry, determined by the EPA, are based on what is technically and economically feasible for the industry. Standards which apply to individual plants within each industry are determined by whether the plant is a

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[8]The CAA was originally enacted in 1970 and then amended in 1977. Congress also amended and expanded the statute in 1990 (Arbuckle, *et al.*, 1990).

[9]The Federal Water Pollution Control Act (FWPCA) was the original water pollution statute which was passed in 1972. Congress renamed the FWPCA in 1977 amendments to the CWA which was again amended in 1987 (Arbuckle, *et al.*,1990).

[10]RCRA was enacted in 1976 and significantly amended in 1984 (Arbuckle, *et al.*, 1990). At the present time mine wastes are exempt from RCRA but the Environmental Protection Agency is now formulating regulations which will bring mining wastes under the jurisdiction of RCRA (EPA, 1990a and 1990b).

new or existing facility. Under this system, new facilities and existing facilities applying for permit renewal will have more stringent requirements. This system provides EPA with the ability to ratchet down standards as technology becomes available.

New facilities applying for a NPDES permit are required to meet technology based effluent limitations set by New Source Performance Standards (NSPS) for their particular industry. These standards are ones which can be achieved if the Best Available Demonstrated Control Technology (BADCT) is applied. Once new facilities are constructed to meet the standards applicable at the time, they will not be subject to any more stringent requirements for five years[11]. Dischargers will be required to meet the standards in effect immediately after this protection period has elapsed.

Traditionally, NPDES permits regulated only four or five pollutants.[12] This policy is now changing with the adoption of EPA's toxic pollutant strategy. This stricter system requires that a detailed waste stream analysis be performed which will allow the EPA to impose standards on virtually all chemicals which are being released (Arbuckle, *et al.*, 1991). The implementation of this system further complicates the permit process for dischargers regulated under this program.

The EPA, at the present time, is the permitting authority for NPDES permits required for mining operations in Alaska.[13] The Alaska Department of Environmental Conservation must, under this system, provide the EPA with certification that the discharge regulated under the NPDES permit will comply with state water quality standards.

Dischargers will be required to meet strict effluent limitations for discharges which affect drinking water supplies, in addition to NPDES permit requirements. The EPA has been given authority to regulate drinking water systems under the Safe Drinking Water Act (SDWA).[14] The statute requires the EPA to determine the presence of any contaminants in drinking water which could cause adverse health effects and set maximum contaminant levels (MCL) for each pollutant present (Arbuckle, *et al.*, 1991). MCL's for each pollutant are determined by the Best Available Technologies (BAT) which are economically achievable.

Section 404 of the CWA gives authority to the COE to issue permits for any discharge of dredged or fill material into navigable waters (Arbuckle, *et al.*, 1991). EPA's responsibility under this section

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[11]"It should be noted, however, that issuance of a permit does not mean that no further action will be required during the permit term. As the permit makes clear, additional applications must be filed and processed whenever modifications to the facility or method of operation will result in changes to the discharge" (Arbuckle *et al.*, 1991).

[12]This usually included biochemical oxygen demand (BOD), suspended solids (SS), and acidity and alkalinity (pH). This system has been used in the past because the treatment of these conventional pollutants will effectively remove other more toxic pollutants.

[13]Under Section 402, the EPA is the issuing authority for NPDES permits in a state until the state elects to take over the program and receives EPA approval (Arbuckle, *et al.* 1991). The state of Alaska is presently seeking approval of their NPDES program and expects to have EPA approval by 1993 (Kruse, 1991).

[14]The SDWA was enacted in 1974 and extensively amended in 1984 (Arbuckle, *et al.*, 1990).

of the CWA is to review the proposed 404 permit to ensure that it is consistent with guidelines established in Section 404 (b)(1) (Kensington Final Scoping Document, 1990).

Section 311 of the CWA prohibits the discharge of oil or hazardous substances into or upon navigable waters of the U.S. (Environmental Law Statutes, 1991). The EPA is required by this statute to supervise the preparation of a Spill Prevention Control and Countermeasure (SPCC) plan for any facility which could cause substantial environmental damage by discharging a hazardous substance into navigable waters or adjoining shorelines (Arbuckle, *et al.*, 1991). The SPCC is a plan "for responding to the maximum extent possible, to a worst case discharge, and to a substantial threat of such a discharge, of oil or a hazardous substance" (Environmental Law Statutes, 1991).

The primary regulatory mechanism under the Clean Air Act (CAA) which applies to mining operations is the State Implementation Plan (SIP). Emission controls are imposed which meet National Ambient Air Quality Standards (NAAQS) under the SIP. EPA's primary responsibility under this system is to review and comment on the Air Quality Permit issued by the state. The full extent of this process will be addressed in the section on the State of Alaska's regulatory responsibility.

Under Section 3010 of Resource Conservation and Recovery Act (RCRA), any individual who manages hazardous waste must notify the Administrator[15] of their activities. The requirements which a mine operator must meet under RCRA will depend on the classification of the hazardous waste activity (*i.e.*, generators, transporters, or owners/operators of Treatment, Storage, Disposal (TSD) facilities). Generators and transporters of hazardous waste must comply with specific notification criteria, while owner/operators of TSD facilities are required to obtain a permit for their activities. The requirements for a TSD facility are much more demanding than those for generators and transporters of hazardous waste materials. The EPA will use specific criteria as listed under RCRA to determine the extent of the regulations that apply to mine operators.

2.1.2.2 Army Corp of Engineers

The COE has four areas of responsibility in the environmental compliance process. These are permitting authority under Section 404 of the CWA, Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA), Section 10 of the Rivers and Harbor Act, and any NEPA compliance requirements.

Section 404 of the CWA has placed stringent controls on dredging and disposal of dredged or filled material into navigable waters (Arbuckle, *et al.*, 1991). The COE has been given authority under this statute to issue permits applying to these activities rather than making them subject to other permitting processes under the CWA. This section of the CWA has substantial affects on development near all waters of the U.S., including wetland areas. The definition of wetlands in this statute has been broadly defined and thus will apply to a majority of mining projects in southeast Alaska.

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[15]The administrator for this program will be the EPA unless the State has a hazardous waste program which has been authorized by the EPA. The EPA is acting as the administrator of the RCRA permitting program in Alaska at the present time.

The COE, in exercising its authority to review permits, must also comply with Executive Orders 11990 and 11998 which refer to the "no-net loss" policy of wetland areas (Kensington, 1990). The goals of this policy have been outlined in an agreement with the EPA and the COE. This policy requires the COE to choose the least environmentally damaging practical alternative (Arbuckle, *et al.*, 1991) for development in a wetland area. The policy is designed to reduce the adverse effects to wetlands through the decisions of the COE on 404 permits.

The COE also has permit authority under Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA). The purpose of this permit program is to regulate the dumping of material into ocean waters which may "endanger human health, welfare, amenities, and the marine environment, ecological systems and any economic potentialities" (Environmental Law Statutes, 1991). The statute only allows the COE to issue permits for dumping dredged material[16] into ocean waters while excluding all radiological, chemical, biological warfare, high-level radioactive and medical waste (Environmental Law Statutes, 1991). The COE, as the administrative agency, is required to give notice to the public of the proposed activity and allow the opportunity for public hearings before permits can be issued. The COE must also consult with the affected state to determine if the proposed activity will comply with the approved Coastal Zone Management Program of the state before issuing permits.

Permits issued under Section 103 are required to include: 1) the type of material to be transported and dumped; 2) the amount of material; 3) the location where dumping will occur; 4) length of time permits are valid; and 5) any special provisions such as monitoring or surveillance requirements (Environmental Law Statutes, 1991). The COE can establish a variety of categories of permits dependent on the requirements listed above.

COE is also the permitting authority pursuant to Section 10 of the Rivers and Harbors Act of 1899 (USFS, 1991). This statute requires a permit for any structure or work which may obstruct traditional navigable waters.

2.1.2.3 Bureau of Land Management

The Bureau of Land Management (BLM) has been granted authority under the Federal Land Policy and Management Act (FLPMA) of 1976, to issue rights-of-way permits on public lands (Environmental Law Statutes, 1991).[17] Rights-of-way permits are required for a variety of activities on public lands including such things as roads and highways, pipelines, systems of transmission and water distribution.[18] The administrative agency is required to consider "national and state land use policies, environmental quality, economic efficiency, national security, safety, and good engineering and technological practices" before they can issue a right-of-way permit (Environmental Law Statutes, 1991).

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[16]Dredged material is defined as any material which has been dredged from navigable waters of the United States (Environmental Law Statutes, 1991).

[17]FLPMA gives authority to the BLM to issue rights-of-way permits for public lands and to the U.S. Forest Service for rights-of-way permits within the National Forest System.

[18]For a complete list of activities requiring a right-of-way permit, consult Section 501 of FLPMA.

Operators of new mining facilities will be required to submit a detailed plan of construction, operation and rehabilitation of the right-of-way area. FLPMA requires the terms and conditions of the permit to: 1) reduce damage to scenic and aesthetic values of fish and wildlife habitat; 2) comply with state and federal air and water quality standards; 3) protect public interest in the land transversed or adjacent to the right-of-way area and; 4) protect federal property and economic interests (Environmental Law Statutes, 1991). These federal regulations do not preclude any state right-of-way requirements. As a result, operators will be required to meet any state requirements which are more stringent than the applicable federal regulations.

2.1.2.4 U.S. Forest Service

The U.S. Forest Service (USFS) has two responsibilities in the environmental compliance process. These are:

* Plan of Operations and,
* Special Use Permits.

The requirements for mining companies to meet USFS specifications can be quite extensive and thus can be a major obstacle for operators to overcome.

A mining project proposed on USFS lands will have to complete a Plan of Operations with the relevant USFS office. The intent of the Plan of Operations is for the operator to cover all stages of the mining project to insure that all USFS standards are met, including exploration, production, mitigation and reclamation. Often, the USFS will use this procedure in a "staging" manner in which additional information must be included in a new Plan of Operations as the project moves into different operational stages (Dersch, 1992).[19]

Operators may be required to obtain a special use permit in addition to submitting a Plan of Operations. These are required for activities which disturb surface areas on USFS acreage so some hard-rock mining operations may not be subject to this requirement. The USFS will usually issue a special use permit upon the approval of the project in a ROD.

USFS also require as part of the Plan of Operations that applicants submit a reclamation bond to ensure that adequate reclamation and restoration is performed to disturbed areas after mining activities have ceased (36 CFR 228.13). The bond is a financial warranty which is forfeited if operators fail to meet reclamation requirements and is sufficient to allow the USFS to perform necessary reclamation activities (USFS, 1991).

2.1.2.5 U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) has authority under the Endangered Species Act of 1973 and the Bald Eagle Protection Act. Often, the USFWS will act in cooperation with the USFS

[19]An example of this would be as an operator finishes exploration of an area they would be required to submit a new Plan of Operations before development can take place.

in the implementation of the Endangered Species Act[20]. Endangered species and bald eagles must be protected to the full extent of these agencies' powers. These statutes require that the impacts on endangered species and bald eagles by the proposed action must be determined. Specific design modifications in the project can be required by the agency(s) which are responsible for protecting the affected species if harmful impacts are projected. Though these statutes do not require any permits, they can add significant costs to mining projects and are an integral part of the environmental compliance process.

Operators of mining projects may also be subject to requirements of other federal agencies. These requirements are not as significant as those discussed above or are not directly related to the environmental compliance process. A list of these agencies and a summary of their requirements are presented in table 2.

2.2 State of Alaska Requirements

There are a number of state agencies that are actively involved in the environmental regulation process in addition to the federal agencies discussed above. State of Alaska agencies which are involved in the environmental compliance process include Alaska Department of Environmental Conservation (ADEC), Alaska Department of Natural Resources (ADNR), Alaska Department of Fish and Game (ADFG), and the Alaska Division of Governmental Coordination (ADGC) and will be discussed in detail below.

2.2.1 Alaska Department of Environmental Conservation

The ADEC plays a very active role in the environmental regulatory process affecting mining activities. The ADEC responsibilities include both issuance of permits and cooperation with other agencies (federal and local) on various environmental compliance issues. The authority of the ADEC includes:

* Issuance of Air Quality Permit (CAA),
* Certification of Reasonable Assurance (CWA),
* Solid Waste Management Permit (RCRA),
* Oil Facilities Approval of Financial Responsibility, and
* Oil Facilities Discharge Contingency Plan.

The ADEC has been given the authority for the State Implementation Plan (SIP) under section 10 of the CAA (Arbuckle, *et al.*, 1991). The SIP is the primary regulatory mechanism in which states can impose emission controls on stationary sources to meet NAAQS for the six primary pollutants.[21] The NAAQS establishes maximum concentrations for each of the primary pollutants that should not be exceeded anywhere in the country.

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[20]The USFWS also will cooperate with other land management agencies, such as the BLM, throughout the environmental compliance process.

[21]The six primary pollutants are sulfur dioxide (SO_2), suspended particulate (PM-10), carbon monoxide (CO), ozone (O_3), nitrogen oxides (NO_x), and lead (Pb) (Arbuckle *et al.*, 1991).

Table 2. Other Federal Agencies Involved in the Permitting Process

Agency	Requirements
Coast Guard	Notice of Fueling Operation
	Permit to Handle Hazardous Materials
	Application for Private Aids to Navigation
Federal Aviation Administration	Notice of Landing Area and Certification of Operation
	Determination of No Hazard
Federal Communications Commission	Radio and Microwave Station Authorizations
Treasury Department[22]	Explosive User Permit
Mine Safety and Health Administration	Mine I.D. Number
	Legal Identity Report
	Miner Training Plan Approval
National Marine Fisheries Service	Threatened and Endangered Species Clearance

The 1990 CAA amendments also require acceptable SIPs to review all new and modified sources for compliance with New Source Performance Standards (NSPS), Prevention of Significant Deterioration (PSD) and Nonattainment Area (NA) requirements (Arbuckle, *et al.*, 1991). These additional requirements placed on the SIPs have been established by the amendments to enable regulators to "ratchet-down" emission standards as new technology becomes available.

NSPS were originally established to achieve two purposes. First, new sources were given stricter requirements because of their flexibility to employ the most efficient pollution control technology presently available. Second, all new sources must meet similar standards regardless of their location. This reduces the chance that certain states may adopt less stringent air pollution standards to attract industry. The importance of NSPSs in the SIPs has declined with the development of PSD and NA programs. NSPSs are now generally used as ceilings on emissions for new sources in the determination of standards for these newer programs.

[22]The Department of Alcohol, Tobacco & Firearms of the Treasury Department is responsible for issuing this permit.

The 1977 CAA amendments modified a zoning approach developed by the EPA which allows states to determine what level of pollution is acceptable based on local conditions. Attainment and nonattainment areas were determined under this program by whether or not NAAQS were met. The goal of these provisions is to bring nonattainment areas into compliance with NAAQS while preventing significant deterioration of attainment areas. This is accomplished by employing a complicated air quality increment system. Air quality increments are numerically defined amounts of air quality degradation. Each area is allotted a predetermined amount of increments for a certain period of time. The emissions in the defined area must not violate the increments available. The stringency of the air quality increments is determined by the area's classification.

The location of most mining projects in Alaska will be in areas classified as attainment areas for all the primary pollutants. As a result, new sources applying for an air quality permit under the SIP for Alaska must meet the requirements of the PSD program. This requires a new, large[23] source to demonstrate that the BADCT will be employed and there will be no violations in NAAQS and also, that emissions will not result in air quality degradation greater than the increments allowed. ADEC, with EPA approval, can issue the applicant an air quality permit, once these requirements have been met.

The 1990 amendments significantly modified Section 112 of the CAA pertaining to the emission of hazardous air pollutants (Arbuckle, *et al.*, 1991). The revisions establishes a sophisticated program to regulate 189 toxic air pollutants. Emissions of the specified pollutants will be regulated through technology based standards and where necessary health-based standards (Arbuckle, *et al.*, 1991). The amendments to Section 112 allow states to implement programs to regulate toxic pollutants with federal approval. The EPA is required to publish a schedule showing which standards will be established at what time. The extent of this program on the mining industry has yet to be determined.

The ADEC is the state agency responsible for the issuance of Certificates of Reasonable Assurance for NPDES and Section 404 permits issued by the EPA and COE. This allows the ADEC the ability to ensure that all state standards are met under the NPDES and Section 404 permit requirements. ADEC will issue a Certificate of Reasonable Assurance stating that the proposed activity meets all state requirements upon approval.

The states are responsible for regulation of non-hazardous waste under Subtitle D of RCRA.[24] The ADEC will issue permits which meet minimum standards which have been set at the federal level. ADEC requires a solid waste management permit for the establishment, modification or operation of a solid waste disposal facility having a total rated capacity of more than 200 pounds of solid waste per hour (Kensington Final Scoping Document, 1990). Any solid or semi-solid waste including garbage, paper or hazardous waste will be regulated under this program.

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[23]The definition of a "large" source for this provision is one which has the potential to emit 100 tons or more of any pollutant regulated by the CAA (Arbuckle, *et al.* 1991).

[24]Proposed amendments to Subtitle D of RCRA were recently released in October of 1991. The amendments will affect the disposal of non-hazardous waste, particularity municipal disposal sites. The full extent of these amendments have yet to be determined.

Section 311 of the CWA, which requires the submission of a SPCC to the EPA concerning any possible spills of oil or hazardous substances into navigable waters, does not in any way preempt state law. This leaves states free to impose additional requirements on applicants for the prevention of oil and hazardous waste spills. The ADEC requires all facilities capable of storing 10,000 barrels of oil or more, to submit an Oil Facility Discharge Contingency Plan. This is very close in nature to a SPCC. The ADEC also requires proof of financial responsibility to compensate for losses caused by an oil spill.[25] Financial responsibility is required sixty days before operations begin and must be renewed annually.

2.2.2 Alaska Department of Natural Resources

Mining projects in Alaska may require the following permits issued by the Alaska Department of Natural Resources (ADNR):

* Water Rights Permits,
* Tidelands Lease,
* Permit to Construct or Modify a Dam,
* Right-of-Way Permit, and
* Land Use Permit.

ADNR requires a water rights[26] permit for certain activities which include mining, milling and disposal uses, and the diversions for control of downstream and marine quality degradation (Kensington Final Scoping Document, 1990). ADNR will determine the conditions of the water rights permit using a public interest determination process. Water rights are not secured with the approval of a permit which only authorizes appropriation. The securing of rights is dependent on actual use of the full amount of water and compliance with all permit requirements. ADNR issues Certification of Appropriation after the use of the water has commenced.

ANDR is the administrator of a tidelands lease and permits to construct or modify a dam. A tidelands permit is required for any permanent improvement to state tidelands or submerged lands.[27] Any activity, including the construction, enlargement, alteration or repair of any dam which is ten feet or more in height and/or stores 50 acre feet or more of water will require a permit[28] from the ADNR (Kensington Final Scoping Document, 1990).

ANDR is the responsible state agency for issuing right-of-way and land use permits. These are required for certain development activities which will take place on state owned lands (BLM, 1991).

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[25]Compensation includes containment and cleanup damages, civil penalties, and civil action.

[26]A water right is defined as the authorization for a property right for the use of public surface and subsurface waters that become attached to the land when the water is used (Kensington Final Scoping Document, 1991).

[27]Procedures for a tideland lease are discussed in 11AAC58.

[28]Procedures for a dam permit are discussed in 11AAC93.

2.2.3 Alaska Department of Fish and Game

Mining projects may be required to obtain permits from the Alaska Department of Fish and Game (ADFG) for their activities. These include a Fish Passage Permit and a Fish Habitat Permit. These permits will be required if the ADFG determines that the proposed activity could impede efficient passage of fish or affect specified anadromous waterbodies. Such activities which may require these permits include stream realignment or diversion, bank stabilization, deposition or removal of any material structure below high water, dams or construction activities (Kensington Final Scoping Document, 1990).

ADFG also participates in any Coastal Zone Management Assessments. The agency acts as a participant in this program which was established in order to coordinate the development of coastal resources on or offshore (City and Borough of Juneau, 1986). The Alaska Coastal Management Program was inspired by the Federal Coastal Management Act of 1972. The goal of this federal statute was to delegate primary regulatory authority to individual coastal states. Alaska gained approval of their program in 1979.

Alaska has taken a similar approach to their Coastal Management Program by beginning to delegate authority to local governments. The interim period, before local jurisdiction can be established, will consist of a dual management program between state and local agencies. The state has established standards, which local agencies must meet or exceed before their program can be approved (City and Borough of Juneau, 1986). Mining operations, in coastal regions, will be subject to the standards established by the state or the approved local coastal management plan.

2.2.4 Alaska Division of Governmental Coordination

The Alaska Division of Governmental Coordination (ADGC) has two roles in the environmental compliance process. First, the agency is responsible for administering the Coastal Project Questionnaire and Certification of Consistency (Kensington Final Scoping Document, 1990). The purpose of this program is to identify what permits are required for a specific project and what are the responsible governmental offices involved. An applicant must complete a Certification of Consistency in order to meet federal requirements.

The ADGC is also the administering agency of the Alaska Coastal Management Program. The agency was given legislative authority of the program by the Alaska Coastal Management Act in 1977 (AS 46.40) (Kensington Final Scoping Document, 1990). The purpose of this program is to organize the review and issuance of permits for projects which would affect natural resources in coastal zones. This program will affect any mining operations which are located in Alaskan coastal areas.

2.3 Local Government Agencies

Local government agencies, as well as state and federal agencies, may also play a significant role in the environmental compliance process. The structure of NEPA gives local agencies the opportunity to participate in the permitting process and many officials are now taking advantage of this situation, particularly in Alaska. This situation may further complicate the permitting process for mining projects.

2.3.1 City and Borough of Juneau

The City and Borough of Juneau (CBJ) is one local government in southeast Alaska which has become very influential in the environmental compliance process. CBJ amended an ordinance which affects all exploration and mining activities within CBJ's jurisdiction on October, 6, 1989 (CBJ Ordinance 89-47am, 1989). These amendments require mining and exploration activities within CBJ's boundary to obtain permits from CBJ. Due to the fact that CBJ's jurisdiction encompasses a very large area (Figure 1), this ordinance may affect several current and proposed mining projects in southeast Alaska.

CBJ requires operators of large[29] mining projects to submit an application for a mining permit in the form of a report. The report contains specific information regarding mining operations which officials can use to determine if the operation complies with federal, state and local environmental requirements. Information which must be included in the application consist of:

* Description of the mine site and affected surface area including all roads, buildings and processing facilities,

* Time table of the proposed mining operation,

* Description of all reclamation operations,

* Description of methods used to control, treat and transport hazardous substances, sewage and solid waste, and

* Description of other potential environmental, health, safety and general welfare effects.

Operators are also required to conduct a socioeconomic impact assessment. This assessment includes all beneficial and adverse impacts of a large mining operation on local conditions. The study must include the direct and indirect effects on facilities and services such as, sewer and water, public safety and fire protection, education, and traffic and transportation.

An additional requirement for a mining permit from CBJ is a financial warranty. The amount of the financial warranty will be determined by city officials using the advice of the engineering department and consideration of all financial warranties given to other agencies.[30] CBJ requires a financial warranty from operators to ensure that all requirements contained in the mining permit will be met. This requirement ensures that operators will conduct their operations in a manner which will protect the environment of CBJ and the health and safety of its citizens or that

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[29]Large mine projects are ones which will disturb 20 or more acres, employ 75 or more or where there is a full DEIS/FEIS involved (CBJ Ordinance 89-47am, 1989).

[30]Operators may be exempt from providing a financial warranty to CBJ if officials determine that warranties already provided to other government agencies are sufficient to cover CBJ's requirements.

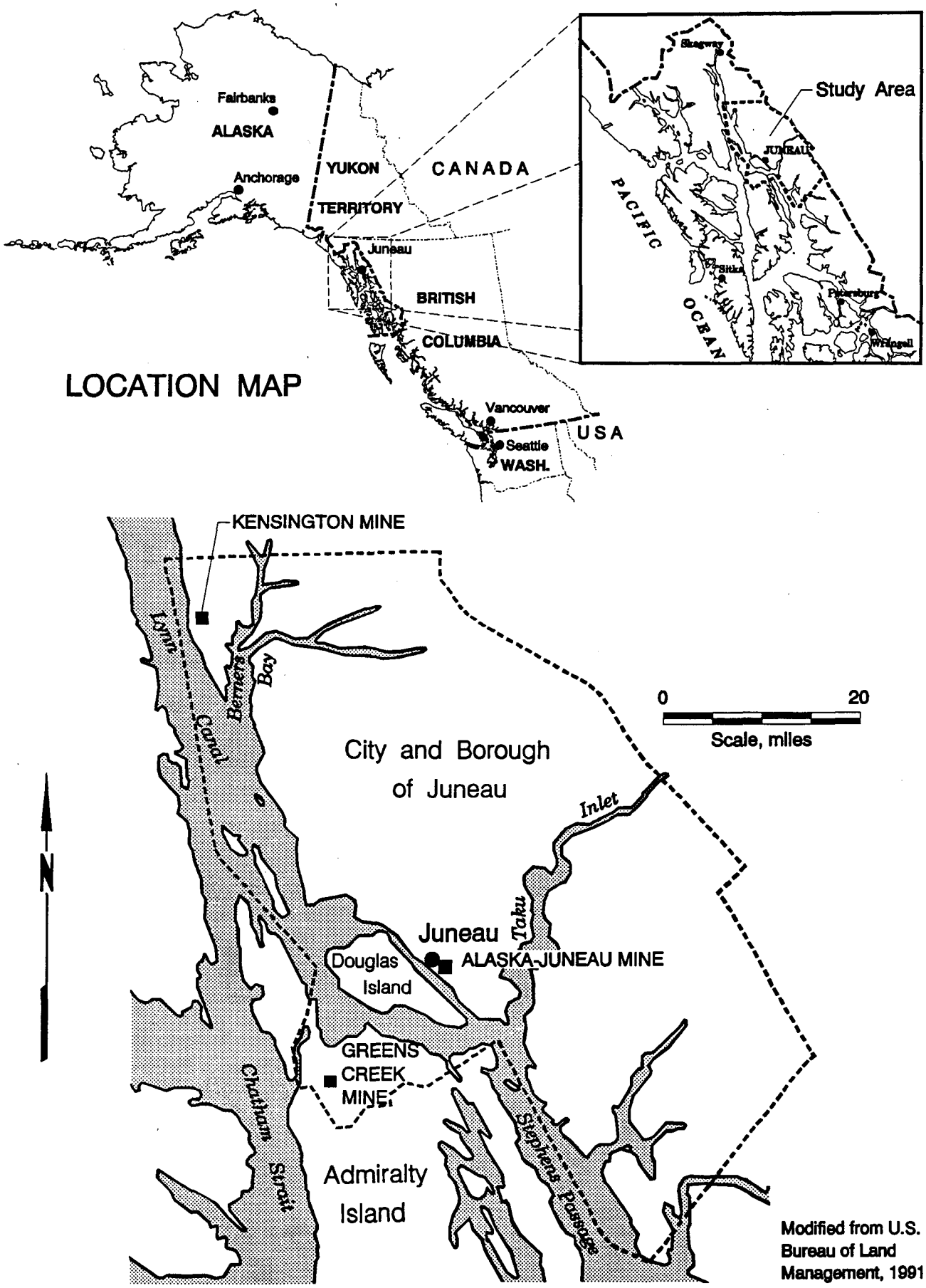

Figure 1. - Mining Activities within City and Borough of Juneau.

sufficient funds are available for CBJ in the event operators fail to complete the necessary work. The warranty will be reviewed annually to determine if the amount should be increased or decreased (CBJ Ordinance 89-47am).

A summary of all major environmental permits and requirements, involving all levels of government, are listed in tables 3, 4, and 5. There are additional requirements which mine operators must meet which are not listed in this summary due to their relative importance to mining operations in southeast Alaska.

Table 3. Summary of Federal Environmental Permits Required for Mining Projects in Southeast Alaska

Agency	CWA	CAA	RCRA	Other
EPA	• NPDES • SPCC • Review Section 404 Permit	PSD Approval	• Notification of Hazardous Waste Activity	NEPA Compliance
COE	Section 404 Permit			• NEPA Compliance • Section 10 (R&HA) • Section 103 (MPRSA)
USFWS				• Threatened and Endangered Species Clearance • Bald Eagle Protection Act Clearance
USFS				• NEPA Compliance • Special Use Permit • Reclamation Bond • Plan of Operations
BLM				• NEPA Compliance • Right-of-Way Permit • Special Use Permit

Table 4. Summary of Alaska State Environmental Permits Required for Mining Projects in Southeast Alaska

Agency	CWA	CAA	RCRA	Other
ADEC	• Certification of Reasonable Assurance • Oil Facility Discharge Contingency Plan	Air Quality Permit	• Solid Waste Management Permit	• Oil Facilities Approval of Financial Responsibility
ADGC				• Coastal Project Questionnaire • Coastal Management Program Certification
ADNR				• Water Right • Tidelands Lease • Permit to Modify or Construct a Dam • Right-of-Way Permit
ADF&G				• Fish Passage Permit • Fish Habitat • Approval of Coastal Zone Management

Table 5. Summary of CBJ Environmental Permits Required for Mining Projects in Southeast Alaska

Agency	CWA	CAA	RCRA	Other
CBJ				• Mining Permit • Financial Warranty • NEPA Compliance

3.0 DESCRIPTION OF MINES IN STUDY AREA

Mining activities in Alaska have increased dramatically in recent years. The area experiencing the greatest increase in activity is the Juneau area of southeast Alaska. Activity in the last four years includes the opening of the Greens Creek Mine and the development of the A-J and Kensington projects. The activities of these three mines will be used to study the effects of the environmental compliance process on mine production activities. The following section discusses the history and development of each of the mines in the area.

3.1 Greens Creek Mine

Greens Creek Mine is located on the northern tip of Admiralty Island within the Tongass National Forest, 18 miles southwest of Juneau (FEIS, 1983) (Figure 1). The mine is currently a joint venture between Kennecott (53.2%), Hecla Mining Co. (28.4%), CSX (12.6%), and Exalas (5.8%) (E&MJ, 1991b). Daily production of sulfide ore is currently running at 1,050 metric tons (mt) per day with 350-400 mt of waste (E&MJ, 1991b). Greens Creek Mine is the largest underground silver lode mine presently in operation in North America with 1990 production exceeding 7.6 million ounces (oz). The mine also produced 38,000 oz of gold, 37,000 standard tons (st) of zinc and 16,500 st of lead (E&MJ, 1991a) in 1990. The mining method employed at the site is a tight drift and fill method (USFS, 1988).

The Pan Sound joint venture consisting of Noranda Exploration, Marietta Resources International, Exalas Resources Corporation (Mitsubishi) and Texas Gas Exploration was formed in 1973 to begin mineral exploration in southeast Alaska. Mineral deposits were discovered near Greens Creek in 1975 which led to further exploration activity. The USFS filed a Notice of Intent to prepare an EIS and a scoping document was released in 1980.[31] Preparation of the Draft Environmental Impact Statement (DEIS) was completed in 1982 and a FEIS was approved by the USFS in January of 1983 (USFS, 1988). Noranda, who had taken responsibility as operator, began the preparation of the Plan of Operation as required by the USFS in June, 1983. The plan was completed and approved in early 1984.

Development of the mine site began in 1985 with the construction of a 13km access road from Hawk Inlet (E&MJ, 1991b). Progress on the access road was very slow with only 3km completed in the first two years. This was due to the difficult conditions in the remote area and the numerous changes in property ownership. The access road and an additional stretch from Hawk Inlet to a landing located in Young Bay was completed in the summer of 1987, after Kennecott obtained control of project operations. Construction of the mine, mill and concentrator were begun in 1987 and the mine was brought into production in February of 1989.

Two events which occurred during the development stages of the project had significant effect on the mining activities at Greens Creek. First, in 1978, Presidential Proclamation established the Admiralty Island National Monument. Then the Alaska National Interest Lands Conservation Act

[31]Those involved with exploration activities were required to file a "Notice of Intent" before conducting an operation which may disturb surface resources (Coggins, 1990). This procedure was required before the USFS filed a Notice of Intent to prepare an EIS.

(ANILCA) of 1980 designated much of the monument as wilderness (FEIS, 1983). The mine site is located within the monument but was specifically excluded by the U.S. Congress from the designated Wilderness Area where development activities are prohibited (Figure 2).

Section 503 (f)(2)(A) of ANILCA allows any holder of a valid mining claim to conduct mining activities as long as those activities are compatible with the purposes for which the monument was established (USFS,1983). ANILCA states the importance of maintaining environmental quality of the monument and gives USFS the ability to establish specific standards which will achieve this goal. These requirements may exceed those already established by other environmental statutes. The one requirement of this statute, which appears to be the most costly to operators of projects in the area, is the stipulation that disturbed areas within the monument must be restored to original monument levels.[32]

3.2 Alaska-Juneau Mine

Echo Bay Mines, Ltd. (EBM) is presently seeking government approval to reopen the Alaska-Juneau Mine (A-J) located adjacent to Juneau (Figure 1). Before its closure in 1944, the A-J mine was one of the largest low-grade underground gold mines in the world (E&MJ, 1991a). The mine was shut down due to labor shortages and increasing production costs related to the war effort (USFS, 1991a). The proposed mine project has 105.8 million tons of proven, probable, and possible mineralization grading 0.05 ounces of gold per ton of ore (FEIS, 1992). The mine is scheduled to produce 22,500 st of ore per/day with the life of the mine estimated to be 13 years (USFS, 1991a).

The proposed project involves building a surface facility on a 30 acre site located at Thane, southeast of Juneau for processing and refining of crushed ore (Figure 3). In addition, the Bradley Adit, a 2.7 mile tunnel, will be constructed connecting the surface facility with an underground crushing facility located next to the ore body. Construction of these facilities and the tailings dam are scheduled to take approximately 18 months (USFS, 1991a).

EBM will use the stoping under rock fill (SURF) mining method (USFS, 1991a). This bulk mining method was chosen due to the low-grade nature of the deposit. The broken gold-bearing ore will be transported to an underground crushing mill where it is crushed and gravity separated. The remaining fine grain material is transported to the surface facility for further refining using a cyanide leaching process. Cyanide treated tailings will be thickened into a slurry and pumped back through the Bradley adit to a tailings impoundment dam located in Sheep Creek valley. Excess wasterock will also be transported to a permanent disposal site in Sheep Creek valley (USFS, 1991a).

The Alaska Mining Company, the original operator of the A-J mine, acquired 13 lode claims and began production in 1893. The mine produced 88.5 million tons of ore which yielded 3.52 million oz of gold from 1893 to 1944. Alaska Electric Light and Power Company (AEL&P) and CBJ purchased all properties and facilities associated with the mine in 1972.

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[32]Additional requirements for this monument area are discussed in the Final EIS for the Greens Creek Mine.

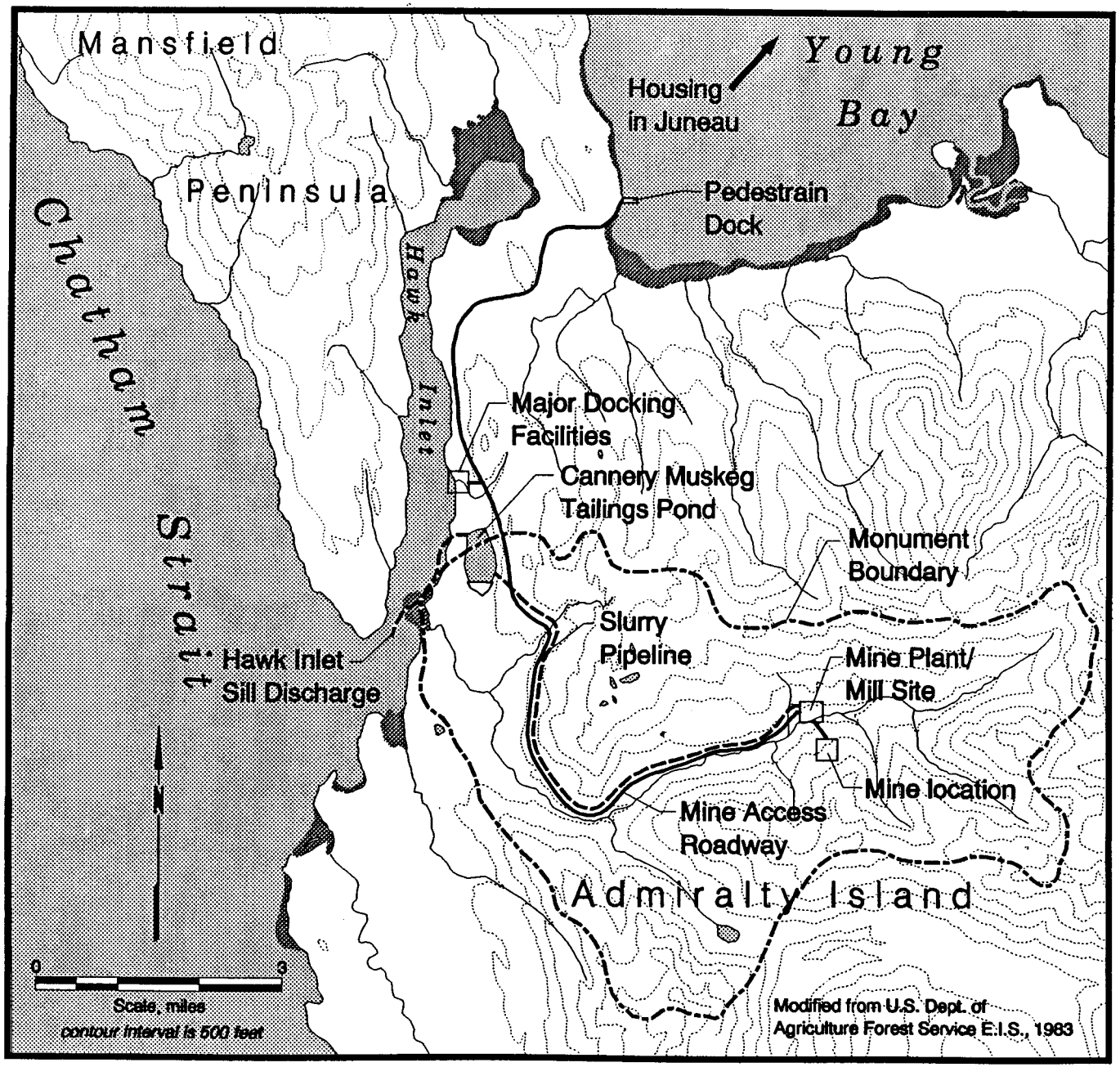

Figure 2. - Original Greens Creek Mine Concept, 1983.[33]

[33] Specifics on the tailings pond and slurry pipeline have changed since the drafting of this map; however, the boundaries and other features have not changed.

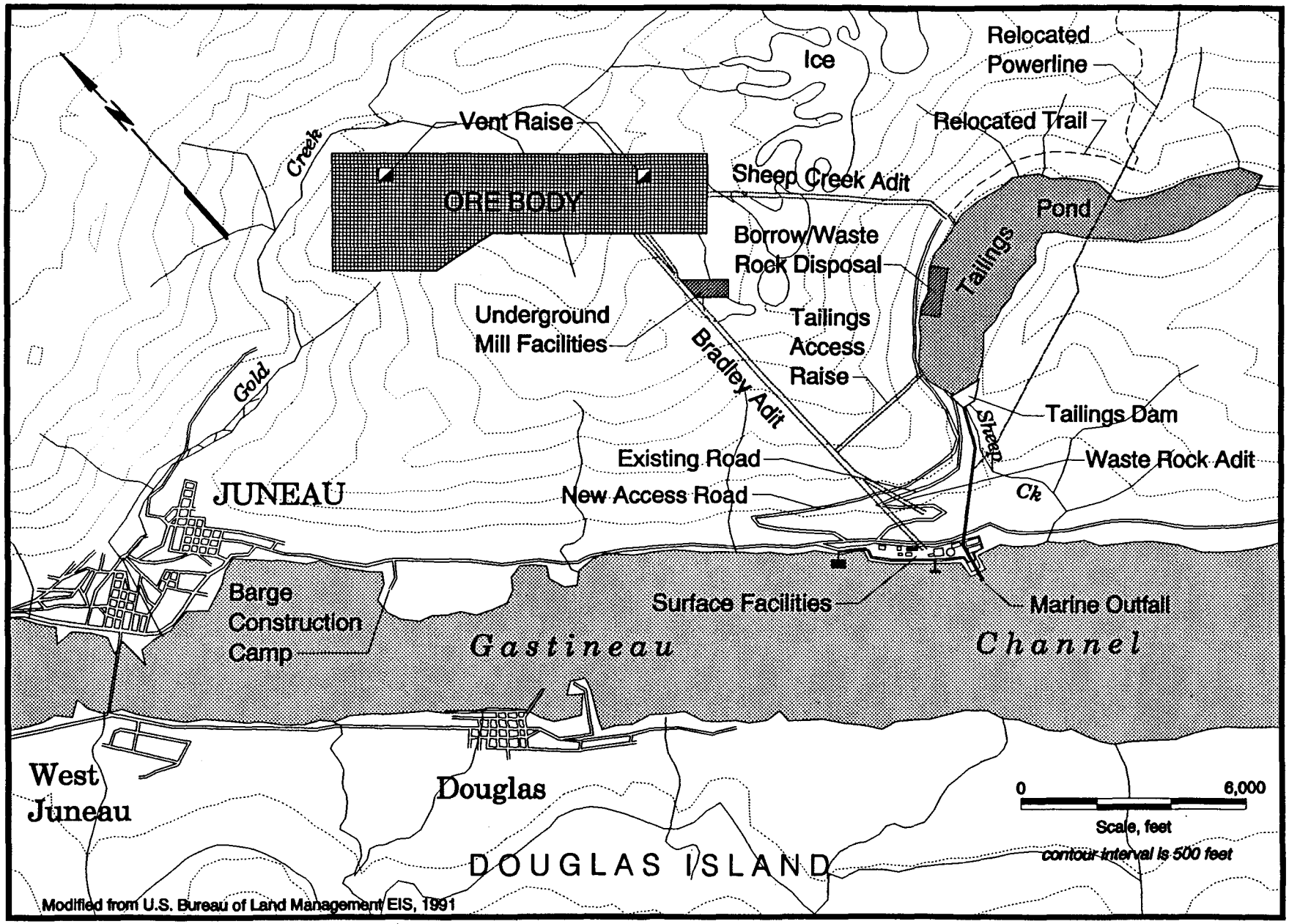

Figure 3. - Preferred Alternative AJ Mine Concept in 1991 EIS.

AEL&P and CBJ reached a unitization agreement in 1980 in which they agreed to handle all future negotiations with any companies concerning the mining property as a single package. EBM is thus required to develop all plans under lease from AEL&P/CBJ. Since CBJ has enacted a mining ordinance which requires approval of all large mining activities within their jurisdiction, CBJ is a cooperator[34] in the preparation of all EIS documents (BLM, 1991). This is a somewhat unique situation and will have important implications in the environmental compliance process.

EBM after several years of exploration and environmental base studies filed the necessary documents with the BLM to begin the NEPA process in 1989. A preliminary DEIS was completed in October, 1989 and the DEIS for general comment was released in January of 1991. The FEIS for the project was completed and released in May, 1992. An interesting development of this project was that most of the changes were due to comments on the preliminary DEIS. This differs from other projects in that normally only a DEIS is prepared.

3.3 Kensington Mine

The Kensington Gold Project is located on the west side of Kakuhan Range adjacent to Lynn Canal in the Tongass National Forest approximately 45 air miles north of Juneau (Figure 1) (USFS, 1991b). The project is a joint venture consisting of Echo Bay Exploration, a subsidiary of Echo Bay Mines, Ltd., and Coeur Alaska, Inc. The mine is planned to produce approximately 4000 tons of ore per day with expected gold production to reach 200,000 oz per year (The Kensington Venture, 1990b). The expected life of the mine is 12 years but may be extended with further exploration. The applicant is proposing to use a long hole, open stoping mining technique (USFS, 1990).

The proposed project will disturb 275 acres in the construction and operation phase. The acreage is both on private and forest service lands. The operation will consist of a crushing facility and refining and processing operations located at the surface. Processing operations will employ a conventional flotation and tank cyanidation process for gold recovery. The presently proposed project will use a wet tailings disposal method to dispose of the tailings at a site in Sherman Creek.

Gold was first discovered at the Kensington site in 1887 (Applicant Proposal, 1990). Throughout much of the following century the mine has experienced sporadic exploration and mining activity by various mining companies. Total production out of the mine is estimated to be 12,000 tons by mainly shallow surface workings. Coeur-Alaska, Inc., in 1987 acquired the property and entered into a 50/50 joint venture with Echo Bay Exploration, Inc. with the intention of allowing Echo Bay to act as the operator. Exploration by the Kensington Venture began in 1988 under the Plan of Operations which was approved by the USFS. A Project Profile and Project Description were submitted to the USFS in 1989 by the Kensington Venture. These two documents led to the preparation of the DEIS for the proposed project. The DEIS was completed in June of 1991 with the FEIS released in February of 1992.

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[34]CBJ's responsibilities as a cooperating agency for this project included participation in the scoping process and reviewing environmental documentation before publication.

4.0 EFFECTS OF ENVIRONMENTAL COMPLIANCE ON MINING IN SOUTHEAST ALASKA

A purpose of this research is to identify impacts on production technology resulting from environmental compliance requirements. The first step in analyzing possible impacts is to identify what areas within a mining project may be affected by the environmental compliance requirements. The following section addresses some of the areas which can be affected by such regulations and includes examples from the three case studies discussed above.

4.1 Project Design Changes

Operators of mining projects that participate in the NEPA process are required to examine several different alternatives for project development. These alternatives can include location of the operation, milling and mining methods, mitigation procedures, tailings disposal method and reclamation strategies. Changes in project design resulting from the environmental compliance process can be costly to mining projects. This is not only due to increased time required to design alternatives but the direct costs associated with this requirement. The following sections discuss the design changes of mines from the three case studies described above.

4.1.1 Greens Creek Mine

Operations at the Greens Creek Mine experienced an evolutionary process of project design changes before production commenced in 1989. Although the deposit had been discovered and extensively explored prior to the designation of the National Monument, this project was subjected to additional environmentally related requirements after its designation as a National Monument. The design changes can only partially be attributed to environmental compliance. Significant design changes included alteration of mining and milling methods, which directly affected tailings and wastewater disposal, and increasing mill water withdrawals from Greens Creek (USFS, 1988).

The designation of the area around the Greens Creek Mine as a National Monument placed additional requirements on the operators which influenced their decisions on project design. Development of projects within a monument area are required to "return as much of the disturbed areas in the monument as possible to pre-project conditions" (USFS, 1983). This requirement forced the operators to consider options which located as much of the development activities as possible outside of the monument boundaries. An option, which was eventually approved by the USFS in 1983, dealt with locating a tailings disposal site partially outside of the monument area because of the extensive reclamation requirement.[35] The decision to change from a slurry system of tailings disposal to the dry tailings method added significant costs to the project due to the timing of the change. The majority of these costs were associated with the construction of a road from the mill site to the tailings disposal area. The road was constructed at constant grade with the intention of building a pipeline alongside to transport tailings (Walker, 1991). Difficult conditions and specific construction requirements pushed costs of the road to $1 million

[35]Other issues affecting project operations which were examined in the EIS scoping process included: location of employee housing, transportation to and on Admiralty Island and, location of millsite and effluent discharge site (USFS, 1983).

per mile (Cottrell, 1991). When the disposal method was changed, there was no longer a need for the constant grade road.[36]

Design changes from the original proposed operation were discussed in a 1988 EA (USFS, 1988). These included a change in the mining method to a tight drift and fill method and an increase in the amount of water used for milling operations (USFS, 1988). The change in mining method also had a direct affect on tailings production and disposal. Design changes can be attributed to potential gains in technical and economic efficiency, as well as reduction in environmental impacts.

The change in the mining method was initiated after data from additional drilling activities in 1985 and 1986 were analyzed (USFS, 1988). This had a direct affect on tailings production and disposal because of their expanded use as backfill material. The drift and fill mining method requires "that backfill material be placed and compacted to a density adequate to allow equipment operation on the backfill within a few days" (USFS, 1988). Dry tailings work well as a backfill material in the mine because they can be placed at a density 50% greater than tailings placed using traditional methods. The mine operators chose to utilize a process which mechanically dewaters tailings at the mill facility and utilizes 68% as mine backfill (USFS, 1988, pg. 1-3).

Operators also elected to increase the amount of water utilized in milling operations. This was because additional metallurgical studies in early 1984 revealed that a water right for 250 gpm withdrawal from Greens Creek would not be sufficient during mill start up or in the processing of difficult ore. Studies indicated that water usage should range from a low of 115 gallons per/minute (gpm) during normal operations to 700 gpm for mill start-up and difficult ore processing (USFS, 1988).

Improvements in technical and economic efficiency of these two methods over previous designs included:

* increase in mine production by reducing problems which are attributed to using a hydraulic method in the placement of tailings as backfill,

* optimal mill processing efficiency during start-up and difficult ore processing, and

* reduction in construction costs for tailings disposal area.

The two changes in project design also had significant environmental effects. The benefits of reduced environmental impacts were largely due to the decision to go to a dry tailings disposal method. This method greatly reduced the area disturbed by the tailings facility, thus diminishing environmental consequences of the project on the Tributary Creek system (Table 6).[37] Additional

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[36]A portion of the costs associated with the construction of the access road were due to the materials used. Operators chose to pave the road in the area of the mine and terminal to reduce cleanup problems if a spill where to occur during transportation of lead concentrate to the marine facility (Cottrell, 1991).

[37]However, by using a dry tailings disposal method, the possibility of an acid mine drainage problem could exist.

environmental benefits from this design change include: 1) reduction in reclamation costs; 2) a reduction in liability for damage to aquatic life in the event of a tailings embankment failure; 3) reduced risk of CERCLA liability; and 4) a reduction in wetland loss.[38] (USFS, 1988)

Table 6. Comparison of Impacts of Dry and Wet Tailing Disposal Alternatives

Alternative	Length of Stream Area	Drainage	Habitat	
			Spawning	Rearing
Total Tributary Creek System	7,400 ft	300 + acres	20 sq. yards	.4 acres
Wet Tailings (amount undisturbed)	2,700 ft (36 %)	150 acres (50 %)	10 sq. yards (50 %)	.1 acres (25 %)
Dry Tailings (amount undisturbed)	5,800 ft (78 %)	271 acres (90 %)	20 sq. yards (100 %)	.35 acres (88 %)

Source: USFS, 1988

4.1.2 Alaska-Juneau Mine

A number of design changes in the A-J mine were proposed by EBM as the project moved through the NEPA process. The majority of these changes can be attributed to the high degree of public scrutiny the project has experienced throughout the NEPA process. This is mainly due to the close proximity of the project to Juneau and Douglas. Design changes include: 1) moving milling operations to an underground site; 2) moving the surface facilities from the Rock Dump site four miles south to Thane; and 3) using liquified petroleum gas (LPG) instead of diesel for power generation.[39]

The decision was made to move milling operations to an underground location because of land availability, noise reduction and reduced surface effects (EBM, 1989). Problems associated with leasing[40] and the physical nature of the area along Gastineau Channel, reduce the number of sites available for milling facility at the surface. Concerns were also raised regarding the noise accompanying a milling operation. The close proximity of Juneau and Douglas reduced the feasibility of placing a milling operation at the surface because of the noise generated during

[38]The tailings design change reduced wetland loss from 13 to 2 acres.

[39]Another project design which was eliminated was a submarine tailings disposal (BLM, 1989). The details of the decision to eliminate this option are discussed in the section on design changes for the Kensington Mine. The alternative was eliminated from both projects for identical reasons.

[40]The location of any surface facilities at the North Rock Dump Site were eliminated from further consideration because of the ongoing litigation surrounding land ownership (Bank of California v. Hayes, IJU-82-2048 Civil Superior Court, First Judicial District at Juneau) (BLM, 1989).

operation. EBM can also decrease surface effects by moving the milling operation below the surface which will reduce intertidal and subtidal fill requirements (BLM, 1991).

EBM has also proposed moving the surface facility four miles south from the Rock Dump site to the Thane location (Figures 3 and 4). The reason for the proposed relocation is the public concern over the aesthetic effects on Juneau and Douglas with a surface operation at the Rock Dump location (BLM, 1991). The relocation of the facility will force EBM to lengthen the Bradley Adit from 11,000 linear feet to 14000 linear feet, increasing project construction costs (BLM, 1991).

Concerns have also been raised regarding the air emissions caused by an underground energy generation process using diesel (BLM, 1991). EBM has since proposed that energy generation at the underground facility use LPG instead of diesel. This will reduce the air emissions of the facility.

4.1.3 Kensington Mine

The Kensington Mine, similar to A-J, is presently completing the NEPA process and has already experienced changes in project design, with other changes pending approval. The changes stemming from close examination in the NEPA process are mainly concerned with tailings disposal. Kensington Mine has not been as closely scrutinized as the A-J project mainly because of its location. This may indicate that the project will not be required to make significant design changes in order to gain project approval from the lead agency, as was the case for the A-J project.

The one project design which was eliminated from further consideration is a submarine tailings disposal. This method was examined by EBM for both the A-J and Kensington projects, but was rejected by the EPA. The EPA ruled on April 19, 1989, that submarine tailings disposal violated the zero discharge limitation of Subpart J of the Ore Mining Regulation and could not be permitted under the NPDES section 402 permit (USFS, 1990).[41] "This tailings disposal method has thus been eliminated from further consideration despite favorable support from the USFS, several federal and state agencies and environmental groups" (Richens, 1992).

Other project design changes which were reviewed include alternative tailings disposal methods. Two of the proposals concerned the location of a wet tailings disposal facility, while the third examined a dry tailings method (USFS, 1991). These options were developed to determine which is feasible at limiting: 1) area stream habitat loss and degradation; 2) terrestrial habitat disruptions; and 3) bioaccumulation of toxic substances (USFS, 1991).

4.2 Time Requirements for Environmental Permitting

Initial analysis of the impacts of environmental regulation on the mining industry indicates that time requirements to bring a mining operation into compliance are significant. While it may be

[41] A detailed discussion of EPA's decision is presented in the USFS Final Scoping Document for the Kensington Gold Project on pages 28-30.

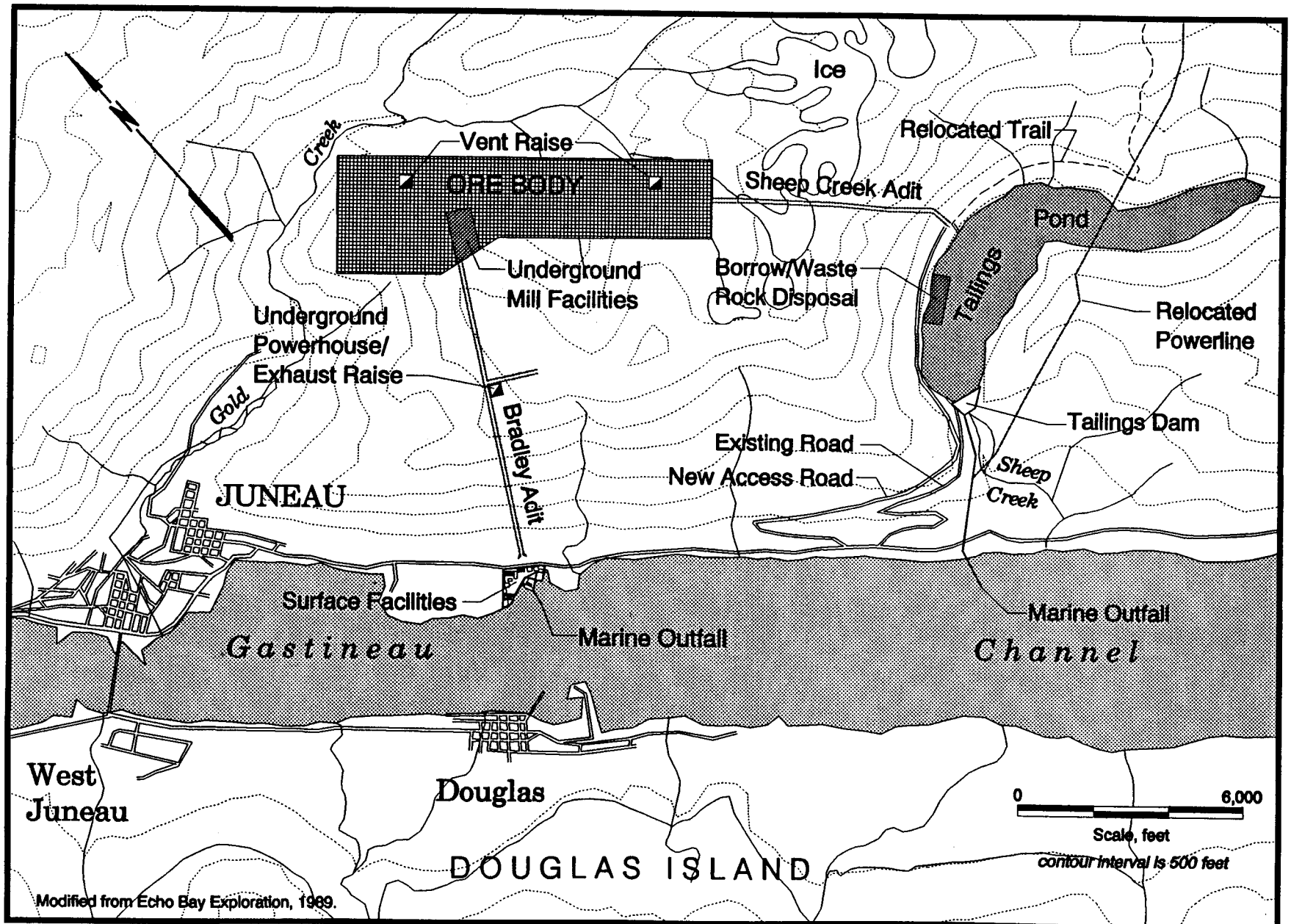

Figure 4. - AJ Mine Design Concept, 1988.

expected that time requirements associated with the administration of relatively new regulations may be quite lengthy, this should be reduced as the regulations evolve. This may not be the case for the U.S. environmental compliance process which may actually be increasing. The answer to this question is very important to operators and policy makers because of its affect on project economics.

The majority of time required to bring a mining project into compliance is due to the NEPA process. This can have dramatic effects on project economics by delaying production for several months or even years. The time required to complete the NEPA process is quite substantial and appears to be increasing with the increase in environmental awareness. A thorough study of the NEPA process is necessary to determine if these increasing requirements are essential to achieve environmental goals.

One of the possible reasons for the increasing time requirements associated with environmental compliance is the overlap of jurisdiction between different governmental agencies. Examples exist where different levels of government have requirements concerning similar environmental entities.[42] Often the different agencies have unique permitting procedures and require separate applications increasing the time required to bring mining operations into compliance. The problem may be reduced as agencies become more familiar with the environmental compliance process and permitting needs and as regulation authority is decentralized to the state and local level. The reduction of these overlapping regulations can increase the efficiency in the environmental compliance process.

Another possible reason for delays in the compliance process is the significant amount of agency coordination required. Often permits require approval from multiple agencies which can add significant time requirements. Difficulties in coordination can emerge when multiple personalities are involved or with frequent turnover in personnel. It is not uncommon that applicants find themselves coordinating the different agencies in order to help speed up the process.

Examination of the three mines in southeast Alaska indicate that all have been delayed but for various reasons (Figures 5, 6 and 7). Analyses indicate that both the A-J and Kensington Mines have been held up in the NEPA process, delaying the projects beyond the original estimated time allotment. In contrast, it appears that Greens Creek Mine was delayed mainly because of the numerous ownership changes which took place during the early 1980s.[43] Delays in the A-J and Kensington projects from the NEPA process appear to be 1-2 years, if approval for the projects is obtained within the next year.

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[42]Examples of this in Alaska are: ADEC and the EPA both have requirements for facilities which deal with the storage of oil, the BLM and USFS both require a Plan of Operations, and CBJ and USFS both require reclamation bonds. However, these agencies can draft a Memorandum of Understanding which would eliminate any overlapping requirements.

[43]It has been suggested that some of the delay may also be attributed to management waiting for improved metal prices.

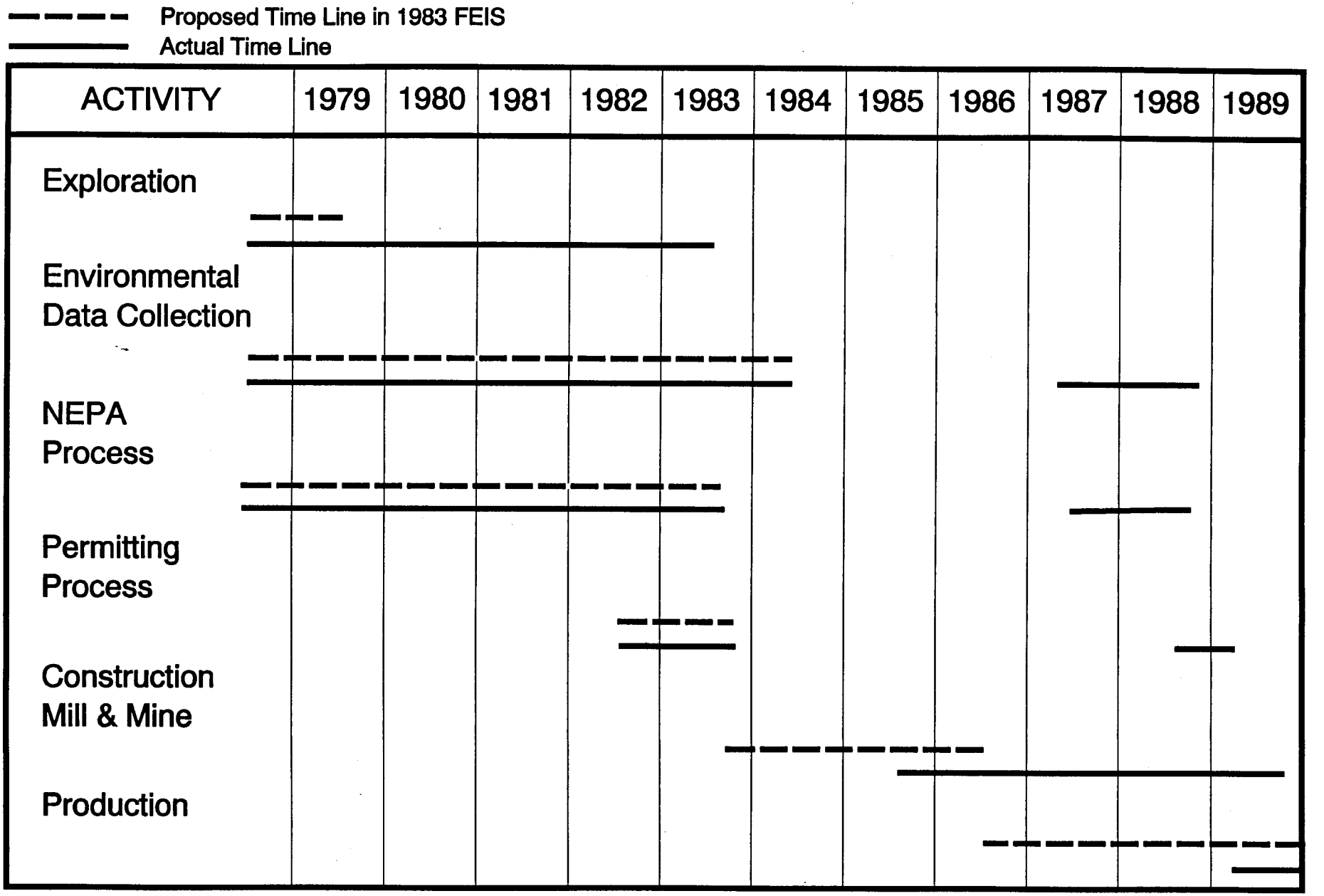

Figure 5. - Time requirements for Greens Creek Mine.

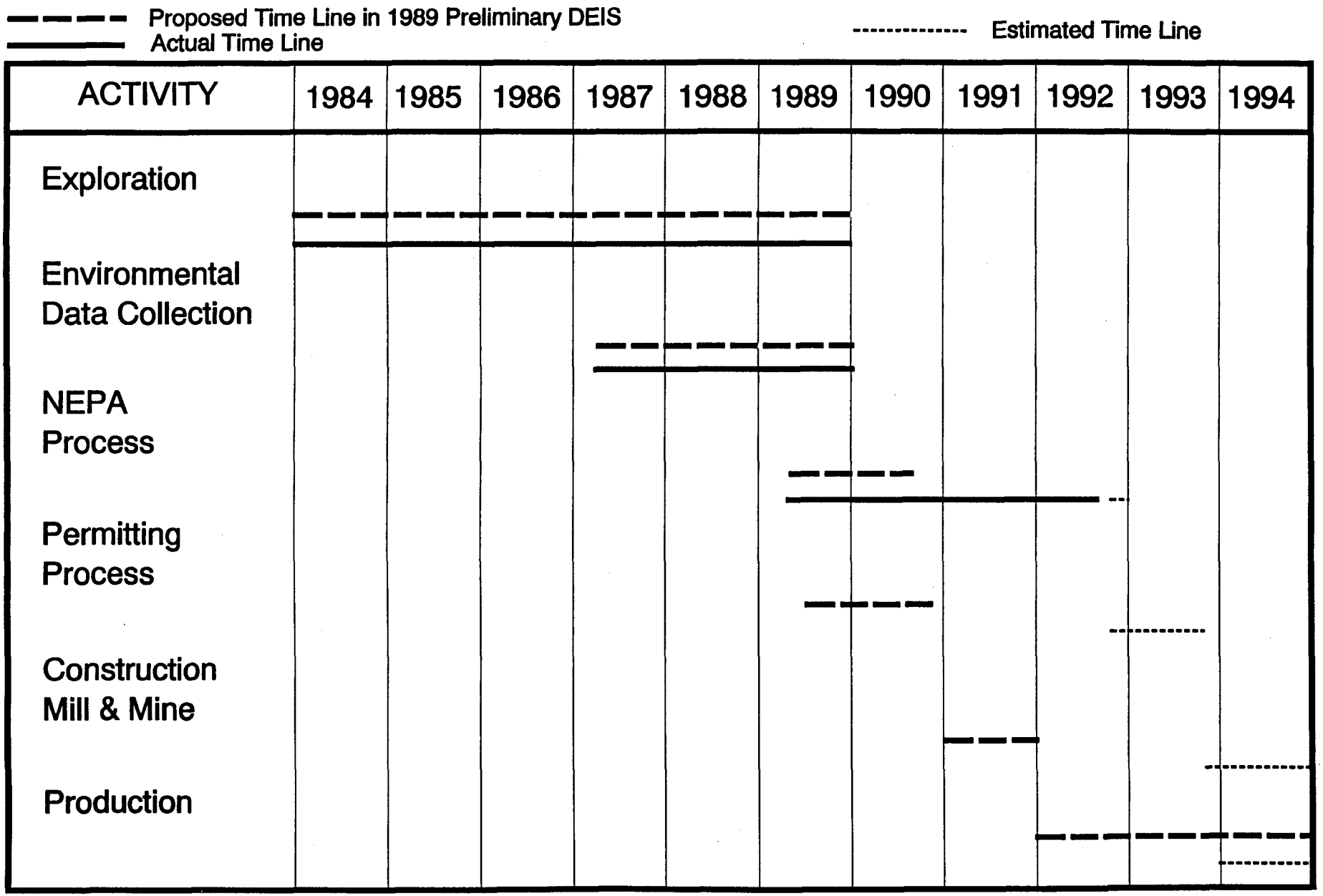

Figure 6. - Time requirements for Alaska-Juneau Mine.

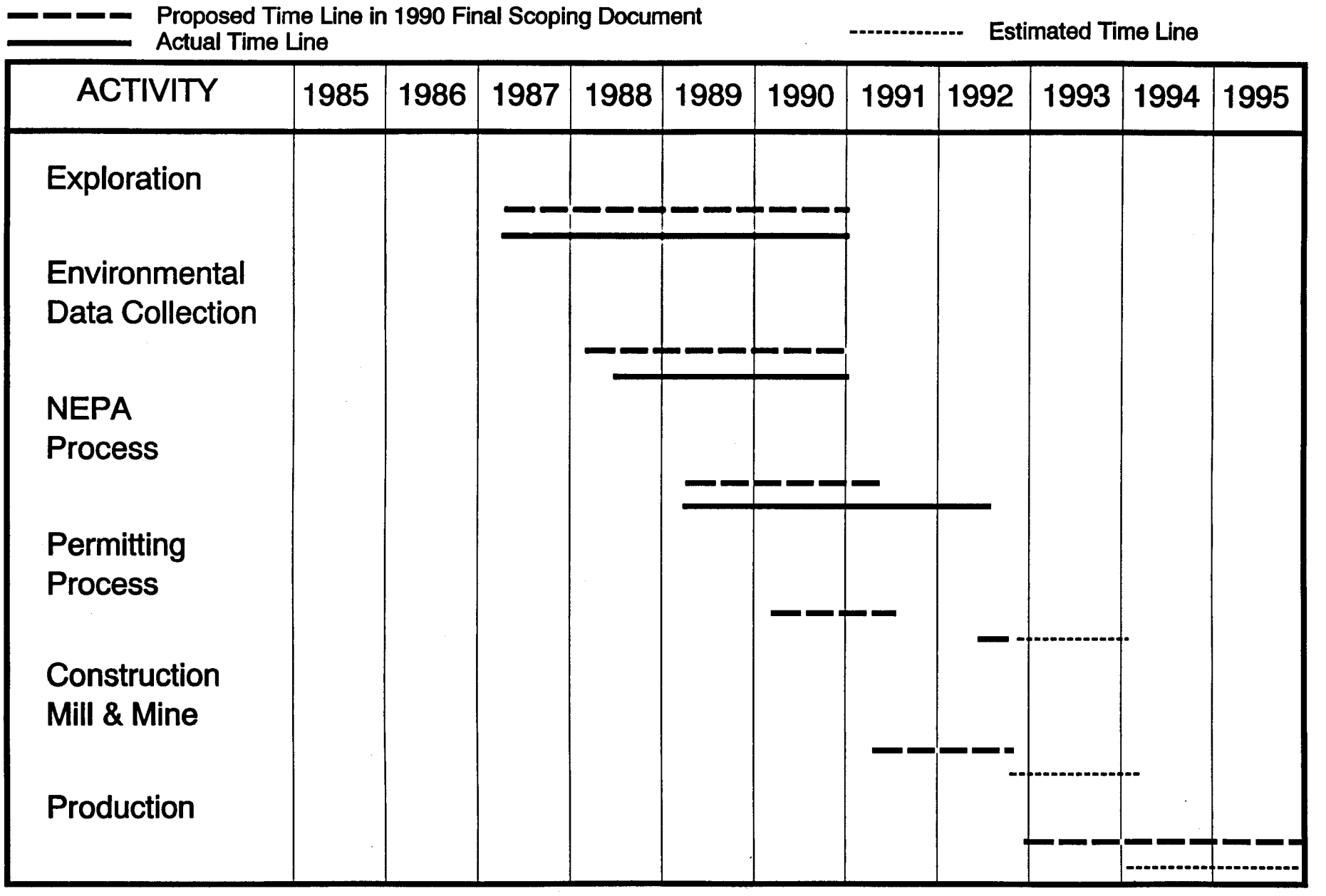

Figure 7. - Time requirements for Kensington Mine.

4.3 Uncertainty Impacts of Environmental Regulation

The increased uncertainty associated with environmental regulations and how this impacts mining operations is of great concern for those involved in the mining industry. Uncertainty associated with environmental policies can be attributed mainly to their continuing evolution. This relatively new area of legislation is still in a trial and error phase, with many laws having been amended with still others pending. While this evolutionary process is necessary to achieve efficiency in the regulatory scheme, it can have very negative impacts on the industries involved.

Uncertainty associated with environmental regulation affect all stages of a mining project's life. The planning phase can be affected by uncertainty in a number of ways, particularly from the NEPA process. This process allows for public review of all activities of federal agencies which may be environmentally sensitive. The nature of this process forces operators of mining projects to chose alternatives which meet public approval. Alternatives which may be technically and economically desirable to the operator may be eliminated from further consideration if public reaction is viewed as being unfavorable. The subjective nature of this process may add significant costs to mining projects. For example, the previous section reviewed a number of design changes which were motivated by the environmental compliance process.

There is also additional uncertainty associated with the length of the public comment period. It appears that operators are having to dramatically increase the amount of public meetings being held in order to gain project approval. This has certainly been the case for the mines studied in southeast Alaska. Greens Creek Mine, which was approved in 1983 only required 2 to 4 public meetings while the A-J project has had over 60 such meetings (Andrews, 1992).

Another source of uncertainty during the planning phase for mining projects are time delays caused by the environmental compliance process. Delays in two of the case studies appear to be quite significant, ranging from one to two years. This can have significant affect on project economics as well as project planning. In addition, there is also a great deal of uncertainty associated with costs of the environmental compliance process for a particular project. Operators often state that estimates of these direct and indirect costs are significantly below the actual costs. This is a significant problem when budgeting for mining projects.

Operators are subject to similar uncertainty during the production phase. This is due to the fact that many environmental permits are only valid for a specific time period. For example, NPDES permits are generally issued for 5 years. Operators are required to comply with current standards immediately in order to have their permits renewed. This may involve major changes in production and pollution technologies to meet new stricter standards and can be quite costly to a mine operator.

Mine operators are also subject to environmental uncertainties associated with post-closure requirements. The most significant of these sources of uncertainty are associated with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA).[44] Superfund regulations, which come into effect after closure of mining facilities, subject operators to significant potential

[44]CERCLA and SARA are commonly referred to as Superfund.

liabilities. Superfund refers to the regulation of "hazardous substances".[45] The structure of this statute gives regulators the ability to impose significant liabilities on operators for the remediation of natural resource damage regardless of whether or not activities were in compliance with all relevant environmental regulations at the time. Uncertainty associated with this particular regulation are related both to the strict and retroactive nature of the statute and the fact that EPA has not fully determined the extent of the Superfund problems associated with the mining industry (Martin & Winters, 1990).

5.0 CONCLUSIONS & FUTURE RESEARCH

The objective of this preliminary study is to develop the framework for a more detailed analysis of the relationship between the requirements of the environmental compliance and permitting processes and the choice of production technology or design. The requirements described above demonstrate the complexity and magnitude of environmental compliance for hardrock-mining firms, particularly in southeast Alaska. The impact of this process on the project economics involves not only the direct costs of obtaining the necessary permits, but also the indirect costs associated with modifications or changes in the production technology. This report does not address the question of whether or not these costs are appropriate compared to the benefits they generate, but only considers a framework for evaluating the direct and indirect costs of the environmental compliance process.

The institutional aspects of the environmental permitting process need to be specified prior to considering the cost of such an arrangement. The institutions in place to regulate the impact of the mining sector on the environment are still in their evolutionary phase. Many of the laws that have created the structure are in the process of being reauthorized and/or amended. For example, only recently (1990) was the Clean Air Act amended. This has generated significant changes for industries. The uncertainties associated with this process are quite extensive and must be considered by firms, particularly since the U.S. Congress will be modifying the Clean Water Act, the Resource Conservation and Recovery Act, and the Toxic Substance and Control Act in the near future.

Although there are currently significant changes occurring at the national level, perhaps the most significant changes from a firm's point of view are occurring at the state and local levels of government. As section 2 states, the federal standards and requirements are *minimum* requirements that must be met and states are able to place more restrictive standards for environmental quality. For example, the State of Alaska has placed a cyanide limit which was two orders of magnitude lower than the EPA standard at the time. Another recent development is the increasing role played by local governments in the regulation of environmental issues through local land use planning laws as is the case with the City and Borough of Juneau.

The involvement in the regulatory process by the three levels of government demonstrates an increased willingness to participate in shaping the direction of development at all levels. Along

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[45]A hazardous substance is "any substance EPA has designated for special consideration under the CAA, CWA, Toxic Substance Control Act (TSCA) and any hazardous waste under RCRA or any substance which will or may reasonably be anticipated to cause any type of adverse effects in organisms and/or their offspring" (Arbuckle, *et al.*, 1991).

with the increased involvement of the various levels of government, numerous private groups are also becoming more involved. With so many groups involved and each having differing objectives regarding the direction of development as well as how best to protect the environment, the process is becoming increasingly complex and time consuming. This was evident from the three mines studied for this report. The Final Environmental Impact Statement for the Greens Creek Mine required approximately one year to complete. The Environmental Impact Statements for both Kensington and A-J have been in preparation for over two years with the FEIS for Kensington and A-J projects being released in February and May, 1992, respectively.

The results of this preliminary study reveal some interesting findings, some expected and others unexpected, regarding the impact of the permitting process on the exploration, development and operation of the three mining projects in the Juneau area. The most critical aspect of the mining operations that was impacted by the environmental compliance process was the disposal of tailings. This was evident for all three mines considered and began with Greens Creek Mine eventually needing to submit an Environmental Assessment, due to design changes, detailing their method of tailings disposal five years after the Final Environmental Impact Statement had been approved. Also, it was found that some milling/processing changes were required but the mining methods did not change for any of the mines from the initial plans. Future research should attempt to confirm this finding.

The overall impact of the environmental compliance process on the attractiveness of mining activities needs to be considered in much more detail. Issues that need to be addressed are interstate comparisons of the permitting process and an analysis of the efficiency of the various approaches. The issue of international competitiveness of domestic mining activities and the effect of environmental constraints is also an important issue and needs to be considered.

Over the last two decades, the time requirements for completing the environmental impact analysis of mining projects has increased dramatically. Determining the cost of compliance with these requirements is an important step in evaluating the appropriate course of action to protecting our environment while providing the necessary raw materials needed for society.

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