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Kensington Gold Project

Final
Supplemental Environmental Impact Statement

Volume 1: Sections 1–10

Lead Agency

USDA Forest Service, Tongass National Forest

Cooperating Agencies

US Environmental Protection Agency, Region 10

US Army Corps of Engineers, Alaska District

Alaska Department of Natural Resources

United States
Environmental Protection
Agency

US Army Corps
of Engineers
Alaska District

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Record of Decision

USDA FOREST SERVICE

Kensington Gold Project

Juneau Ranger District

Tongass National Forest

Decision to be made

This Record of Decision documents my selection of an alternative that will be used to amend the 1997 Plan of Operations for the Kensington Gold Project. My decision is based on the analysis and evaluations in the 2004 Final Supplemental Environmental Impact Statement (FSEIS) as well as information incorporated by reference from the 1997 FSEIS and ROD and the 1992 FEIS and ROD.

While the 2004 FSEIS considers and discloses all direct, indirect and cumulative impacts related to this project, regardless of land ownership or jurisdiction, my decision addresses only those project components subject to my authority over National Forest System lands. Other Federal and State agencies and the City and Borough of Juneau have authority to issue specific permits on National Forest System lands and elsewhere. In particular, both the Environmental Protection Agency and the U.S. Army Corps of Engineers have yet to exercise their permitting authority over this project and have indicated their intent to issue separate Records of Decision based on this FSEIS. The State of Alaska will also rely on much of this analysis to approve activities on state lands and issue applicable permits. Implementation of my decision to select an alternative is subject to the completion of those necessary permit processes by the other federal, state, and local authorities.

As part of this decision I will also consider recommendations from an interagency team to modify three small Old Growth Habitat reserves located in the project area.

Background

The Kensington Gold Project is an underground gold mine located approximately 45 miles north-northwest of Juneau, Alaska. The recent history of the Kensington Gold Project began in 1990 when the Kensington Venture (a joint venture between Coeur Alaska, Inc. [Coeur] and Echo Bay Exploration) submitted plans to the Forest Service to develop the Kensington mine. The Forest Service completed the *Kensington Gold Project Final Environmental Impact Statement* (1992 FEIS) and Record of Decision (ROD) in 1992 to consider and disclose environmental impacts that could arise from the project. Alternative F, Water Treatment – Option1 was selected as the basis for a plan of operations which was subsequently approved by the Forest Service in July 1992. Alternative F consisted of underground mining, ore processing using cyanide vat leaching, tailings impoundment in Sherman Creek, marine discharge of process wastewater and various support facilities including liquefied petroleum gas for power generation.

In 1995, prior to obtaining all necessary permits, the joint venture was dissolved and Coeur became the sole stakeholder in the property. Coeur submitted an Amended Plan of Operations to the Forest Service in September 1995.

In June 1996 Coeur revised the 1995 Amended Plan of Operations in response to issues raised during scoping and at meetings with state and federal agencies. The 1996 Amended Plan of Operations was analyzed in the *Kensington Gold Project Final Supplemental Environmental Impact Statement* (1997 SEIS) and a ROD signed in August 1997 in which Alternative D (the No Action Alternative in the current SEIS) was selected. Major project changes approved as part of Alternative D in the 1997 decision included off-site shipment of concentrate rather than on-site cyanide leaching, elimination of the slurry disposal dam in Sherman Creek in favor of a dry tailings disposal facility and use of diesel fuel rather than liquefied petroleum gas for power generation. The Forest Service approved an amended plan of operations, consistent with the selected alternative, on May 28, 1998. Coeur obtained all permits necessary for construction from federal, state, and local authorities.

In 2001 Coeur submitted an amendment to the approved 1997 Plan of Operations for the stated purpose of improving efficiency and reducing the extent of surface disturbance of the approved project. The amended plan proposes a number of changes to the 1997 approved plan, including changing the location of the processing facilities from National Forest System lands in the Sherman Creek drainage to private lands in the Johnson Creek drainage near the historic Jualin Mine workings, tailings disposal in Lower Slate Lake, an access tunnel from the mill to the Kensington claims and a daily commute of workers via shuttle boat rather than on-site housing with helicopter access. The operation would also mine a smaller portion of the ore body containing a higher average gold concentration than proposed under previous plans. The amended plan calls for the construction of two marine terminals on state tidelands; one at Slate Creek Cove and one at Cascade Point, adjacent to lands owned by Goldbelt Incorporated (Goldbelt), an Alaska Native corporation. Goldbelt would own and operate the Cascade Point dock as well as the ferry service between the two marine facilities. See Chapters 1 and 2 of the FSEIS for a more detailed description of the proposed action and alternatives.

The Forest Service directed the preparation of this SEIS using a third-party contractor, Tetra Tech, Inc. The U.S. Environmental Protection Agency (USEPA), U.S. Army Corps of Engineers (USACE), and Alaska Department of Natural Resources (ADNR) participated as cooperating agencies with the Forest Service in preparing the SEIS.

Record of Decision

The current SEIS was developed to evaluate proposed changes to the approved plan of operations which could effect National Forest System, State of Alaska, Goldbelt Native Corporation and private lands. Approval for components not on NFS lands will be accomplished through other state and federal agencies with jurisdiction. This SEIS is intended to supplement the 1997 SEIS and 1992 FEIS. According to requirements in the Council on Environmental Quality regulations for implementing NEPA (40 CFR Part 1500), this document analyzes and discloses the direct, indirect, and cumulative impacts associated with the proposed changes to the approved plan of operations.

Decision

Based on the analysis and evaluation in the SEIS for the Kensington Gold Project, it is my decision to select Alternative D. In conjunction with this decision, I am also approving a non-significant Forest Plan amendment to enlarge three Old Growth Habitat reserves as recommended by an interagency review team and described in Appendix 1 to this ROD.

My decision is based upon the analysis and evaluation in this 2004 Final SEIS as well as information incorporated by reference from the 1997 SEIS and ROD and the 1992 EIS and ROD.

My selection of Alternative D, as described in the SEIS, approves modifications to the 1997 Approved Plan of Operations to include the following:

- A Tailings Storage Facility (TSF) will be located at Lower Slate Lake rather than a Dry Tailings Facility (DTF) near Comet Beach. The TSF will be sized to accommodate 4.5 million tons of tailings and will ultimately increase the size of Lower Slate Lake from 23 acres to 56 acres. East Fork Slate Creek will be dammed between Upper and Lower Slate Lakes and diverted by pipeline around the TSF. The construction and operation of a water treatment system for the TSF discharge is authorized as required to meet NPDES permit limits. All discharge waters are required to comply with conditions to be established in a National Pollution Discharge Elimination System (NPDES) permit administered by the USEPA.
- Surface processing of ore will be done at mill facilities located on patented (private) lands in the Johnson Creek drainage. A floatation process will be used to separate gold from tailings and gold concentrate will be shipped off-site for further processing. Tailings will be transported as slurry through a 3.5-mile long pipeline from the mill to the TSF at Lower Slate Lake. Approximately 40% of tailings will be backfilled into underground workings.
- The existing Kensington and Jualin Mine access roads will be upgraded to safely accommodate mine traffic. Two new bridges will be constructed on the Kensington access road and two existing bridges will be upgraded on the Jualin access road. A 3.5-mile pipeline access road and a 1-mile cutoff road will be constructed. All road construction on NFS land will be subject to Forest Service standards and guidelines utilizing Best Management Practices (BMPs).

- Dry Tailings Facility (DTF), personnel camp, and mooring facilities located at Comet Beach will be eliminated.
- A tunnel to connect the Kensington Mine with ore processing facilities on private land near the Jualin Mine in the Johnson Creek drainage will be built.
- A permanent waste rock disposal facility at a 31.5-acre site near the Kensington 850-foot portal and a 4.8-acre site near the Jualin Mine process area will be developed.
- Surface water diversions will be built above the Kensington Mine 850-foot portal and waste rock disposal area, the Jualin process area and mine portal, and the diversion pipeline around the TSF.
- A fresh water infiltration gallery will be constructed in Johnson Creek, subject to ADNR approval, and a 300,000 gallon tank will be built at the Jualin process area for fresh water. A water recycle pipeline will be constructed alongside the tailings slurry pipeline to return process water to the mill.
- Diesel fuel delivery, transport, and storage using 6,500 gallon isotainers. Isotainers will be placed in the laydown area at Slate Creek Cove, near power generation facilities, and at equipment fueling areas. All isotainers will be stored in HDPE-lined and bermed storage areas.
- The development of two new sand and gravel borrow areas, as well as the continued use of two existing borrow areas, disturbing approximately 7.1 acres will provide construction materials.

Included in the Selected Alternative is my decision to adopt the mitigation and monitoring measures identified in the 2004 SEIS as described in section 2.5 that are within the authority of the Forest Service. This includes mitigation measures for safety, and the protection of the environment. My decision is also premised upon other permitting agencies adopting the mitigation and monitoring measures identified in the SEIS that are within their authority. In the event that the other mitigation and monitoring measures are not adopted, I will review this decision to determine whether any changes are needed.

The legal framework applicable to authorizing a large mine requires permits from different federal agencies, each of which must engage in consultation under Section 7 of the Endangered Species Act before the project may proceed. In particular, the mine operator must receive a permit under Section 404 of the Clean Water Act from the U.S. Army Corps of Engineers before construction or operation of marine terminals in Berners Bay. The USACE (and the Forest Service) initiated formal consultation under Section 7 and the USACE will not issue any permit for the marine terminals until consultation is completed. The USACE retains full discretionary authority to deny or condition the terminal permits in response to a biological opinion or the identification of reasonable and prudent alternatives. Therefore, my decision on the plan of operations does not constitute an irretrievable or irreversible commitment of resources foreclosing any reasonable and prudent alternatives with regard to the marine terminals that might be found necessary to avoid jeopardy to an endangered or threatened species.

In addition to a Section 404 permit, the operator must receive Tidelands Leases (Alaska Department of Natural Resources) for construction and operation of marine terminals. Operation of crew transport ferries across Berners Bay and barge traffic is subject to National Marine Fisheries Service (NMFS), U.S. Coast Guard, and Alaska Department of Environmental Conservation regulation. The City and Borough of Juneau (CBJ) has issued an Allowable Use Permit to Coeur for mining operations and Slate Creek Cove marine facility operation. Goldbelt has received a CBJ Conditional Use Permit for operations at Cascade Point.

Rationale for the Decision

In making my decision, I considered the many concerns raised during the analysis of this project, as well as those raised during the preparation of earlier NEPA documents related to the Kensington Mine. I took into account competing interests and values of the public and included mitigation measures, where possible, to avoid or minimize undesirable effects. All alternatives considered in detail are consistent with Forest Plan standards and guidelines designed to protect resources within the project area. I have carefully reviewed relevant information documented in the SEIS, discussions between cooperating agencies, and mitigation measures applicable to the project. Chapter 2 of the SEIS contains a detailed summary of the effects of each alternative both in tabular and narrative form. Based on that review, I believe that the actions described in Alternative D will be permitted by the other regulatory agencies.

I have also considered input from USEPA in their December 1, 2004, memo (SEIS – Appendix K) identifying their Environmentally Preferred Alternative (Alternative A) and Preferred Alternative (Alternative. A). USEPA stated that their input was provided without the benefit of a completed practicability evaluation by the USACE or a completed Biological Opinion from NMFS.

I am confident those analyses, when completed, will provide information leading to reasonable environmental mitigation measures for project components subject to the regulatory authority of the cooperating agencies.

I have also considered the advice of the State of Alaska in its memo December 1, 2004 (SEIS – Appendix K) to me regarding environmentally preferable and preferred alternatives. The State identified both Alternatives A and D as environmentally preferable and Alternative D as its preferred alternative. The State of Alaska is confident that mitigation measures identified in the FSEIS, the conditional and allowable use permits issued by the CBJ, agreed to by Coeur in its transportation plan, and those identified in the BA/BE submitted to NMFS on November 17, 2004, will all serve to reduce impacts to minimal levels for resources under the jurisdiction of the State of Alaska, herring in particular. The State of Alaska will be including a number of those mitigation measures in its Tidelands leases for marine facilities and Alaska Coastal Zone consistency review. I agree with the comment and analysis provided by the State.

As noted above, other agencies have the final decision in authorizing the type of transportation system to be used to access National Forest System lands. The FSEIS does, however, attempt to predict likely effects to non-National Forest resources based on anticipated activities and both mandatory and anticipated mitigation. Based on this analysis and current mitigation requirements it appears that the effects to wildlife, fish, and recreational resources in Berners Bay are minimal. It is also possible that additional permit conditions could be imposed under both the USCOE permit and the State of Alaska tidelands lease that would further reduce impacts. Given this conclusion, and the level of concern regarding the effects of helicopter transport on wildlife and recreation expressed during the 1992 and 1997 analyses, both helicopter and vessel transport result in low to moderate effects on various resources, including the recreational setting. As a result transportation related effects are not a deciding factor in my selection of Alternative D.

Alternative D provides the best combination of components to minimize ground disturbance, reduce impacts to wetlands, provide safe and efficient transportation of workers, and reduce on-site fuel storage with the related risk of fuel spills within the framework of existing laws, regulations, and policies while meeting the stated purpose and need.

The Forest Service generally encourages use of private land for construction of privately owned facilities and roads where possible. Alternative A has the greatest impact on NFS lands in terms of surface disturbance (248 acres) whereas alternatives B, C, and D put more of the disturbance onto privately held lands, and impact less acreage of NFS lands (157 acres, 177 acres, and 159 acres respectively for alternatives B, C, and D).

The EPA has indicated that both Alternative A and Alternative B could be permitted under an NPDES permit pursuant to the Clean Water Act. Without additional water treatment, neither Alternative B nor Alternative C could meet expected NPDES permit conditions at all times and, therefore, could not discharge to Slate Creek under all conditions. Alternative C also does not include process water recycling which the EPA has indicated will be required by the NPDES permit (40 CFR 440.104(b)). The open channel diversion of East Fork Slate Creek around the TSF in Alternative C would provide the same minimum in-stream flows to Slate Creek as Alternative D, but would result in more ground disturbance and be more difficult to maintain than the pipeline diversion in Alternative D. Modifying either alternative to address these concerns would make them similar to Alternative D.

Alternative D disturbs approximately 197 acres, of which 96 acres are wetlands, while Alternative A (No Action) disturbs 268 acres, all of which are wetlands. Although the total disturbed wetland acreage is low for all alternatives, Alternative D does reduce wetland disturbance by 171 acres compared to the previously approved plan and virtually all of the wetlands affected by Alternative D will be reclaimed following closure. Approximately 164 acres of wetlands lost to the TSF under Alternative A would not be regained.

Under Alternative D, water treatment and tailings capping offer reasonable assurances that water quality downstream of the TSF will be protected. Reclamation of the TSF, post closure, will recreate habitat lost during operations and restore a viable fish population comparable to pre-operational conditions.

Both the DTF under Alternative A and the TSF under Alternative D pose a minor threat due to the potential for design failure. Any tailings facility approved will be required to be built to high standards. Construction of the TSF dam will require certification from the Alaska State Dam Officer and bonding for maintenance in perpetuity.

Alternative D provides for safer handling of fuels compared to Alternative A. The risk of diesel spills is reduced under Alternative D by requiring all diesel fuel to be delivered, transported, and stored in isotainers rather than pumped from a fuel barge at Comet Beach as under Alternative A. Since fuel storage facilities under all alternatives would be within approved containment the effects of a spill at those facilities would be minimal should one occur.

Slate Creek Cove offers more reliable and safer conditions for marine traffic. This reduces the need to store excess fuels, chemicals, and materials onsite as a contingency for weather delays.

Construction of 4.5 miles of road, common to alternatives B, C, D, results in a minimal change to the character of Roadless Area 301. Roads not required for future monitoring and maintenance will be reclaimed following mine closure and revegetated with native plant species.

The 122-acre DTF under Alternative A would be highly visible from Lynn Canal, the only Visual Priority Travel Route (VPTR) impacted by project components on NFS lands. Figure 4-1 in the SEIS provides a visual simulation of this effect. By eliminating this component, my decision reduces visual impacts along the VPTR.

I recognize the high recreational value of Berners Bay to users. Berners Bay is an outstanding resource that provides unique opportunities for wildlife and landscape viewing. Portions of the operations will be visible from the Forest Service Berners Bay Cabin, Echo Cove, and Point Bridget. Impacts to users of Berners Bay are related to marine facilities at Cascade Point/Echo Cove and Slate Creek Cove and the vessel traffic between them. Although these project components are outside of National Forest System lands, the impacts related to them have been evaluated in the SEIS and are considered in my decision. The Forest Service will work, to the extent practicable, with the other Federal, State, and local agencies, as well as with the operator to minimize these impacts. I believe recreational values will be maintained with the mitigation measures considered in the SEIS. I also recognize that there may be some forest users that find even these minimal impacts to be unacceptable.

Alternatives Considered in Detail

Four alternatives were considered in detail, including the No Action Alternative. This range of alternatives addressed the major issues associated with this project. The three action alternatives differed from each other in the type and location of various project components. The alternatives are summarized below. Table 2-5 in the FSEIS compares alternatives by key project components.

Alternative A – No Action – As a result of this alternative, the Forest Service would not approve proposed changes to the 1997 Approved Plan of Operations. This alternative includes underground crushing of ore with aboveground grinding and flotation. Flotation concentrate would be shipped to a processing facility off-site. Employees would be housed on-site and transported by helicopter for weekly rotations. Supplies, including fuel, would be delivered to a marine terminal on Comet Beach. Tailings would be dewatered before being placed in a dry tailings facility (DTF) facing Lynn Canal. The DTF would have the design capacity to hold 20 million tons of tailings and would include an engineered berm around each cell of the facility. The production rate would be 4,000 tons of ore per day and 400 tons of waste rock per day. The waste rock would be used in the construction of the DTF. Road and DTF construction would require the development of sand, gravel, and till borrow areas.

Alternative A1: Reduced Mining Rate, DTF – Alternative A1 illustrates the impacts that might occur if the No Action Alternative were selected and the operator chose to mine the same ore volumes proposed in the action alternatives. Alternative A1 reflects a mining plan similar to that described for Alternative A but uses a mining rate and tailings production levels consistent with the Proposed Action (2,000 tons per day and 7.5 million tons total, respectively). *The effects of Alternative A1 were included in the FSEIS for comparison purposes only. The Forest Service does not regulate mining rate or target ore body.*

Alternative A1 would result in 4.5 million tons of tailings being placed in the DTF, assuming 40 percent of the tailings would be backfilled. The DTF would be approximately 65 percent smaller than it would be under Alternative A. The reduced mining rate presented under Alternative A1 would produce very limited amounts of waste rock for DTF construction. For this reason, the impact analysis assumes the same number of acres of sand and gravel borrow areas would be required as under Alternative A, although the coarse and fine till borrow area would be reduced in size. Other aspects of Alternative A1, including transportation of employees and materials, would remain the same as those described under Alternative A. The life of the operation would be reduced to ten years following two years of construction.

Alternative B: Proposed Action – Alternative B reflects a number of changes to the mine plan compared with the No Action Alternative, including constructing a tailings storage facility (TSF) in Lower Slate Lake, relocating milling operations to the Johnson Creek drainage, and eliminating the personnel camp. The operation would mine a smaller amount of ore with a higher average gold concentration compared with that proposed under Alternative A. Alternative B would include the development of a tunnel connecting the existing Kensington Mine to the process area located near the Jualin Mine in the Johnson Creek drainage. Access to the site would be from marine terminals built in Slate Creek Cove and at Cascade Point. Crew shuttle boats would transport employees daily to and from the project site. The TSF would be sized to accommodate the disposal of 4.5 million tons of tailings. Borrow areas would need to be developed for construction of the TSF dam and roads. The production rate would be approximately 2,000 tons of ore per day. This alternative includes recycling water from the TSF to the mill circuit. Alternative B would require upgrading the 5-mile-long access road from Slate Creek Cove and constructing a 3.5-mile pipeline access road and a 1-mile cutoff road connecting the other two roads.

Alternative C: Dock Location and Design/Diversion- Alternative C would eliminate the dock at Cascade point and instead include a dock in Echo Cove, approximately 0.75 mile north of the existing Echo Cove boat ramp. Also, the landing craft ramp at the Slate Creek Cove marine terminal would be eliminated, minimizing the amount of fill placed in the intertidal zone. Alternative C does not include recycling process water from the TSF and the mill circuit. This alternative would include diversion channels to direct the flow from Mid-Lake East Fork Slate Creek and overland runoff from undisturbed areas around the TSF. The diversion would discharge to a spillway at the top of the TSF dam. The diversions would require a dam on Upper Slate Lake to maintain water levels sufficient to reach the spillway at the TSF dam. The purpose of the diversion would be to minimize the volume of fresh water in contact with the tailings. The remaining project components, including the production rate of 2,000 tons per day of ore and the access tunnel, would be the same as those under Alternative B.

Alternative D: Modified TSF Design and Water Treatment- Alternative D was developed to address comments received and concerns about the TSF effluent meeting NPDES permit limitations intended to protect downstream water quality in East Fork Slate Creek below the TSF. Alternative D includes a dam in Mid-Lake East Fork Slate Creek that would gravity feed a pipeline diversion around the TSF. Water would be pumped from the TSF to a reverse osmosis treatment system that would remove solids and metals to ensure compliance with permit limits. The treatment system would discharge to the diversion pipeline. Alternative D also requires the tailings placed in Lower Slate Lake to be capped if the operator cannot demonstrate that the tailings are re-colonized by plant and shallow-water macro invertebrates at least comparable to pre-mining conditions. The remaining project components would be same as those under Alternative B. Alternative D, the selected alternative, is described in more detail above.

Environmentally Preferable Alternative

Environmentally Preferable Alternative(s) is (are) the alternative(s) that cause the least damage to the biological and physical environment and which best protect, preserve, and enhance historic, cultural, and natural resources.

I have identified Alternatives A and D as the environmentally preferable alternatives. While both alternatives include environmental impacts ranging from short to long term, each are protective of water and air quality standards. Each has different environmentally negative and positive aspects that, when compared, make the two alternatives different but near equal with respect to overall impact to the environment. I have reviewed input from the USEPA and the ADNR in reaching my determination. The written conclusions and rationale from both agencies are provided in Appendix K to the SEIS. While the Forest Service and ADNR appear to be in agreement about the relative effects of the alternatives on the environment, the USEPA differs in its relative weighing of project effects. Several interagency working meetings were held to attempt to reach consensus regarding the environmentally preferable alternative but, contrary to the USEPA's view, no group consensus was reached.

Comparing numerical differences of similar effects between alternatives (i.e. acres) provides one means of differentiating between the alternatives but is limited to easily measurable effects. Weighing the actual importance of an impact on one resource against a different impact on another resource is a much more difficult undertaking. For example; weighing the extremely low risk of a catastrophic event in one alternative against the certainty of a very small impact in a different alternative results in a very subjective ranking of one alternative against another. In the end, in my opinion, a meaningful difference between Alternatives A and D was not apparent based on the resource values affected, nor the degree to which those values would be affected Chapter 2 of the SEIS contains a detailed summary of the effects of each alternative both in tabular and narrative form. Chapter 4 of the SEIS contains a detailed discussion of those effects.

Alternatives Eliminated from Detailed Analysis

There were a number of alternatives and project components studied in the 1992 FEIS and 1997 SEIS including submarine tailings disposal, marine discharge of wastewater, and wet tailings disposal in the Sherman Creek drainage, among others. Those discussions are not repeated here. This FSEIS discusses a number of additional alternatives and components including disposal of tailings in Upper Slate Lake, use of tailings in the construction of the Juneau Access Road, helicopter access during eulachon and herring runs, and Cascade Point to Comet Beach crew shuttle access among others. Each is briefly discussed and reasons for not considering the alternative or project component in detail are listed.

Mitigation, Monitoring, and Reclamation

The FSEIS, Chapter 2, Mitigation and Monitoring list the mitigations measures required as part of alternative D that are designed to avoid or minimize potential environmental impacts during construction, operation, and project reclamation. A summary of mitigation measures and a summary of monitoring measures, including various authorities and the responsible parties, are identified in Table 2-6 and 2-7of the FSEIS respectively. These mitigation measures have been used successfully in other projects with similar types of activities. As a result, they are considered effective and are made part of this decision. The mine operator will be required, as part of the amended plan of operations, to submit mitigation and monitoring plans. Mine construction may not begin until the Forest Service approves the plan of operations.

Environmental monitoring programs that meet the requirements of the Forest Service, USEPA, ACOE, ADNR, ADEC and other agencies will be implemented. These programs will be designed to determine compliance of the project with the plan of operations, other federal, state and local permits, and to validate the projected effects of the project's construction, operation, reclamation, and post-closure conditions. Impacts that are likely to or do result in violations of regulatory stipulations will require alterations of project operations and/or additional mitigation actions.

Permits, Licenses and Certifications

To proceed with development of the Kensington Gold Project as approved in this ROD, various permits, licenses and certifications must be obtained from federal, state, and local agencies. The following permits must be obtained:

USDA Forest Service

Approval of the amended plan of operations including posting of the approved reclamation bond.

U.S. Army Corps of Engineers

Clean Water Act Section 404 Permits

Rivers and Harbors Act Section 10 Permits

U.S. Environmental Protection Agency

Clean Water Act Section 402 - National Pollutant Discharge Elimination System Permit

Clean Air Act

State of Alaska, Department of Environmental Conservation

Clean Water Act Section 401 Certification of the USACOE Section 404 permit
Clean Water Act Section 401 Certification of the USEPA Section 402 - NPDES permit
Air Quality Control Permit
Domestic wastewater system plan approval
Boat requirements (SPCCP and financial assurances)

State of Alaska, Department of Natural Resources

Water rights authorizations
Tidelands leases for marine facilities
Alaska Coastal Zone consistency review
Certificate of Approval to Construct a Dam
Title 41 authorizations for fish passage and fish habitat
Right-of-way authorizations
Approval of the reclamation plan.

City and Borough of Juneau

Allowable Use Permit for Gold Mine Development and Production within the Rural Mining District at Berners Bay. (Approved September 13, 2004)

Conditional Use Permit to allow development of a ferry dock and related access at Cascade Point. (Approved October 15, 2004)

Public Involvement

On September 13, 2002, the Forest Service published a Notice of Intent to prepare a Supplementary Environmental Impact Statement (SEIS) for the proposed project in the Federal Register (Vol. 67, No. 178, Page 58011-58012). Cooperating agencies as defined in 40 CFR, section 1501.6 are the U.S. Army Corps of Engineers, Environmental Protection Agency, and The State of Alaska. The National Marine Fisheries Service (NMFS) was invited to participate as a cooperating agency, but declined. A Memorandum of Understanding was executed that included the following State of Alaska agencies as participants in the development and review of the SEIS: Alaska Department of Natural Resources (ADNR), Alaska Department of Environmental Conservation (ADEC), and Alaska Department of Fish and Game (ADF&G). On the date of the Notice of Intent, the *Kensington Gold Project Amended Plan Of Operations; Supplemental Environmental Impact Statement; Scoping Document; USDA Forest Service, Juneau Ranger District; September 2002* was distributed to agencies, organizations, tribes, and persons who had previously expressed interest in minerals projects on the Tongass National Forest. Outreach was conducted with public service announcements in the Juneau Empire and by radio media.

On September 17, 2002 a scoping meeting/open house was held in Juneau, Alaska at Centennial Hall, and a second open house on September 19, 2002 in Haines, Alaska at the City Council chambers in City Hall. The open houses were designed to provide background information or technical assistance that the public or interested agencies might need before commenting. The scoping document was made available at these meetings. The formal comment period ended October 15, 2002.

The following significant issues were identified based on comments from the public, other agencies, federally recognized tribes, and non-governmental organizations.

1). Marine-related transportation will impact users of and resources within Berners Bay.

2). Construction and operation of the tailings disposal facility and other mine facilities will impact aquatic resources from Slate and Johnson Creeks to Slate Creek Cove and Berners Bay.

3). The Lower Slate Lake tailings storage facility, docks, access road, and other mine facilities will impact the scenic character of Berners Bay for recreationists.

To address these issues, the Forest Service developed alternatives to the Proposed Action, as described above.

A Notice of Availability of the Draft SEIS was published January 23, 2004 in the Federal Register (Vol. 69, No. 15, Page 3340-3341) and copies of the document distributed to interested and affected parties. A public meeting was held on February 24, 2004 at Centennial Hall in Juneau and on February 26, 2004 at the American Bald Eagle Foundation Building in Haines. The extended comment period for the Draft SEIS closed April 7, 2004. Based on comments to the Draft SEIS, Alternative D was developed. The only new component introduced in Alternative D was a reverse osmosis water treatment facility to address concerns about the TSF effluent meeting NPDES permit limitations intended to protect downstream water quality in East Fork Slate Creek below the TSF.

Planning Record

The planning record for this project includes the Draft SEIS, Final SEIS, appendices, public comments, response to public comments, Forest Plan, all material incorporated by reference including the 1997 SEIS and ROD and 1992 EIS and ROD, and all materials utilized during the analysis of this project. The planning record is being compiled and will be available for review at the Juneau Ranger District office when legal notice of this decision is published in the Juneau Empire.

Findings Required by Law

Tongass Land and Resource Management Plan, 1997

All project alternatives are consistent with the 1997 Land and Resource Management Plan for the Tongass National Forest. The site is located within an area designated as Modified Landscape with a Minerals prescription. My decision to approve the amended plan of operations for the Kensington Gold Project as described in Alternative D is consistent with the intent of the Forest Plan's long-term goals and objectives listed on pages 2-2 to 2-5. The project was designed in conformance with Forest Plan standards and incorporates appropriate Forest Plan guidelines for Modified Landscape with a Minerals prescription (Forest Plan, pages 3-135 to 3-136 and 3-151 to 3-157).

As part of the Kensington Gold Project analysis, three small Old-Growth Reserves (OGR) within the project area were reviewed by an interagency team . These OGRs are synonymous with the Old-Growth Habitat land use designation in the Forest Plan. A non-significant amendment expands the OGRs in VCUs 160, 190, and 200 to meet the requirements of the Forest Plan. (ROD, Appendix 1)

The Roadless Area Conservation Rule (Roadless Rule)

On January 12, 2001 the Forest Service published a final rule for roadless area conservation known as the "Roadless Rule", which generally prohibited commercial timber harvest and road construction within inventoried roadless areas on national forests. In December 2003, the Forest Service exempted the Tongass National Forest from the roadless rule.

Alaska National Interest Lands Conservation Act (ANILCA)

An ANILCA Section 810 subsistence evaluation was conducted. The Kensington Gold Project is located within the City and Borough of Juneau, whose residents are non-rural for subsistence purposes in terms of the ANILCA. Documented subsistence use of the area is limited to the some fishing off Comet Beach by Skagway and Haines residents.

The documented use of the project area by rural residents is well below the levels considered for subsistence use. Therefore, no significant restrictions on subsistence resources would be expected by implementing any of the alternatives..

Endangered Species Act

No threatened or endangered species either occur upon or would be affected by project components occurring on NFS land and approved by my decision. The Forest Service has determined that project components occurring outside of NFS land are not likely to affect threatened and endangered species. As indicated above, formal consultation with the NMFS is ongoing, and implementation of my decision is subject to the completion of this process. The USACE retains the full authority to deny or condition the activities at the marine terminals in response to a biological opinion and any reasonable and prudent alternatives to protect listed species. Other agencies may, as a result of NMFS recommendations and findings, incorporate additional mitigations or modifications. Such mitigations and modifications will be incorporated within the permits of agencies with jurisdiction. The Final Biological Assessment/Biological Evaluation (BA/BE) submitted to NMFS on November 17, 2004 is included as Appendix J to the SEIS and contains current and expected operating conditions. In the event that other mitigation measures or operating conditions are incorporated, I will review my decision to determine whether any changes are needed.

Essential Fish Habitat

The potential effects of the Kensington Gold Project on essential fish habitat (EFH) have been evaluated. No adverse effects to freshwater EFH will occur as a result of my decision. Although the risk of measurable impact on essential fish habitat has been minimized, I have determined that this project could adversely affect essential fish habitat in the marine environment. Marine components of this project could have short- and long-term adverse effects on EFH. These components will be addressed by other Federal, state, and local agencies that may require mitigation measures to reduce adverse impacts to EFH. In addition, Coeur is sponsoring a monitoring plan by NMFS and the state to assess the effects of petroleum releases into Berners Bay. I will continue to work with the NMFS in evaluating monitoring results. For specific information regarding essential fish habitat and potential impacts refer to sections 4.9 and 4.10, and the EFH Assessment included as Appendix B in the SEIS.

National Historic Preservation Act

A cultural resource survey of the area of potential effect for the Kensington Gold Project was completed in 2003, in compliance with Section 106 of the National Historic Preservation Act. Determinations of eligibility for 43 historic sites within the area of potential effect were submitted to the State Historic Preservation Officer for its concurrence with our determinations of eligibility. In March 2004 the Forest Service completed the determinations of effect for each of the historic properties in each of the proposed alternatives. A mitigation plan to address the adverse effects to historic properties has been documented in a Memorandum of Agreement (MOA) between Coeur Alaska Inc., Alaska State Historic Preservation Officer, and the Tongass National Forest as executed by the Forest Service on November 29, 2004 (FS No. 05MU-111005-017).

Implementation of this MOA during all phases of the mining operations, through closure, evidences that the Tongass National Forest has satisfied its section 106 responsibilities for all undertakings pursuant to the plan of operations.

The area of potential effect was also evaluated for the presence of any Traditional Cultural Properties (TCP). The State Historic Preservation Officer concurred with our determination of "No Traditional Cultural Properties Affected". Members of the Auk Kwaan were consulted regarding TCP in a May 2003 meeting in Juneau in order to complete and verify Forest Service records.

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) requires that the Forest Service, when conducting or authorizing activities or development be consistent with the approved Alaska Coastal Management Program (ACMP) to the maximum extent practicable. This activity is one authorized under a Forest Service permit, as defined in 15 CFR 930.51(a). The Forest Service/State of Alaska Memorandum of Understanding on Coastal Zone Management Act/Alaska Coastal Management Program Consistency Reviews (MOU) lists permitted activities normally requiring a consistency determination (MOU, Section 302.B.2.). This activity is listed in Section 302.B.2 as normally requiring a consistency determination. Coastal Project Questionnaires have been completed by Coeur Alaska, and submitted to the State of Alaska for a consistency determination. A consistency determination must be received before the state can issue any permits and before the Forest Service can approve the plan of operations.

Executive Orders

Executive Order 11988 (Floodplain Management)

This area is not located within floodplains as defined by executive order 11988.

Executive Order 11990 (Protection of Wetlands)

Because wetlands are so extensive in the Kensington Gold Project area, it is not feasible to avoid all wetland areas. I have determined that the selected alternative includes all reasonable measures to minimize harm to wetlands, which may result from such use. A separate permit, issued by the USACOE, is required for all wetland fill. The selected alternative eliminates the permanent loss of 122 acres of wetlands resulting from construction of the DTF. Construction of the TSF will impact 23 acres of wetlands, however, a similar amount of wetlands are expected to develop naturally or be created along the edges of Lower Slate Lake upon the completion of reclamation.

Executive Order 12898 (Environmental Justice)

Implementation of this decision will not result in disproportionate adverse human health or environmental effects to minority or low-income populations.

Executive Order 12962 (Recreational Fisheries)

With the application of Forest Plan standards and guidelines, including those for riparian areas, no significant adverse effects to freshwater or marine fisheries will occur. Most recreational fishing throughout the Tongass National Forest occurs by boat in saltwater, and any adverse effects would be minimal.

Executive Order 13175 (Indian Tribal Governments)

The Forest Service conducted consultations with the Chilkoot Indian Association, Chilkat Indian Village, and the Tlingit-Haida Central Council, as well as regional corporations, on the proposed project.

Executive Order 13186 (Migratory Birds)

Implementation of this decision will not have any significant adverse effects to migratory birds and their habitat. (SEIS Appendix H)

Process for Change During Implementation

Proposed changes to the authorized project actions will be subject to the requirements of National Environmental Policy Act (NEPA), National Forest Management Act (NFMA), Section 810 of Alaska National Interest Lands Conservation Act (ANILCA), Coastal Zone Management Act (CZMA), 36 CFR 228 (Subpart A), and other laws concerning such changes.

In determining whether and what kind of NEPA action is required, the Forest Supervisor will consider the criteria set forth in the Code of Federal Regulations (40 CFR 1502.9(c)), and FSH 1909.15, sec. 18, for determining whether to supplement an existing EIS. In particular, the Forest Supervisor will determine whether the proposed change is a substantial change to the Selected Alternative as planned and already approved, and whether the change is relevant to environmental concerns. Connected or interrelated proposed changes regarding particular areas of specific activities will be considered together in making this determination. The cumulative impacts of these changes will also be considered.

The intent of field verification is to confirm field conditions and to determine the feasibility and general design and location of a structure or road, but not to designate final locations. Minor adjustments are expected during implementation to better meet on-site resource management and protection objectives. Many of these minor changes will not present sufficient potential impacts to require any specific documentation or other action to comply with applicable laws. Some minor changes may still require appropriate analysis and documentation to comply with FSH 1909.15, sec. 18.

Implementation of this Decision

Implementation of decisions subject to appeal pursuant to 36 CFR part 215, may occur on, but not before, 5 business days from the close of the appeal filing period.

Right to Appeal

This decision is subject to administrative review (appeal) pursuant to 36 CFR Part 215. Individuals or organizations who submitted substantive comments during the comment period specified at 215.6 may appeal this decision. The notice of appeal must be in writing, meet the appeal content requirements at 215.14 and be filed with the Appeal Deciding Officer:

Denny Bschor, Regional Forester
USDA Forest Service, Region 10
P.O. Box 021628
Juneau, AK 99802-1628

E-mail: appeals-alaska-regional-office@fs.fed.us

The Notice of Appeal, including attachments, must be filed (regular mail, fax, e-mail, express delivery or messenger service) with the Appeal Deciding Officer at the correct location within 45 calendar days of publication of notice of this decision in the Juneau Empire, the newspaper of record for the Tongass National Forest. The publication date in the newspaper of record is the exclusive means for calculating the time to file an appeal. Those wishing to appeal this decision should not rely upon dates or timeframe information provided by any other source.

Hand delivered appeals will be accepted at the Regional Office in Juneau, Alaska during normal business hours (8:00 am through 4:30 pm) Monday through Friday, excluding holidays.

In accordance with 36 CFR Part 215.14, it is the responsibility of those who appeal a decision to provide the Appeal Decision Officer sufficient evidence and rationale to show why the Responsible Official's decision should be remanded or reversed. The written notice of appeal filed must meet the following requirements:

1. State the document is a Notice of Appeal filed pursuant to 36 CFR part 215;
2. List the name, address, and telephone number of appellant;
3. Identify the decision document by title and subject, date of the decision, and name and identify the specific change(s) in the decision that the appellant seeks or portion of the decision to which the appellant objects;
4. State how the Responsible Official's decision fails to consider comments previously provided, either before or during the comment period specified in 36 CFR 215.6 and, if applicable, how the appellant believes the decision violates law, regulation, or policy.

Contact Person

For additional information concerning this decision or the Forest Service appeal process, contact

Pete Griffin
Juneau District Ranger
8465 Old Dairy Road
Juneau, Alaska 99801(907) 586-8800

FORREST COLE — 12.9.04 **Date**

Forest Supervisor

Appendix 1

Non-significant amendment to Forest Plan

SIGNIFICANCE ANALYSIS FOR A NON-SIGNIFICANT AMENDMENT TO THE FOREST PLAN

Small Old-Growth Reserve (Habitat) Modifications in Value Comparison Units 160, 190, and 200

During the development of the *1997 Forest Plan Final Environmental Impact Statement*, a conservation strategy was designed to ensure that implementation of the Forest Plan would provide a reasonable assurance of maintaining viable and well-distributed wildlife populations across the Tongass National Forest for 100 years. As part of this conservation strategy, a forest-wide system of large, medium, and small Old-Growth Habitats or Reserves (OGRs) was established and a set of standards and guidelines developed to preserve the integrity of the forest's old-growth ecosystem. The habitats have been identified and mapped in the 1997 Forest Plan.

The Old-Growth Habitat land use designation provides for evaluation and possible adjustment of the location of the habitats based on site-specific information. Where feasible, the boundaries should follow geographic features so that they can be recognized in the field. The 1997 *Forest Plan Record of Decision* committed the Forest Service to work with the Alaska Department of Fish and Game (ADG&G) and the U.S. Fish and Wildlife Service (USFWS) to review the location, size, and suitability of the OGRs during project-level planning.

As part of the Kensington Gold Project analysis, three small OGRs were identified within the project area (Figure 1). Small OGRs require a contiguous landscape of at least 16 percent of the total Value Comparison Unit (VCU) area and 50 percent of this area must be productive old-growth timber. Along with the general criteria of size and productivity, connectivity is also a criterion. The design of each habitat should be based on wildlife concerns specific to the area. Criteria commonly used in designing small habitats include important deer winter range, probable goshawk nesting habitat, probable marbled murrelet nesting habitat, large forest blocks, rare plant associations, and landscape linkages. VCUs are distinct geographic areas encompassing one or more large stream systems with boundaries that follow watershed divides.

The study area includes three VCUs (160, 190, and 200) with a small OGR within each. The Forest Service, ADF&G, and USFWS conducted an interagency review of the existing mapped small OGRs in November 2003. The review team determined that none of the mapped small OGRs in the study area met the requirements for size or the amount of productive old growth established under the Forest Plan and recommended non-significant modifications to each of the small OGRs. The findings and recommendation of the interagency review team are summarized below by VCU and explained in more detail in Appendix F of the *2004 Kensington Gold Project Supplemental Environmental Impact Statement* (SEIS).

VCU 160
Finding: The small OGR in VCU 160 does not meet Forest Plan standards and guidelines for size. This small OGR covers 802 acres and is 573 acres short of the 16 percent of VCU requirement.

Recommendation: Increase the size of the small OGR in VCU 160. The redrawn boundaries of this OGR will border but not include the tailings storage facility, access roads, pipeline, and maintenance access facilities.

VCU 190
Finding: The small OGR in VCU 190 does not meet the Forest Plan standards and guidelines for size nor percentage of productive old growth (POG) needed. This small OGR covers 1,299 acres and is 106 acres short of the 16 percent of VCU requirement. Existing POG is 615 acres; 106 acres short of the 50 percent POG requirement.

Recommendation: Expand to the north in light of existing natural fragmentation and limited amounts of productive old growth.

VCU 200
Finding: The small OGR within VCU 200 does not meet the Forest Plan standards and guidelines for productive old growth. Existing POG is 648 acres; 227 acres short of the 50 percent POG requirement.

Recommendation: Due to the naturally fragmented area, additional acres were used in the adjacent VCU160. Appendix K of the Forest Plan allows for up to 30 percent of an OGR to be mapped in an adjacent VCU if the resulting habitat achieves the objectives of the old-growth habitats. The interagency review team agreed that expanding the small OGR in VCU 200 to include portions of VCU 160 would increase connectivity values, capture important beach and estuary fringe habitats and riparian habitats, and include higher-volume stands. The approximately 36 percent of the recommended modified OGR would extend into VCU 160.

The Secretary of Agriculture's implementing regulation indicates the determination of significance is to be "…based on an analysis of the objectives, guidelines and other contents of the forest plan" (36 CFR 219.10(f)). The Forest Service has issued guidance for determining what constitutes a "significant amendment" under the National Forest Management Act. This guidance, in Forest Service Handbook (FSH) 1909.12 - Chapter 5.32, identifies four factors to be used in determining whether a proposed change to a forest plan is significant or not significant. These four factors are (1) timing; (2) location and size; (3) goals, objectives, and outputs; and (4) management prescriptions. An analysis of the factors is presented below.

Timing - The Tongass Forest Plan Revision was completed in 1997. The Old-Growth Habitat land use designation provides for evaluation and possible adjustment of the location of the habitats based on site-specific information. Project level analysis for the Kensington Gold Project in 2003 determined that existing OGRs in the study area did not meet Forest Plan standards and guidelines.

Location and Size – These modifications increase the size of three small OGRs to meet Forest Plan standards and guidelines and better preserve areas of old-growth forest and their associated natural ecological processes to provide habitat for old-growth associated resources. OGRs in VCUs 160, 190, and 200 will be increased in size by 652,163, and 458 acres, respectively.

Goals, Objectives, and Outputs - The boundary modifications approved here will increase the connectivity from higher elevations to the beach and estuary fringe habitats and additional riparian habitat, and would increase the number of intact patches of medium- and high-volume old-growth stands. Maintaining forested corridors between OGRs or other non-development land use designations is a key component to maintaining viable wildlife populations on the forest.

Management Prescriptions

These recommendations would move 1,615 acres of productive old growth in land use designations suitable for timber harvest, into OGRs unsuited for timber harvest. Table A-1 summarizes the cumulative effects of small OGR adjustments on the Forest to date. Individually and cumulatively the changes to acres suitable for timber harvest are minor.

Table A-1
Effects of Forest Plan Amendments on Acres Suitable for Timber Harvest as of December 2004

Project	Non-development to Development LUD Suitable Acres	Development to Non-development LUD Suitable Acres	Net Change in Suitable Acres
Kensington Gold EIS	0	1,615	-1,615
Madan EIS	377	1,501	-1,124
Finger Mountain EIS	0	593	-593
Cholmondoley EIS	894	6,873	-5,979
Woodpecker EIS	180	130	+50
Polk Small Sales EA	0	153	-153
Threemile EIS	458	826	-368
Fire Cove Salvage	186	633	-447
Salty EA	99	126	-27
Luck Lake EIS	257	794	-537
Doughnut EIS	0	19	-19
Kuakan EIS	416	542	-126
Sea Level EIS	185	500	-315
Canal Hoya EIS	0	151	-151
Chasina EIS	0	78	-78
Control Lake EIS	446	142	+304
Crystal Creek EIS	481	1,153	-672
Nemo Loop EA	177	932	-755
Todahl Backline EA	2	363	-361
Niblack EA	252	0	+252
Total	**4,700**	**17,759**	**-13,059**

Conclusion

Based on the analysis and recommendations of the interagency review team and the significance analysis above, the OGRs within VCUs 160, 190, and 200 will be modified as described in Appendix F of the 2004 Kensington Gold Project SEIS and shown in Figure 2. No direct or indirect effects on OGR is expected other than the positive effect of adjusting the boundaries of the existing small OGRs to comply with Forest Plan standards and guidelines. This amendment is fully consistent with current Forest Plan goals and objectives.

This analysis in combination with the 2004 Kensington Gold Project SEIS and ROD document my decision to amend the Forest Plan with a non-significant amendment expanded OGRs in VCUs 160, 190, and 200.

Forrest Cole
Forest Supervisor

12.9.04
Date

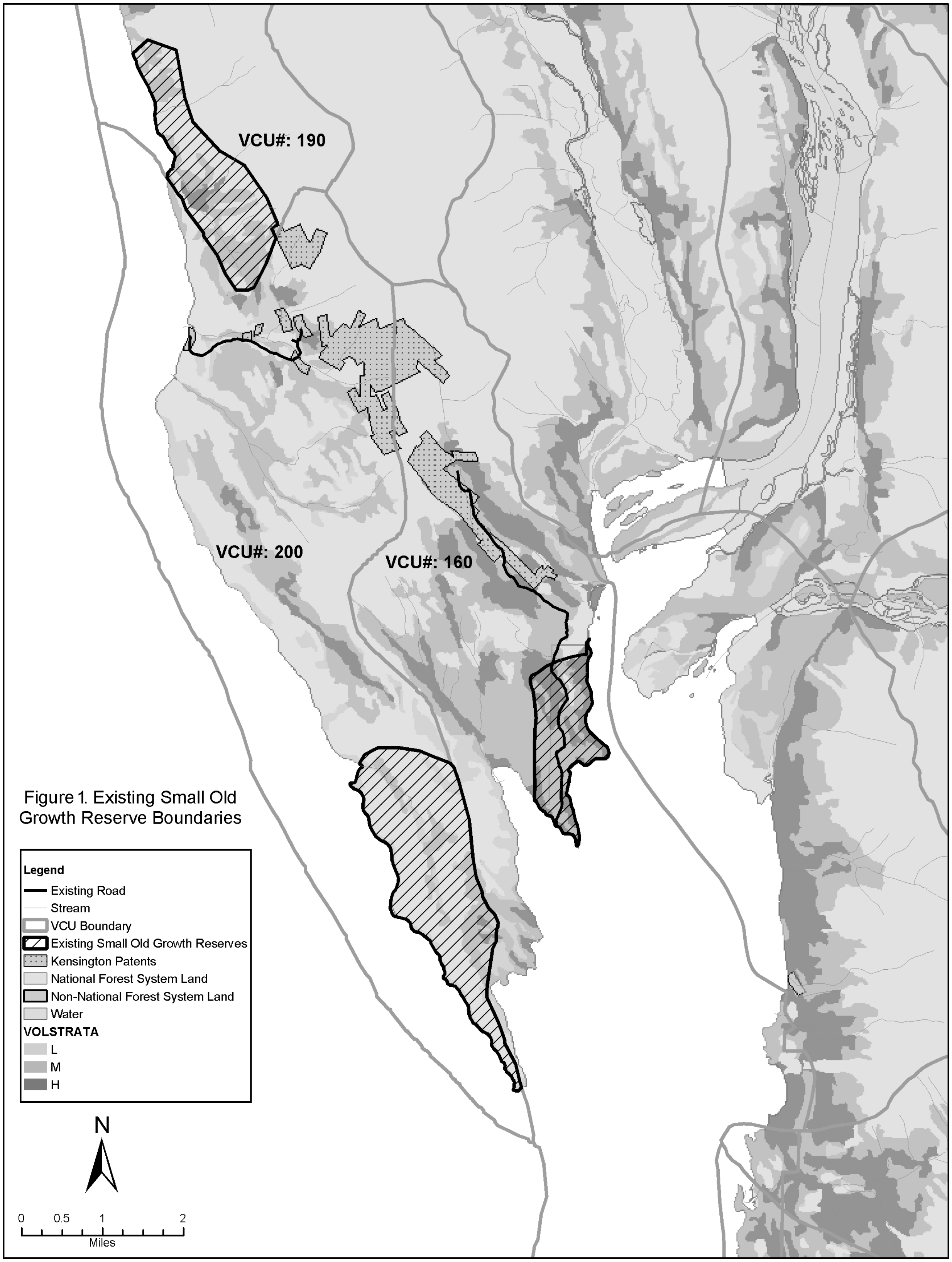
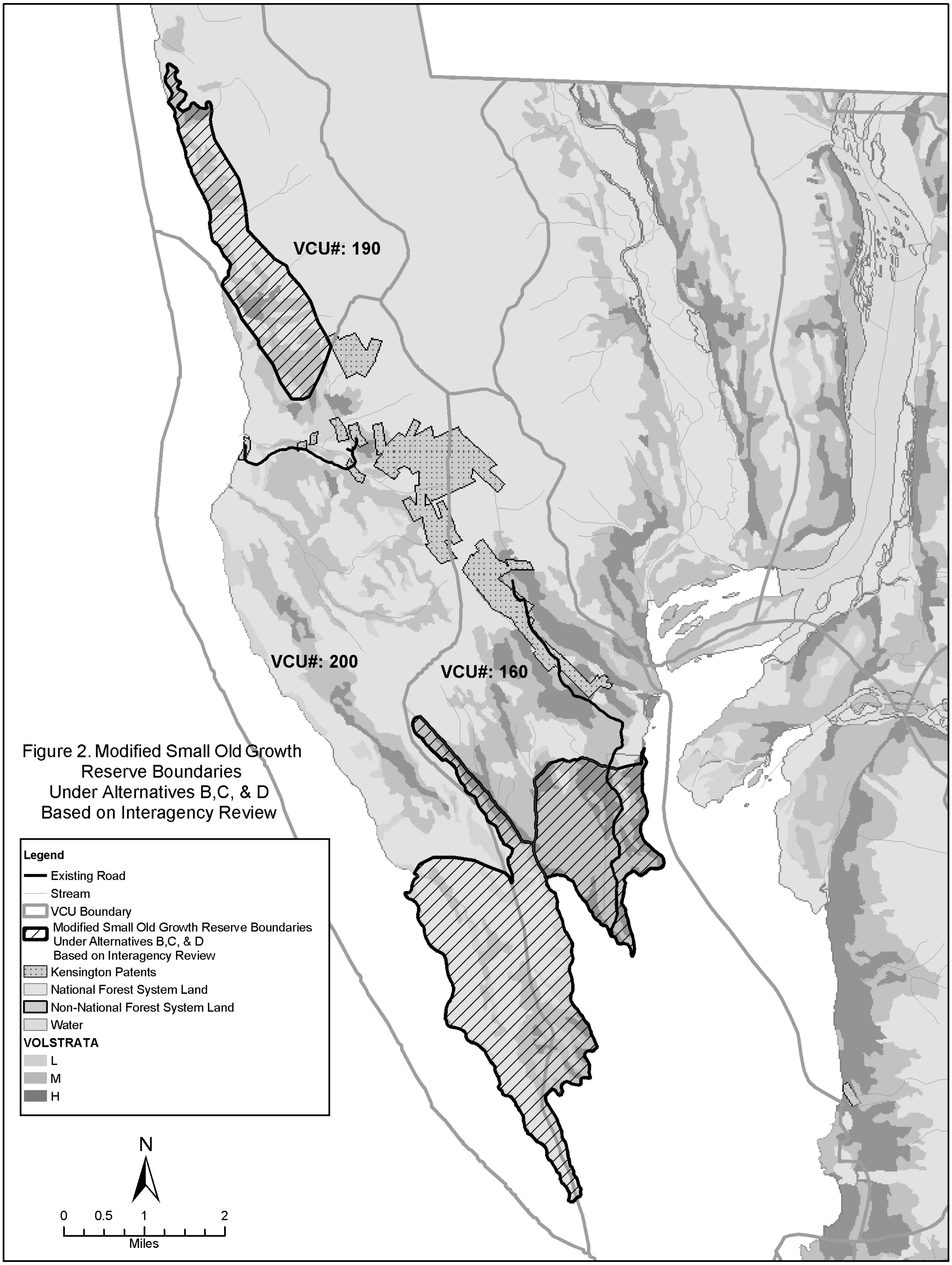


Figure 1. Existing Small Old Growth Reserve Boundaries


VCU#: 190
VCU#: 200
VCU#: 160
Figure 2. Modified Small Old Growth
Reserve Boundaries
Under Alternatives B,C, & D
Based on Interagency Review
Legend
Existing Road
Stream
VCU Boundary
Modified Small Old Growth Reserve Boundaries
Under Alternatives B,C, & D
Based on Interagency Review
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National Forest System Land
Non-National Forest System Land
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Kensington Gold Project

Final

Supplemental Environmental Impact Statement

Volume 1 of 2
Sections 1–10

United States Department of Agriculture
Forest Service
Tongass National Forest
R10-MB-500a

December 2004

COVER SHEET

Lead Agency:	USDA Forest Service Tongass National Forest
Responsible Officer:	Forrest Cole
Cooperating Agencies:	U.S. Army Corps of Engineers U.S. Environmental Protection Agency
Point of Contact:	Steve Hohensee Tongass Minerals Group 8465 Old Dairy Road Juneau, AK 99801 (907) 586-8800
Document Designation:	Draft Supplemental Environmental Impact Statement
Abstract:	This document evaluates the potential environmental consequences associated with the proposed modifications of the 1997 Plan Operations for the Kensington Gold Project. The Kensington Gold Project is a proposed gold mine located 45 miles north of Juneau, Alaska. If the proposed action were implemented, it would include the use of a subaqueous tailings facility build within Lower Slate Lake, off-site processing of flotation concentrate, and access the site using a ferry between Slate Creek Cove and Cascade Point, located in Berners Bay. Processing facilities would be located in the Johnson Creek drainage. Evaluation factors for the proposed modifications include effects on marine and fresh water resources, air quality, wetlands, wildlife, recreation, and visual resources. The document considers the No Action Alternative, the Proposed Action, and two other alternatives developed based on scoping and agency comments.
Comments should be Addressed to:	Steve Hohensee Tongass Minerals Group 8465 Old Dairy Road Juneau, AK 99801
Review Comment Deadline:	March 8, 2004

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FIGURES

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Section 1

Purpose and Need for the Proposed Action

SECTION 1.0
PURPOSE AND NEED FOR THE PROPOSED ACTION

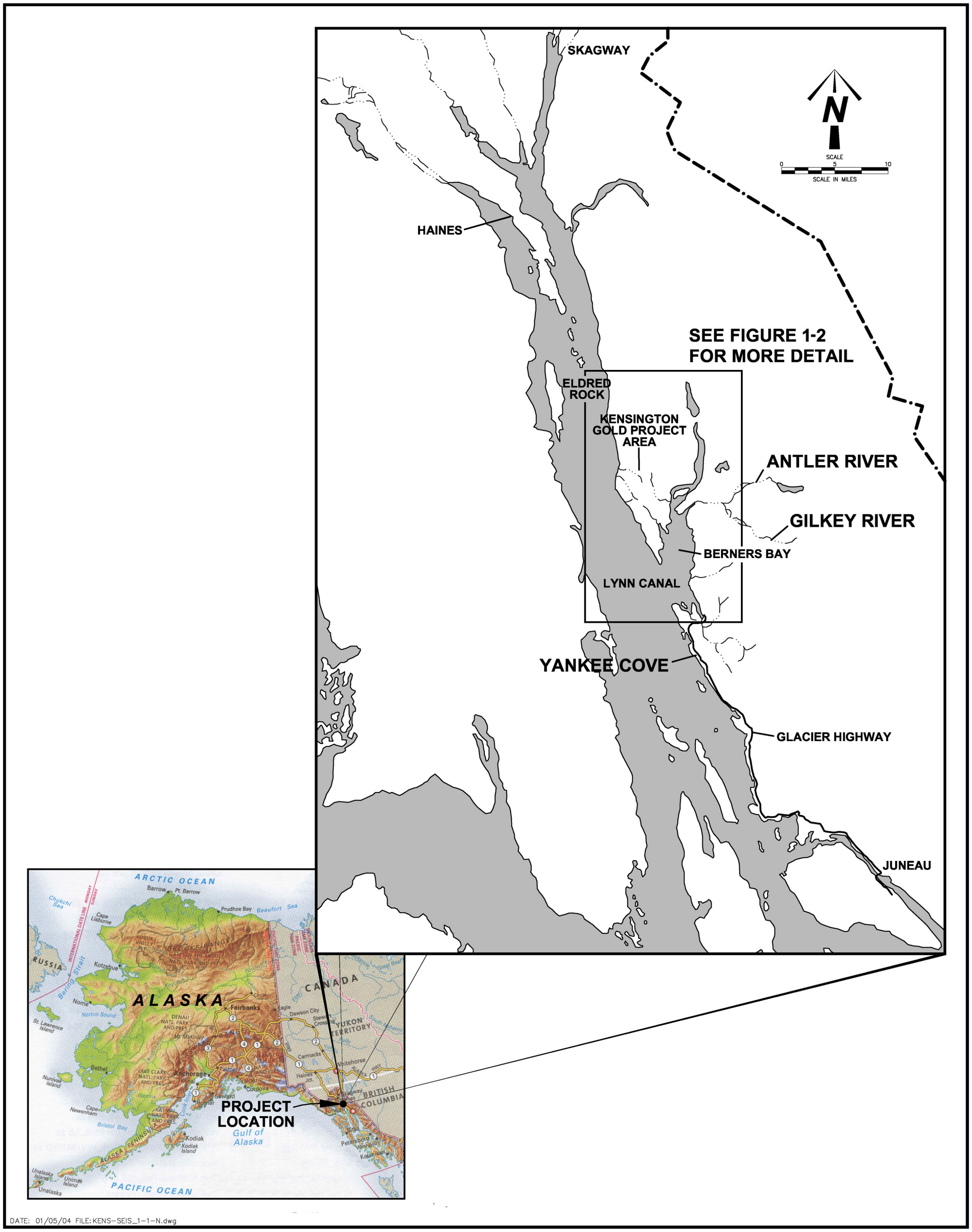
1.1 BACKGROUND

The Kensington Gold Project is a permitted underground gold mine approximately 45 miles north-northwest of Juneau, Alaska (Figure 1-1). Coeur Alaska, Inc. (Coeur), the project operator, maintains a wastewater treatment plant, including settling ponds, near the 850-foot portal in the vicinity of the Kensington Mine site. The settling ponds treat mine drainage and are authorized to discharge to Sherman Creek under a National Pollutant Discharge Elimination System (NPDES) permit. A waste rock pile resulting from exploration activities is in the same vicinity. A small personnel camp at Comet Beach houses workers conducting maintenance activities at the site. The mine received all permits required to begin construction and operations following publication of the 1997 *Kensington Gold Project Final Supplemental Environmental Impact Statement* (1997 SEIS) and issuance of a Record of Decision (ROD).

Coeur has not yet constructed the mine. A desire to improve efficiency and reduce the extent of disturbance of the approved project motivated Coeur to submit an Amended Plan of Operations (Amended Plan) to the U.S. Department of Agriculture, Forest Service, Tongass National Forest, Juneau Ranger District (Forest Service). The Amended Plan forms the basis for this Final SEIS.

This Final SEIS represents the third time the Kensington Gold Project has undergone a review under the *National Environmental Policy Act* (NEPA). In 1992 the Final EIS was completed (1992 FEIS). The Kensington Venture, a joint venture between Coeur and Echo Bay Exploration Inc., initially proposed to develop the Kensington Gold Project. Their proposal, submitted to the Forest Service in 1990, described mining the Kensington deposit. The operations proposed would have used underground techniques to recover the ore, processed the ore on-site using flotation and cyanidation circuits, and disposed of the tailings in a tailings impoundment built in the Sherman Creek drainage. The impoundment would have been sized to accommodate 30 million tons of tailings. The proposal included discharging wastewater to Lynn Canal following treatment and shuttling employees to the mine site using helicopters. The operation would have used liquefied petroleum gas to fuel on-site generators. A marine terminal developed at Comet Beach in Lynn Canal would have handled supply deliveries and gold shipments. One of the alternatives not considered in detail in the 1992 FEIS involved tailings disposal in Slate Lakes. This was eliminated from further consideration in large part because of difficulties of and disturbance associated with transporting tailings from the mill in the Sherman Creek drainage. At the time, the Jualin claims were under separate ownership.

The Kensington Venture never obtained all the permits necessary to build the mine, and in 1995 Coeur became the sole stakeholder in the property. Coeur then submitted an Amended Plan of Operations to the Forest Service in September 1995. Coeur's 1995 Plan of Operations included the same mining and tailings disposal scenario but proposed enhanced treatment of the tailings wastewater and a discharge to Sherman Creek rather than Lynn Canal. The proposal also included backfilling the cyanidation tailings and changing the fuel source from liquefied petroleum gas to diesel. The Forest Service published a Notice of Intent to prepare a supplemental environmental impact statement for the proposed changes, and scoping meetings were held in October 1995 to solicit public comments on the project.



Source: Forest Service, 1997a

FIGURE 1-1. GENERAL PROJECT AREA (APPROXIMATELY 45 MILES NORTHWEST OF JUNEAU)

In response to comments received during the scoping process and meetings with federal, state, and local agencies, Coeur again revised its Plan of Operations and resubmitted it to the Forest Service in June 1996. The 1996 plan called for the elimination of on-site cyanidation in favor of shipping flotation concentrate off-site for gold recovery. The 1996 plan also proposed the construction of a dry tailings facility (DTF) on a "terrace area" between Sherman and Sweeny creeks and the backfilling of at least 25 percent of the tailings. Runoff from the DTF would be collected in a settling pond and discharged to Camp Creek (a small creek within the terrace area) under an NPDES permit.

The Forest Service held a second round of scoping meetings to solicit input on the 1996 plan. The Forest Service then completed the 1997 SEIS and identified Alternative D as the Selected Alternative in the 1997 ROD. Alternative D, the currently permitted project, consists of site access from Comet Beach, helicopter transport of employees, wastewater discharge to Sherman Creek, and construction of a DTF for tailings disposal.

Coeur submitted an Amended Plan of Operations for the Kensington Gold Project to the Forest Service in November 2001. The Amended Plan proposes a number of changes to the approved plan, such as changing the location of the milling facilities, tailings disposal, and site access and employing a different means of employee transportation. The operation would also mine a smaller portion of the ore body than that proposed under previous iterations. The Amended Plan proposes to use a dock to be built at Cascade Point on state tidelands adjacent to property held by Goldbelt Incorporated (Goldbelt), an Alaska Native corporation.

The Forest Service completed an EIS for the Cascade Point Access Road and issued a ROD in March 1998. The EIS and the ROD addressed access to Goldbelt's property across Forest Service lands but did not include an impact analysis for construction of a dock. Following Goldbelt's submittal of a *Clean Water Act* (CWA) Section 404 permit application for the facility in 1999, the U.S. Army Corps of Engineers (USACE) evaluated the potential effects of a dock at the site. The USACE denied the permit at the time, citing a lack of demonstrable need for the facility, as well as a number of environmental concerns.

The Forest Service directed the preparation of this Final SEIS by a third-party contractor, Tetra Tech, Inc. The U.S. Environmental Protection Agency (USEPA), USACE, and Alaska Department of Natural Resources (ADNR) participated as cooperating agencies with the Forest Service in preparing this Final SEIS (under Title 40 of the *Code of Federal Regulations* [CFR] Section 1501.6). The Forest Service requested that the National Marine Fisheries Service (NMFS) also participate as a cooperating agency although NMFS declined (Kurland, 2003). This Final SEIS was developed to evaluate the operator's proposed changes to the approved Plan of Operations for the mine on National Forest System lands and a dock on state tidelands at Slate Creek Cove. Other components include construction of a dock facility on state tidelands and private lands at Cascade Point. Approval for components not on National Forest System lands will be accomplished through other state and federal agencies with jurisdiction. This SEIS is intended to supplement the 1997 SEIS and 1992 FEIS. Information from the previous documents has been brought forward into this document to the extent practicable so the reader will not necessarily need to refer back to the previous analyses. According to requirements in the Council on Environmental Quality regulations for implementing NEPA (40 CFR Part 1500), this document analyzes and discloses the direct, indirect, and cumulative impacts associated with the proposed changes to the approved Plan of Operations.

The document is structured to present the project background and information on regulatory compliance in this section. Section 2.0 describes the Proposed Action along with alternatives to the Proposed Action. Section 3.0 describes the environment that would be affected by the Proposed

Action or alternatives. Section 4.0 discusses the environmental consequences of the Proposed Action and alternatives.

The following appendices are included at the end of the document to provide additional information:

A. Water Quality Analysis
B. Essential Fish Habitat Assessment
C. Ecological Risk Assessment of Aqueous Tailings Disposal at the Kensington Gold Mine
D. Preliminary Reclamation Plan
E. Best Management Practices and Mitigation Measures
F. Old-Growth Habitat
G. Ground Water Quality
H. Migratory Birds: Birds of Conservation Concern and Priority Species
I. CBJ Notices of Decision
J. Biological Assessment/Biological Evaluation (BA/BE)
K. USEPA and State of Alaska Preferred Alternative and Environmentally Preferable Alternative Letters
L. Draft SEIS Comment Letters and Forest Service's Responses

1.2 PURPOSE AND NEED

The purpose of the Proposed Action is to consider certain changes to the 1998 approved Plan of Operations for the Kensington Gold Project regarding access, tailings disposal, and support facilities. The Proposed Action is needed to improve efficiency and reduce the area of surface disturbance.

The proposed changes are intended to provide more reliable transportation and access by improving worker safety during transit to the site and eliminating shipping delays related to weather and sea conditions at Comet Beach. The improved reliability of access would allow Coeur to reduce the amount of fuel storage, as well as inventories of materials and supplies.

The proposed changes are also intended to reduce the area of disturbance compared to the approved plan and to be more efficient in terms of operational cost and material handling. There would be no requirement to dewater the tailings, no trucking associated with hauling and placement, and two of the sand and gravel borrow pits would be eliminated.

1.3 PROPOSED ACTION

The Forest Service proposes to approve certain changes to an existing plan of operations based on an Amended Plan of Operations submitted by Coeur in November 2001. Under the currently approved plan, all mining operations would take place in the vicinity of the Kensington Mine. Under the Proposed Action, the mill and administrative facilities would be built in the Johnson Creek drainage in the vicinity of the Jualin Mine. Supplies and ore concentrate would be shipped into and out of the facility by barge via a dock in Slate Creek Cove, in Berners Bay. A more selective mining plan would be followed. The ore processing methods used would be the same as those under the approved plan; however, access to the ore body would be through a 12,000-foot-long tunnel connecting the Jualin Mine to the Kensington Mine. Tailings would be disposed of in a tailings storage facility (TSF) built in Lower Slate Lake. Employee housing would be eliminated in favor of a daily crew shuttle boat service that would operate between Cascade Point and Slate Creek Cove. The existing road between Slate Creek Cove and the Jualin Mine would be upgraded to handle mine-related traffic. Treatment of the mine water and storage of waste rock would occur near the Kensington 850-foot portal in the

Sherman Creek drainage. Figure 1-2 shows the location of the project area, including Sherman Creek and Berners Bay.

1.4 DECISIONS TO BE MADE

The Forest Supervisor of the Tongass National Forest is the responsible official for deciding whether to select the Proposed Action or another alternative for implementation. The Forest Supervisor will identify any additional mitigation measures and monitoring required for this project. His decision will be documented in a ROD, which will include the reasons for his decision based on the analyses presented in this Final SEIS. It should be noted that in the case of this document, the No Action Alternative is not a "no-build" alternative. Selection of the No Action Alternative as a result of this Final SEIS would deny the proposed changes to the currently approved operating plan but would allow the company to proceed under the terms of the ROD for the 1997 SEIS and the approved operating plan. A No Action Alternative that considered the effects of no mining in the project area was evaluated in the 1992 FEIS.

The Director of the Office of Water and Watersheds for USEPA Region 10 will decide whether to issue a permit under Section 402 of the Clean Water Act, and what terms and conditions apply. USACE will also decide whether to issue permits under Section 404 of the Clean Water Act. Section 1.7 below provides additional information on agency responsibilities.

1.5 SCOPING AND PUBLIC INVOLVEMENT

The Notice of Intent to prepare this SEIS for the Kensington Gold Project was published in the *Federal Register* on September 13, 2002. The publication of the Notice of Intent started the scoping process, a public review and comment period required under NEPA (40 CFR 1501.7). The formal scoping comment period ended on October 15, 2002.

Scoping is a public participation process with several objectives:

- Provide the public, tribes, and regulatory agencies with a basic understanding of the Kensington Gold Project and the proposed changes to the mine's Amended Plan of Operations.
- Provide opportunities for people to ask questions, voice concerns, identify specific issues, and recommend options other than those proposed by the mine operator.
- Ensure that potentially significant issues from the public, tribes, and agencies are identified and fully addressed during the course of the EIS process.
- Explain where people can find additional information about the project.

The Forest Service sent email notification of the Notice of Intent, as well as an electronic link to a copy of the scoping document, to approximately 40 agencies, tribes, organizations, and private individuals that had previously expressed interest in the project. The scoping document provided a brief history of the Kensington Gold Project dating back to 1990; numerous maps; discussions on the proposed action, agency involvement, permits and authorizations, and the scoping process; an SEIS preparation schedule; and information sources.

Source: U.S. Geological Survey, 1985

FIGURE 1-2. SPECIFIC PROJECT AREA

Public notices and email were used to advertise the scoping open houses held in Juneau on September 19, 2002, and in Haines on September 21, 2002. The purpose of the open houses was to meet the scoping process objectives listed above. The open houses provided a venue for personal conversations between the public, the Forest Service, Tetra Tech (the third-party contractor), and the mine operator.

Throughout the scoping process, the Forest Service solicited comments from local, state, and federal agencies; nongovernmental organizations; and the public. Sixty-one people signed the attendance sheets at the open house in Juneau, and 11 signed in at the Haines open house. The scoping process produced 64 individual comment documents. The term *comment document* refers to traditional letters (handwritten or typed), faxes, emails, and the written comment sheets that were available at the public open houses. Many of the comment documents contained more than one comment. The Interdisciplinary Team (composed of Forest Service specialists, USEPA, USACE, ADNR, National Marine Fisheries Services [NMFS], and Tetra Tech) reviewed each letter to identify and catalog the individual comments. Ultimately, the team identified 227 comments. More than half of the comment documents supported the project. The remaining comments were considered in developing the significant issues discussed below. Three Alaska Native corporations—Goldbelt, Kootznoowoo, and Sealaska—supported the project, as did the Central Council Tlingit and Haida Indian Tribes of Alaska, because of its economic benefit, the reduced footprint, or both.

The Draft SEIS was released to the public for comment on January 23, 2004. Public meetings on the Draft SEIS were held on February 24, 2004, in Juneau and on February 26, 2004, in Haines. The Forest Service received approximately 380 comment documents, which contained 1,415 individual comments on the Draft SEIS. These comment documents and the Forest Service's responses are discussed in Appendix L to this Final SEIS. On June 21, 2004, USEPA and the State of Alaska issued draft permits for the proposed action for public comment. On the same date, USACE published public notices for its permits. Comments received on the draft permits and public notices have been considered, where appropriate, in preparing this Final SEIS.

1.6 SIGNIFICANT ISSUES

With respect to an EIS, issues are points of discussion, debate, or dispute about the environmental impacts of the Proposed Action. Issues may be determined to be significant based on the extent, duration, or magnitude of the environmental effect. Significant issues focus the environmental analyses on the aspects of the project that are of the most concern to the public or regulatory agencies or have the most potential for producing adverse environmental effects. Alternatives to the Proposed Action or specific mitigation measures are developed in response to significant issues. By associating measures with individual issues, the public and decisionmakers are better able to differentiate among different alternatives in terms of environmental impacts. The significant issues summarized below are based on public, tribal, and agency comments made during the scoping process.

Issue 1: Mine-related transportation would affect users of, and resources in, Berners Bay.

Two aspects of mine-related transportation impacts in Berners Bay were determined to be significant issues. The first aspect relates to how seeing or hearing a crew shuttle or the dock facilities would affect the wildland experience of recreating in Berners Bay. One specific concern is the effect of wakes generated by the crew shuttle on the shoreline and boaters. The second aspect focuses on how mine-related transportation could disturb birds, fish, and wildlife in Berners Bay and the resulting secondary impacts on human users from a recreational or economic perspective. Concerns include the impacts of noise on wildlife; collisions with marine mammals; impacts on water quality from spills of ore concentrate, process chemicals, or petrochemicals; and the effects of propeller wash on benthic (bottom-dwelling) organisms.

Issue 2: Construction and operation of the tailings disposal facility and other mine facilities would affect aquatic resources from Slate and Johnson creeks to Slate Creek Cove and Berners Bay.

Commenters expressed concerns that construction of the TSF would produce long-term changes to habitat structure in Lower Slate Lake and adversely affect Slate Creek downstream of the dam. Related concerns include siltation in Johnson Creek from the access roads and the effect water quality impacts might have on fisheries in Slate Creek and Berners Bay. Another identified concern is impacts related to flow modification from water withdrawals and operation of the TSF.

Issue 3: The Lower Slate Lake TSF, docks, access road, and other mine facilities would affect the scenic character of Berners Bay for recreationists.

A number of scoping comments indicated that a mining operation in the Berners Bay watershed would negatively affect the natural beauty of the lands surrounding Berners Bay. Commenters indicated that part of the appeal of the area to recreational users is its unspoiled character, which would be jeopardized by the operations of a crew shuttle, docks, and traffic along the road from Slate Creek Cove to the process area at Jualin.

1.7 AGENCY RESPONSIBILITIES, APPROVALS, AND COMPLIANCE

This section describes the role of each agency involved in the Kensington Gold Project. The discussion includes a description of the major permits and authorizations required for the project. It also addresses how this document or the project itself complies with environmental laws and executive orders as they pertain to each of the responsible agencies.

1.7.1 Federal Government

USDA Forest Service

- NEPA compliance and ROD on the Final SEIS
- Approval of 2002 Amended Plan of Operations
- Compliance with Section 106 of the *National Historic Preservation Act* (NHPA)
- Compliance with Sections 313 and 319 of the *Clean Water Act* (CWA)
- Compliance with Section 7 of the *Endangered Species Act*
- Compliance with Section 305 of the *Magnuson-Stevens Fishery Conservation and Management Act* (MSFCMA), including consultation with NMFS on essential fish habitat (EFH)
- Compliance with applicable Executive Orders (specifically 11988, 11990, 12088, 12898, 12962, and 13175)
- Consistency with 1997 *Tongass National Forest Land and Resource Management Plan*

The Forest Service is the lead agency in the preparation of the 2004 Kensington Gold Project SEIS. The Forest Service's authority to require, evaluate, and approve or modify the operator's 2001 Amended Plan is based on the *Organic Act* of 1897 and on the *Mining Law* of 1872, which is described in 36 CFR Part 228, Subpart A. If another agency cannot meet its regulatory responsibilities, the Forest Service is ultimately responsible for ensuring that federal and state regulations are implemented on National Forest System lands.

All alternatives are consistent with the 1997 *Tongass National Forest Land and Resource Management Plan* (Forest Service, 1997b). The site is in an area with the following designated land uses: Modified Landscape with a Minerals Overlay, Old-Growth Habitat, and Remote Roadless Recreation. The emphasis for management in the area is the encouragement of mineral development conducted in an environmentally sensitive manner and limited to the area necessary for efficient, economic, and orderly development. The long-term goal of reclamation is consistent with a Modified Landscape land use designation. The Modified Landscape land use designation is discussed in Section 3.13, along with the other land use designations.

The Forest Service conducted consultations with Alaska Native groups in April 2003 to comply with Executive Order 13175, which addresses consultation and coordination with Indian tribal governments. The purpose of the meetings was to explain the nature of the project and to solicit comments and concerns. The Forest Service conducted government-to-government consultations to solicit comments on the project from the Chilkoot Indian Association (Haines), the Chilkat Indian Association (Klukwan), and the Tlingit-Haida Central Council on April 8 and April 15, 2003. A meeting was also held with Alaska Natives on May 2, 2003, in compliance with consultation requirements established under Section 106 of the NHPA. Forest Service representatives further met with members of Sealaska Corporation on April 1, 2003, and Kootznoowoo Incorporated on April 15, 2003, to solicit comments on the proposed project.

The *Tongass National Forest Land and Resource Management Plan* identified the Gilkey River (Figure 1-1) as suitable for a Wild River designation (Forest Service, 1997b). The Forest Service must protect rivers found suitable as Wild and Scenic until Congress determines whether to designate them as such. The Kensington Gold Project would have no effect on the Gilkey River; consequently, the river's eligibility would not be affected by this project.

Before approving the 2001 Amended Plan, the Forest Service must comply with Section 106 of the NHPA. The NHPA requires the protection of historic, cultural, and archaeological sites and resources within the project area. Compliance with the NHPA typically involves (1) identification of historic properties that might be affected, (2) assessment of potential effects on those properties, (3) consultation with the State Historic Preservation Officer and interested parties, and (4) notification of the Advisory Council on Historic Preservation if historic properties could be affected.

Under an agreement between the Forest Service and the Alaska Department of Environmental Conservation (ADEC), the Forest Service has committed to fulfilling specific responsibilities to ensure that activities on National Forest System lands are consistent with the requirements of CWA Sections 319(b)(2)(f), 319(k), and 313 and Executive Order 12088. Section 319 addresses nonpoint source pollution, and Section 313 and Executive Order 12088 require the Forest Service to adhere to the goals set forth in state water quality standards. The NPDES permit issued for the project will require that the operator comply with state water quality standards.

The MSFCMA requires the Forest Service to consult with the NMFS regarding the protection of EFH prior to approving the Plan of Operations. Executive Order 12962 requires federal agencies to evaluate the potential effects of proposed federal actions on recreational fisheries. There is limited recreational fishing at the Kensington Gold Project site because the streams (Johnson, Sherman, and Slate creeks) support small populations of Dolly Varden char. Recreational fishing occurs in Berners Bay. This Final SEIS complies with Executive Order 12962 by considering the potential mining and transportation impacts of each alternative on water quality, habitat, and fish populations.

Executive Order 12898 requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of proposed activities on minority and low-income populations. This document addresses Executive Order 12898 by considering the potential impacts of each alternative on minority and low-income populations in the discussions of recreation and socioeconomic impacts and environmental justice.

Executive Orders 11988 and 11990 are discussed below under the U.S. Army Corps of Engineers.

U.S. Environmental Protection Agency

- Participation as cooperating agency
- NEPA compliance for permits under its jurisdiction
- Compliance with the CWA
- Compliance with the *Clean Air Act* (CAA)
- Compliance with the *Safe Drinking Water Act* (SDWA)
- Compliance with the MSFCMA
- Compliance with applicable Executive Orders (specifically 11988, 11990, 12088, 12898, 12962, 13045, and 13175)
- Notification of hazardous waste activity

USEPA is a cooperating agency with the Forest Service on this Final SEIS. USEPA has primary responsibility for implementing CWA Sections 301, 306, 311, and 402. USEPA shares responsibility for Section 404 with the USACE.

Sections 301 and 306 of the CWA require that USEPA develop wastewater effluent standards for specific industries, including gold mines. These standards are established for both existing sources and new sources. Because this project would be a new source, the New Source Performance Standards (NSPS) for gold mines and mills are applicable to the project (40 CFR 440.104). Section 402 of the CWA established the NPDES program, and under that section the Kensington Gold Project is required to obtain an NPDES permit for the proposed discharges. NPDES permit limits and other requirements are established to ensure compliance with the NSPS and state water quality standards. The NSPS specifically include effluent limits applicable to discharges of mine drainage; they also prohibit the discharge of process water (including tailings effluent). An exception is provided for excess flows associated with net precipitation where the discharge of such flow is subject to the comparable effluent limits for mine drainage. In states that have not been delegated NPDES permitting authority, such as Alaska, USEPA is authorized to permit point source discharges of effluent, including process wastewater and stormwater.

In accordance with CWA Section 511(c)(1), NPDES permit actions for new sources may be defined as major federal actions subject to NEPA (40 CFR Part 6, Subpart F). Therefore, USEPA would issue a ROD before the final permit action.

USEPA issued an NPDES permit for the Kensington Gold Project on May 14, 1998. The permit addresses the discharge from the Kensington portal, which is treated and discharged to Sherman Creek. It also addresses the discharge from the permitted DTF. The 5-year permit expired on May 14, 2003, but was administratively extended by USEPA until a new permit is issued. Coeur has submitted an application for a revised NPDES permit, consistent with the proposed project revisions. The application addresses the current discharge to Sherman Creek, a sewage treatment plant and the proposed discharge from the TSF.

USEPA also has authority under CWA Section 404 to review project compliance with Section 404(b)(1) guidelines and Section 404(c). Under Section 404(c), USEPA may prohibit or withdraw the specification (permitting) of a site upon determination that use of the site would have an unacceptable adverse effect on municipal water supplies, shellfish beds, fishery areas, or recreational areas.

On May 17, 2004, USEPA issued a policy memorandum regarding regulation of activities in waters of the United States associated with hard rock mining in Alaska with specific emphasis on the proposed TSF for the Kensington Mine Project (USEPA, 2004). This memorandum indicates that disposal of tailings into the TSF would be a discharge of "fill" material and would be addressed through a permit issued by the USACE (see below) under Section 404 of the CWA. The discharge from the TSF to East Fork Slate Creek would be addressed through an NPDES permit under Section 402 of the CWA.

Section 311 of the CWA establishes requirements related to discharges or spills of oil or hazardous substances. Under 40 CFR Part 112, USEPA requires each facility that handles substantial quantities of oil to prepare a Spill Prevention, Control and Countermeasures (SPCC) plan. A registered engineer must certify the SPCC plan. The USEPA Regional Administrator would make a determination regarding whether a Facility Response Plan (FRP) is required.

The most basic goals of the CAA are to protect public health and welfare. CAA Section 309 requires USEPA to review and comment on EISs. In addition, USEPA approves state implementation plans for air quality and reviews Air Quality Control Permit to Operate applications, including requirements for prevention of significant deterioration.

The SDWA requires underground injection control (UIC) permits. A Class V UIC permit might be required for proposed leach fields. The UIC program is authorized by Part C of the SDWA. Injection wells are defined broadly to include boreholes, sumps, dry wells, drain fields, and other subsurface disposal devices used to put fluids into the ground. The Class V category consists of injection wells that are not included in the other classes of wells (Classes I through IV). USEPA will determine whether any discharges from the proposed project, including the leach fields, will be covered by a Class V UIC permit.

The MSFCMA requires USEPA to consult with NMFS regarding the protection of EFH before a final NPDES permit may be issued.

U.S. Army Corps of Engineers

- Participation as cooperating agency
- NEPA compliance for permits under its jurisdiction
- Issuance of Section 404 Permit: CWA (Dredge and Fill)
- Issuance of Section 10 Permit: *Rivers and Harbors Act* of 1899
- Compliance with all Executive Orders (specifically 11988, 11990, 12088, 12898, 12962, 13045, and 13175)
- Compliance with Section 106 of the NHPA
- Compliance with the MSFCMA
- Compliance with Section 103 of the *Marine Protection, Research, and Sanctuaries Act* (MPRSA)

The USACE is a cooperating agency with the Forest Service on this Final SEIS. CWA Section 404 authorizes the USACE to issue permits for discharge of dredged or fill material into waters of the United States. The CWA prohibits such a discharge except pursuant to a Section 404 permit. To the degree that the various activities undertaken in connection with mining operations affect waters of the United States, they could require a Section 404 permit. Such activities associated with the Kensington Gold Project include construction of roads, the TSF or DTF, stream diversion structures, and docks and marine terminals. As discussed above, a Section 404 permit would be specifically required for discharge of tailings into the TSF. The USACE is responsible for determining whether an action complies with CWA Section 404(b)(1) guidelines; a Section 404 permit may not be issued without such compliance.

All federal agencies, including the USACE, must comply with Executive Orders 11990 and 11988, which address minimizing impacts on the nation's wetlands and floodplains, respectively. The USACE's regulatory program provides some flexibility when considering the national goal of "no net loss" of wetlands. Because the "no net loss" goal cannot always be achieved on an individual project-by-project basis, the Alaska District of the USACE may consider site-specific conditions and impacts when determining the extent of compensatory mitigation required for wetland losses. Under Executive Order 11988, the bridges proposed under each of the alternatives would need to be constructed to ensure public safety and minimize impacts on the floodplain.

Under the *Rivers and Harbors Act* of 1899 and Section 103 of the MPRSA, the USACE has permitting authority to regulate various activities that affect traditionally navigable waters. Pursuant to Section 10 of the *Rivers and Harbors* Act of 1899, a permit is required for any structure or work that could obstruct traditionally navigable waters. Lynn Canal, Berners Bay, Slate Creek Cove, and Echo Cove are considered navigable waters of the United States. The Kensington Gold Project's marine terminals, therefore, would require Section 10 permits.

The MSFCMA requires the USACE to consult with NMFS regarding the protection of EFH before Section 404 or Section 10 permits may be issued.

National Marine Fisheries Service

- Compliance with Section 7 of the *Endangered Species Act* (ESA), Threatened and Endangered Species Consultation
- Compliance with the Marine Mammal Protection Act
- Compliance with Section 305 of the MSFCMA, EFH Consultation
- Fish and Wildlife Coordination Act

The Forest Service must consult with NMFS regarding the Kensington Gold Project in accordance with the ESA. The consultation has resulted in NMFS's confirming that Steller sea lions (threatened) and humpback whales (endangered) occur within the project area. The MSFCMA establishes consultation responsibilities for NMFS for projects that could affect EFH. EFH includes habitat necessary to a fish species for spawning, breeding, feeding, or growth to maturity. As part of this project, the Forest Service has provided NMFS with an EFH assessment, which is attached to this Final SEIS as Appendix B. NMFS will consult with USACE and USEPA on their permitting actions as well. If any impacts on threatened or endangered marine species under NMFS jurisdiction, or EFH, are projected, specific design measures must be developed to protect the affected species.

U.S. Fish and Wildlife Service

- Compliance with Section 7 of the ESA, Threatened and Endangered Species Consultation
- Compliance with the *Migratory Bird Treaty Act*
- Compliance with the *Bald Eagle Protection Act*
- Fish and Wildlife Coordination Act

The USFWS administers the ESA and the *Bald Eagle Protection Act*. The Forest Service must consult with the USFWS regarding any threatened or endangered species under its jurisdiction that might be affected by the proposed Kensington Gold Project. If any impacts are projected, specific design measures must be developed to protect the affected species. The USFWS has indicated that no threatened or endangered species occur within its jurisdiction in the Tongass National Forest.

1.7.2 State and Local Government

Alaska Department of Natural Resources

- Participation as a cooperating agency and coordination of all state agency review
- Water rights authorizations
- Tidelands leases for marine facilities
- Coastal zone consistency review
- Certificates of approval to construct and operate a dam
- Title 41 authorizations for fish passage and fish habitat
- Right-of-way authorization
- Reclamation Plan approval

ADNR is the lead state agency involved in permitting mine projects in Alaska. ADNR's Office of Project Management and Permitting is responsible for coordinating all state agency review of the project. Other state agencies involved in the permitting and review of the Kensington Gold Project include the ADEC, Alaska Department of Fish and Game (ADF&G), Alaska Department of Community and Economic Development, and the Alaska Department of Law. The State of Alaska established a large mine project team from these agencies to coordinate state permitting activities for the Kensington Gold Project.

ADNR's Division of Mining, Land, and Water is responsible for issuing water rights authorizations for the use of surface and subsurface waters of the state. These authorizations require compliance with instream flow requirements. In addition, the Division is responsible for issuing tidelands leases for permanent improvements to tidelands, such as marine facilities, fuel transfer facilities, and concentrate transfer facilities. The Division would also need to issue authorizations for any improvements or use restrictions to public Revised Statute (RS) 2477 rights-of-way that might be used by the Kensington Gold Project. The Division is also responsible for approval of the reclamation plan.

In addition, ADNR's Office of Project Management and Permitting (OPMP) is responsible for certification that the project complies with the Alaska Coastal Management Program (ACMP). OPMP administers that program and coordinates state reviews of activities in the coastal zone involving state and federal permits. Projects are reviewed for consistency with Title 6 of the *Alaska*

Administrative Code (AAC), Sections 80.040 through 80.130, and the enforceable policies of an affected coastal district. For purposes of determining consistency with 6 AAC 80.140, the air, land, and water quality standard, the issuance of the ADEC authorization establishes consistency with the ACMP for that standard only.

ADNR's Office of Habitat Management and Permitting (OHMP) is responsible for issuing Fish Habitat (Title 41) permits for activities that occur in salmon streams or that could represent an impediment to the efficient passage of fish. OHMP also coordinates project review by the ADF&G.

Alaska Department of Environmental Conservation

- Section 401 certification of the USACE CWA Section 404 permit (including tailings disposal)
- Section 401 certification of the USEPA NPDES CWA Section 402 permit
- Waste management permit no. 9811-BA001 (covers underground and aboveground disposal of waste and expires on March 11, 2008)
- Air quality control permit
- Engineering review/approval of the sanitary wastewater treatment disposal systems

ADEC is responsible for water and solid waste permits. Under Section 401 of the CWA, ADEC's responsibilities include certification of the USEPA NPDES permit and the USACE Section 404 permit. ADEC must certify that the requirements of those permits comply with state water quality standards. These standards include designation of the beneficial uses of the water, as well as numerical and narrative water quality criteria established to protect the beneficial uses.

ADEC will not review an Oil Discharge Prevention and Contingency Plan (C-Plan) for the proposed action. Coeur has advised ADEC that permanent oil storage at the facility would be well below the regulatory threshold amount of 10,000 barrels (420,000 gallons). A C-Plan is required for the previously approved project, i.e., the No Action Alternative.

City and Borough of Juneau

- Allowable Use Permits

The City and Borough of Juneau (CBJ) recently amended its mining ordinance, simplifying the review and approval of permits for mines within the newly created Rural Mining District. The CBJ issued a Notice of Decision for an Allowable Use Permit to Coeur Alaska for gold mine development and production on September 15, 2004. The CBJ issued a Notice of Decision to Goldbelt for the dock at Cascade Point on October 21, 2004.

Section 2

Description of Proposed Action and Other Alternatives

SECTION 2.0
DESCRIPTION OF PROPOSED ACTION AND OTHER ALTERNATIVES

This section describes the alternatives that form the basis for evaluating the current proposal for the Kensington Gold Project. Evaluating a reasonable range of alternatives ensures that significant impacts are avoided or mitigated to the extent possible. Various project components were evaluated as part of the alternatives analysis under the previous National Environmental Policy Act (NEPA) actions associated with the Kensington Gold Project. Alternatives in this Final Supplemental Environmental Impact Statement (SEIS) target project components that are different from those previously proposed and that could address the significant issues identified during the scoping process.

The alternatives evaluated in this Final SEIS focus primarily on employee housing, transportation of personnel and material to and from the site, tailings disposal and management, and the location of wastewater discharges. Since publication of the 1992 Final Environmental Impact Statement (FEIS) and the 1997 SEIS, the operator has continued to collect baseline data on hydrology, water quality, aquatic life, and other key environmental resources in the vicinity of the Kensington Gold Project site. These data, as well as data collected by the U.S. Fish and Wildlife Service (USFWS), have been used to evaluate the feasible project alternatives and mitigation measures.

The following discussions explain the development of alternatives, present a brief description of each alternative, and describe individual project components, including tailings disposal, water management, and transportation. Section 2 closes with a description of mitigation and monitoring, a tabular comparison of impacts, by alternative, on the various resource areas discussed in greater detail in sections 3 and 4, and identification of the Forest Service's environmentally preferable alternative.

ALTERNATIVES FOR THE KENSINGTON GOLD PROJECT

Alternative A (No Action): 1997 SEIS Alternative D: Dry tailings facility (DTF) with engineered berm; wastewater discharged to Sherman Creek and DTF drainage to Camp Creek; employee transportation by helicopter; personnel camp.

Alternative A1 (Reduced Mining Rate DTF): Similar to Alternative A with smaller production rate and smaller DTF.

Alternative B (Proposed Action): Wet tailings storage facility (TSF) in Lower Slate Lake; TSF wastewater discharged to Slate Creek and mine water discharged to Sherman Creek; employee transport by daily crew shuttle boat between marine terminals at Cascade Point and Slate Creek Cove; no personnel camp.

Alternative C (TSF Diversion/Modified Dock): Same as Alternative B except diversions to route Mid-Lake East Fork Slate Creek and overland flow around the TSF; employee transport by daily crew shuttle boat between marine terminals at Slate Creek Cove and Echo Cove; minimized subtidal footprint of the Slate Creek Cove marine terminal.

Alternative D (Modified TSF Design): Same as Alternative B except that Mid-Lake East Fork Slate Creek is diverted around the TSF via a pipeline, TSF water is treated by reverse osmosis prior to discharge into diversion pipeline, and a cover is installed over the tailings.

2.1 ISSUES AND ALTERNATIVE DEVELOPMENT

The formulation of alternatives to the Proposed Action is one of the most important components of the NEPA process. Significant issues identified during the scoping process drive the formulation of such alternatives. The alternatives can alter or reduce the magnitude of potential environmental impacts associated with the Proposed Action.

The alternatives developed for this Final SEIS reflect the significant issues identified during scoping, which consist of the following:

- Mine-related transportation would adversely affect users of, and resources in, Berners Bay.
- Construction and operation of the tailings storage facility (TSF) and other mine facilities would adversely affect aquatic resources from Slate and Johnson creeks to Slate Creek Cove and Berners Bay.
- The Lower Slate Lake TSF, docks, access road, and other mine facilities would adversely affect the scenic character of Berners Bay for recreationists.

Table 2-1 summarizes the development of alternatives, including the No Action Alternative (Alternative A), in response to the significant issues identified during scoping.

Table 2-1
Development of Alternatives in Response to Scoping Issues

Issues	Alternative A (No Action)	Alternative A1	Alternative B (Proposed Action)	Alternative C	Alternative D
Mine-related transportation would adversely affect users of, and resources in, Berners Bay.	None of the project facilities would be located in the Berners Bay watershed or viewshed. Twelve round trips by helicopter weekly across mouth of Berners Bay.	None of the project facilities would be located in the Berners Bay watershed or viewshed. Twelve round trips by helicopter weekly across mouth of Berners Bay.	Crew shuttle boat between Cascade Point and Slate Creek Cove to transport workers; barges would deliver supplies to Slate Creek Cove.	Crew shuttle boat between Echo Cove and Slate Creek Cove to transport workers; barges would deliver supplies to Slate Creek Cove.	Crew shuttle boat between Cascade Point and Slate Creek Cove to transport workers; barges would deliver supplies to Slate Creek Cove.
Construction and operation of the TSF and other mine facilities would adversely affect aquatic resources from Slate and Johnson creeks to Slate Creek Cove and Berners Bay.	None of the project facilities would be located in the Slate Creek, Johnson Creek, or Berners Bay watersheds or viewsheds.	None of the project facilities would be located in the Slate Creek, Johnson Creek, or Berners Bay watersheds or viewsheds.	TSF constructed in Lower Slate Lake; discharge to East Fork Slate Creek; infiltration gallery in Johnson Creek; marine terminals in Slate Creek Cove and at Cascade Point.	TSF diversions would limit volume of water contacting tailings; Echo Cove marine facility would avoid herring spawning habitat.	Treatment of the TSF effluent would further protect downstream surface water quality and aquatic life. Tailings would be capped if necessary to prevent potential adverse effects on benthic organisms or fish in Lower Slate Lake.
The Lower Slate Lake TSF, docks, access road, and other mine facilities would adversely affect the scenic character of Berners Bay for recreationists.	None of the project facilities would be located in the Berners Bay watershed or viewshed. Twelve round trips by helicopter weekly across mouth of Berners Bay.	None of the project facilities would be located in the Berners Bay watershed or viewshed. Twelve round trips by helicopter weekly across mouth of Berners Bay.	Dock facilities would be located at Cascade Point and Slate Creek Cove.	Footprint of Slate Creek Cove marine terminal would be reduced in size; crew shuttle dock would be placed in Echo Cove north of existing boat ramp, eliminating fill at Cascade Point.	Dock facilities located at Cascade Point and Slate Creek Cove.

2.2 OVERVIEW OF PROJECT ALTERNATIVES

This section introduces the four alternatives for the Kensington Gold Project. Section 2.3 provides a detailed discussion of each alternative by project component. Table 2-2 provides a comparison of alternatives based on the number of acres affected and presents the total acreage of disturbance compared to the disturbance on National Forest System lands. Table 2-3 provides a comparison of the size of various project components among alternatives. Figure 2-1 depicts the overall project location for all alternatives and provides insets that correspond to Figures 2-2 through 2-12. Figure 2-2 shows the facilities that would be constructed under Alternative A. Figure 2-3 depicts the facilities that would be built under Alternative A1. Figures 2-4 through 2-8 show the facilities that would be constructed under Alternative B. Figures 2-4, 2-5, 2-9, 2-10, and 2-11 apply to Alternative C, and Figures 2-4, 2-5, 2-7, 2-8, and 2-12 apply to Alternative D.

Most of the activities conducted under the Kensington Gold Project would occur on federal lands managed by the Forest Service. There are, however, some parcels of private land in the area, which are identified in the figures. The State of Alaska owns the land below the mean high tide line, which is also indicated in the figures. Figure 2-1 further identifies state-selected lands under the National Forest Community Grant provision of the Alaska Statehood Act.

2.2.1 Alternative A: No Action Alternative

The No Action Alternative functions as the baseline against which the effects of other alternatives are compared. In NEPA analyses, the No Action Alternative typically represents a "no build" alternative or maintaining the status quo. Because this is an SEIS, the No Action Alternative reflects a previous action, which in this case is the project identified in the Record of Decision (ROD) issued for the 1997 SEIS. Alternative A corresponds to the 1997 SEIS's Alternative D, which includes underground crushing of ore with aboveground grinding and flotation. Flotation concentrate would be shipped to a processing facility off-site (most likely in Canada or Asia), and the on-site cyanidation process proposed in 1992 would be eliminated. Employees would be housed on-site and transported to the site by helicopter. Supplies, including fuel, would be delivered to a marine terminal on Comet Beach. Approximately 25 percent of the tailings would be backfilled into the mine. The remaining tailings would be dewatered before being placed in the dry tailings facility (DTF). The DTF would have the design capacity to hold 20 million tons of tailings and would include an engineered berm around each cell of the facility to enhance stability. Road and DTF construction would require the development of sand and gravel and till borrow areas. The production rate would be 4,000 tons of ore per day and 400 tons of waste rock per day. The waste rock would be used in the construction of the DTF.

Table 2-2
Comparison of Alternatives by Area

Disturbance by Alternative (in acres)	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Existing disturbances (roads, facilities)	23 (18.4)	23 (18.4)	55.2 (37.4)	55.2 (37.4)	55.2 (37.4)
Maximum additional disturbance during operations	245 (229.3)	164 (148.3)	140.3 (119.8)	160.3 (139.8)	142.2 (121.7)
Total surface disturbance during operations	268 (247.7)	187 (166.7)	195.5 (157.2)	215.5 (177.2)	197.4 (159.1)

Note: Disturbances on National Forest System lands are presented in parentheses.

Table 2-3
Size of Selected Project Components (in acres)

	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Process Area	34.2	34.2	17.2	17.2	17.2
Marine Facilities	4.4	4.4	6	6	6
Explosives Magazine	2.9	2.9	–[a]	–[a]	–[a]
Fuel Storage	0.3	0.3	–[b]	–[b]	–[b]
Access Roads	22.8	22.8	28.9	28.9	28.9
Tailings Facility	113.4	50[c]	86.1[d]	86.1[d]	86.1[d]
Stormwater Detention/ Sediment ponds	7.5	7.5	–[e]	–[e]	–[e]
Laydown Area	0.8	0.8	5	5	5
Borrow Site(s)	54.7	36.6	8.4	8.4	8.4
Topsoil (Growth Media) Stockpile	9.3	9.3	1.6	1.6	1.6
Personnel Camp	5	5	NA	NA	NA
Batch Plant	1.3	1.3	NA	NA	NA
Mine water treatment ponds	6	6	6	6	6
Waste Rock Storage	Temporary	Temporary	36.3	36.3	36.3
Upper Portals	6	6	–[f]	–[f]	–[f]
Diversions and Treatment	–[g]	–[g]	–[e]	8.8	1.9
Inundation (during operations only)	NA	NA	NA	11.2	NA
Total Disturbance	**268.6**	**187.1**	**195.5**	**215.5**	**197.4**

[a] Located underground.
[b] Isotainer storage included in laydown area, process area, and marine facility acreages.
[c] Figure includes 33-acre DTF, 6-acre berm, and 10-acre staging area.
[d] Figure includes pipeline access road and cutoff road.
[e] Figure is included in the process area acreage.
[f] Not required because of Jualin access tunnel.
[g] Figure included in DTF acreage.
NA = Not applicable.

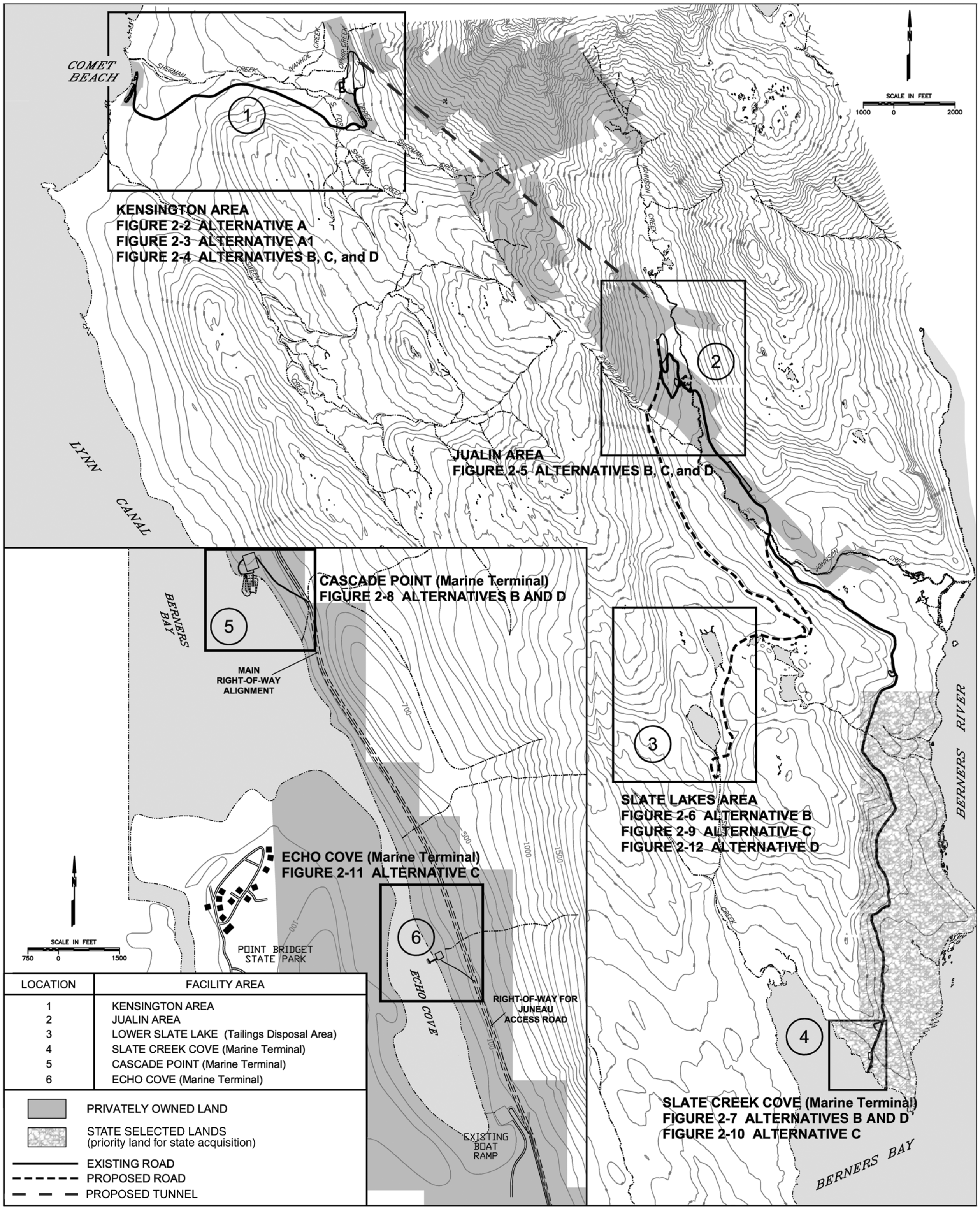
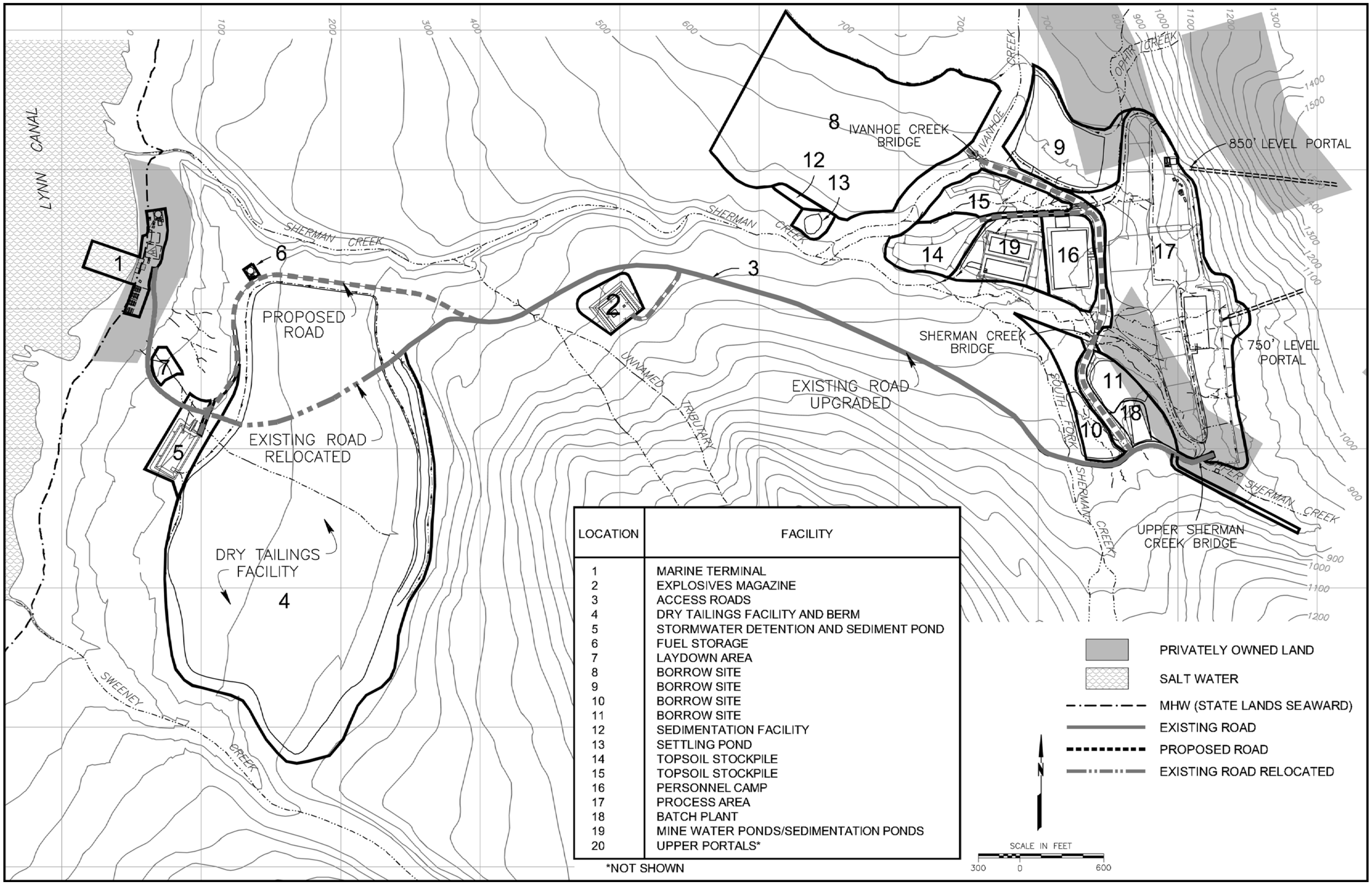


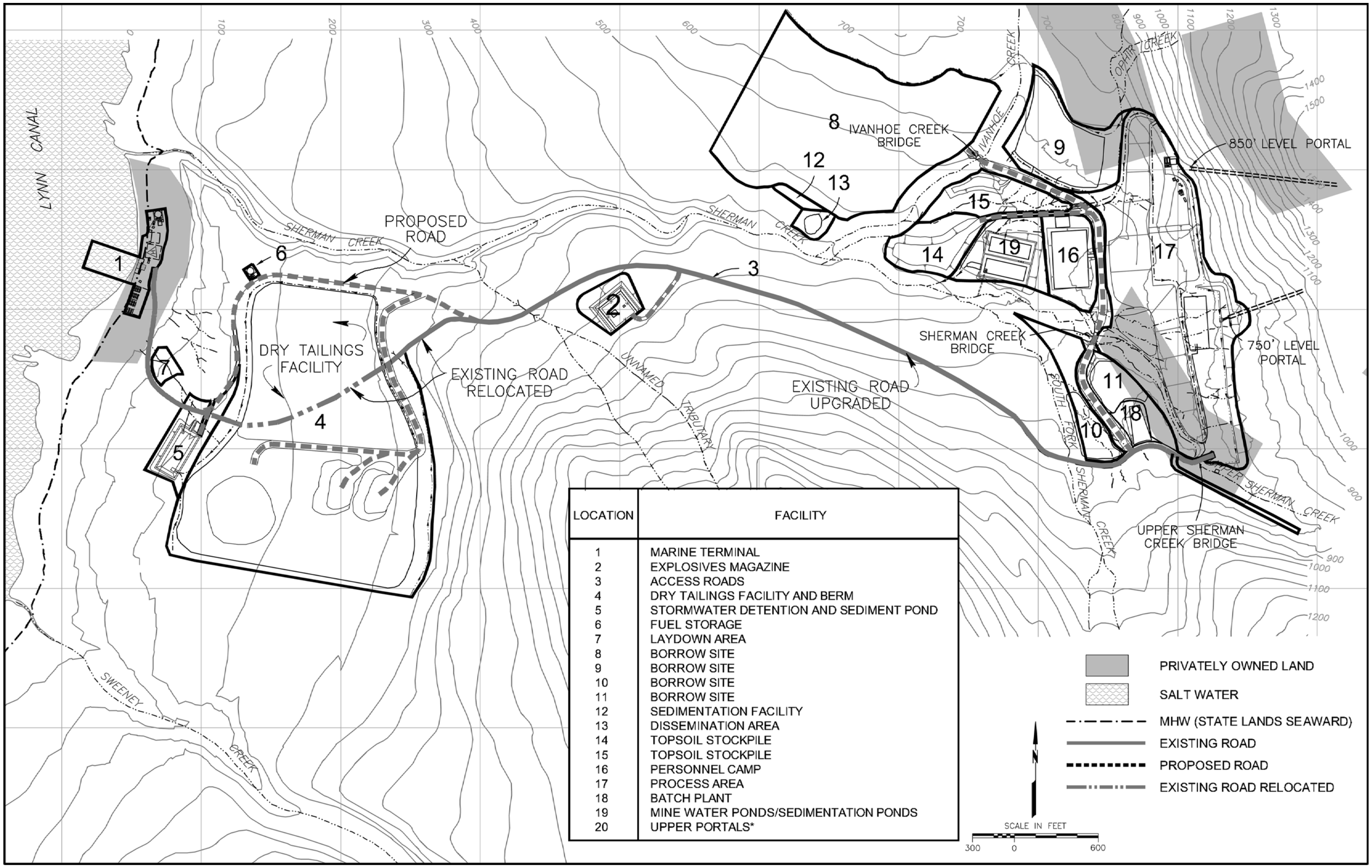
FIGURE 2-1. OVERALL LOCATION OF FACILITIES



LOCATION	FACILITY
1	MARINE TERMINAL
2	EXPLOSIVES MAGAZINE
3	ACCESS ROADS
4	DRY TAILINGS FACILITY AND BERM
5	STORMWATER DETENTION AND SEDIMENT POND
6	FUEL STORAGE
7	LAYDOWN AREA
8	BORROW SITE
9	BORROW SITE
10	BORROW SITE
11	BORROW SITE
12	SEDIMENTATION FACILITY
13	SETTLING POND
14	TOPSOIL STOCKPILE
15	TOPSOIL STOCKPILE
16	PERSONNEL CAMP
17	PROCESS AREA
18	BATCH PLANT
19	MINE WATER PONDS/SEDIMENTATION PONDS
20	UPPER PORTALS*

*NOT SHOWN

FIGURE 2-2. NO ACTION (ALTERNATIVE A)



LOCATION	FACILITY
1	MARINE TERMINAL
2	EXPLOSIVES MAGAZINE
3	ACCESS ROADS
4	DRY TAILINGS FACILITY AND BERM
5	STORMWATER DETENTION AND SEDIMENT POND
6	FUEL STORAGE
7	LAYDOWN AREA
8	BORROW SITE
9	BORROW SITE
10	BORROW SITE
11	BORROW SITE
12	SEDIMENTATION FACILITY
13	DISSEMINATION AREA
14	TOPSOIL STOCKPILE
15	TOPSOIL STOCKPILE
16	PERSONNEL CAMP
17	PROCESS AREA
18	BATCH PLANT
19	MINE WATER PONDS/SEDIMENTATION PONDS
20	UPPER PORTALS*

FIGURE 2-3. NO ACTION (ALTERNATIVE A1)

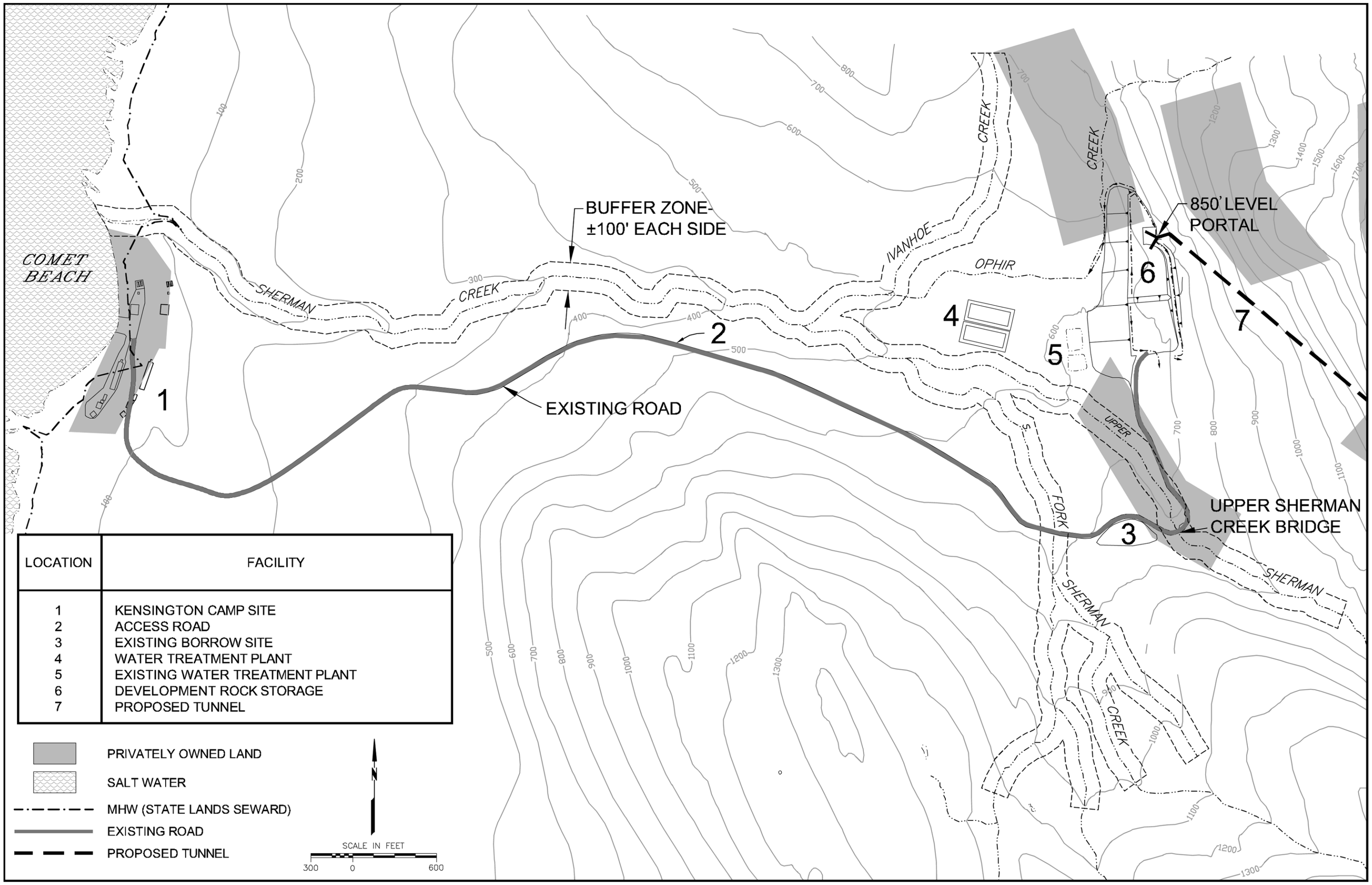


FIGURE 2-4. ALTERNATIVES B, C, AND D, KENSINGTON AREA

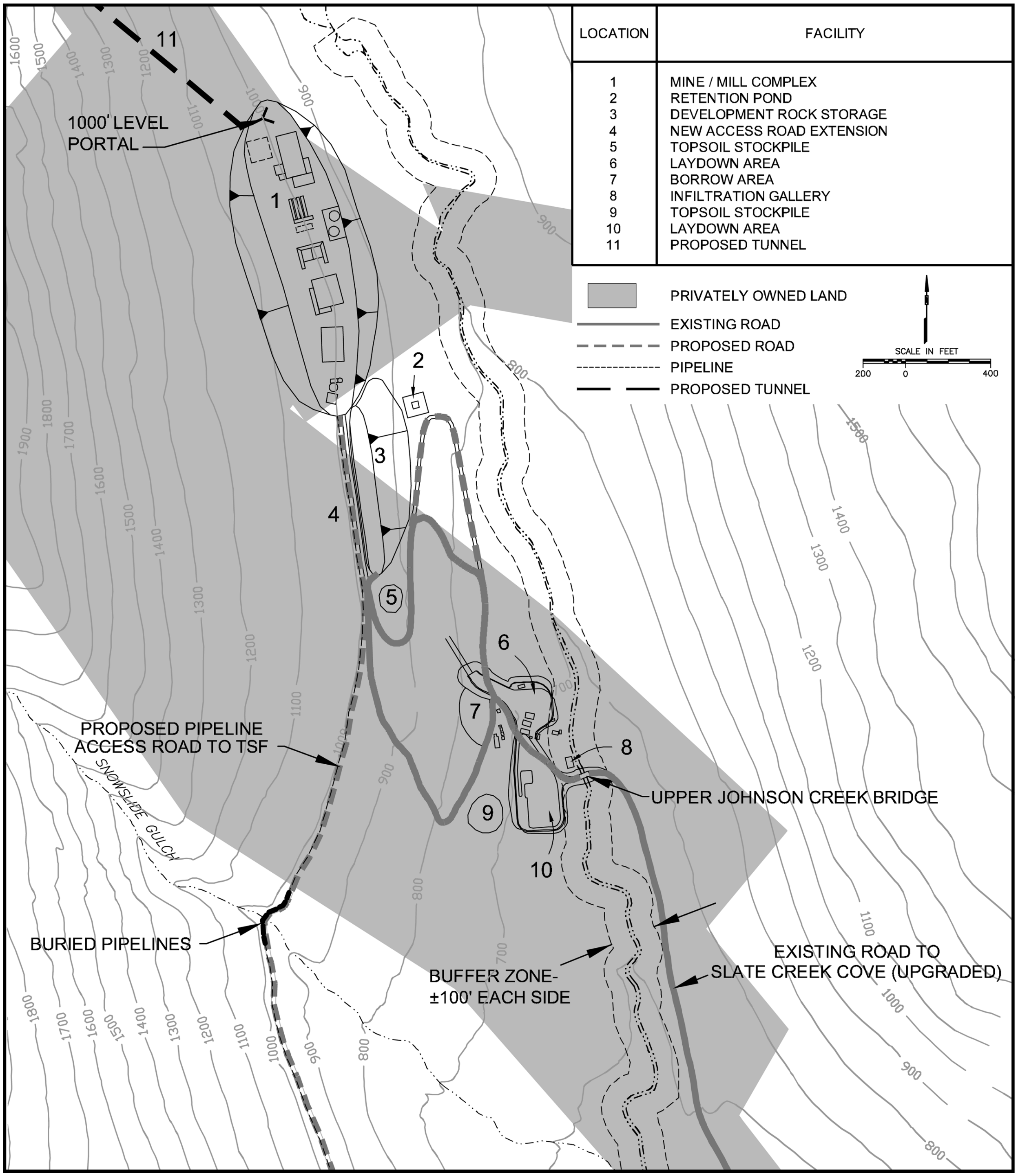


FIGURE 2-5. ALTERNATIVES B, C, AND D, JUALIN PROCESS AREA

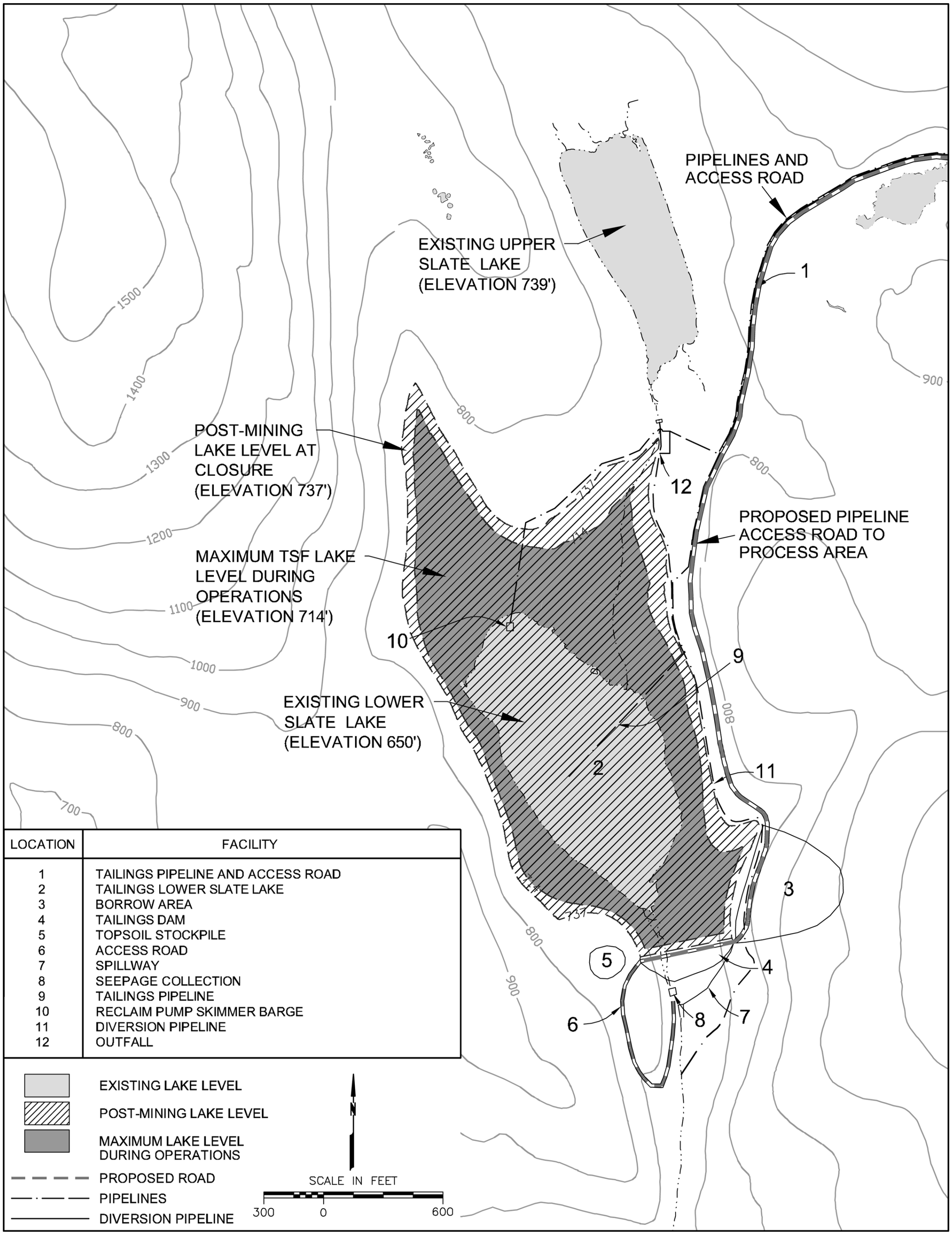


FIGURE 2-6. ALTERNATIVE B, TSF

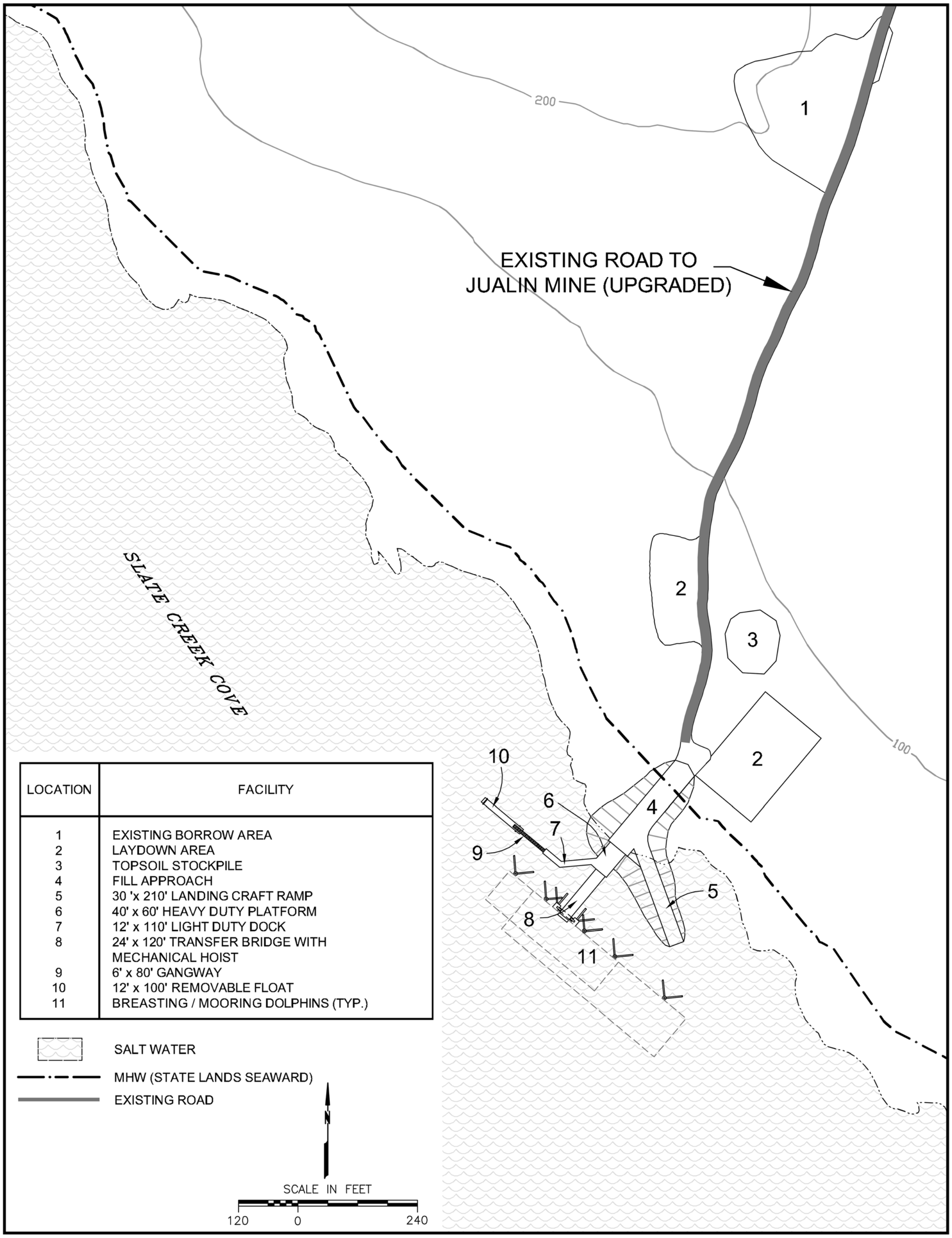


FIGURE 2-7. ALTERNATIVES B AND D, SLATE CREEK COVE MARINE TERMINAL

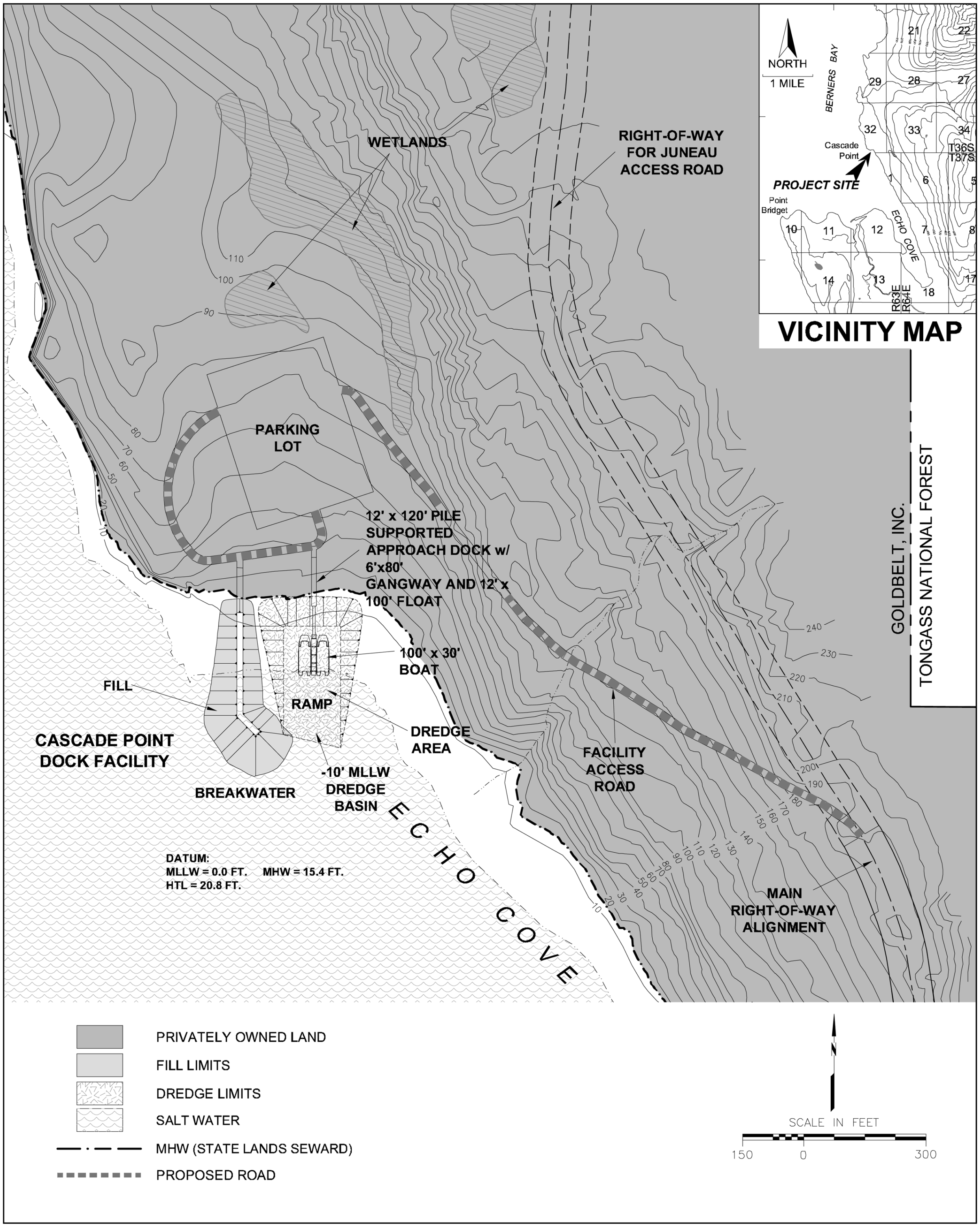


FIGURE 2-8. ALTERNATIVES B AND D, CASCADE POINT MARINE TERMINAL

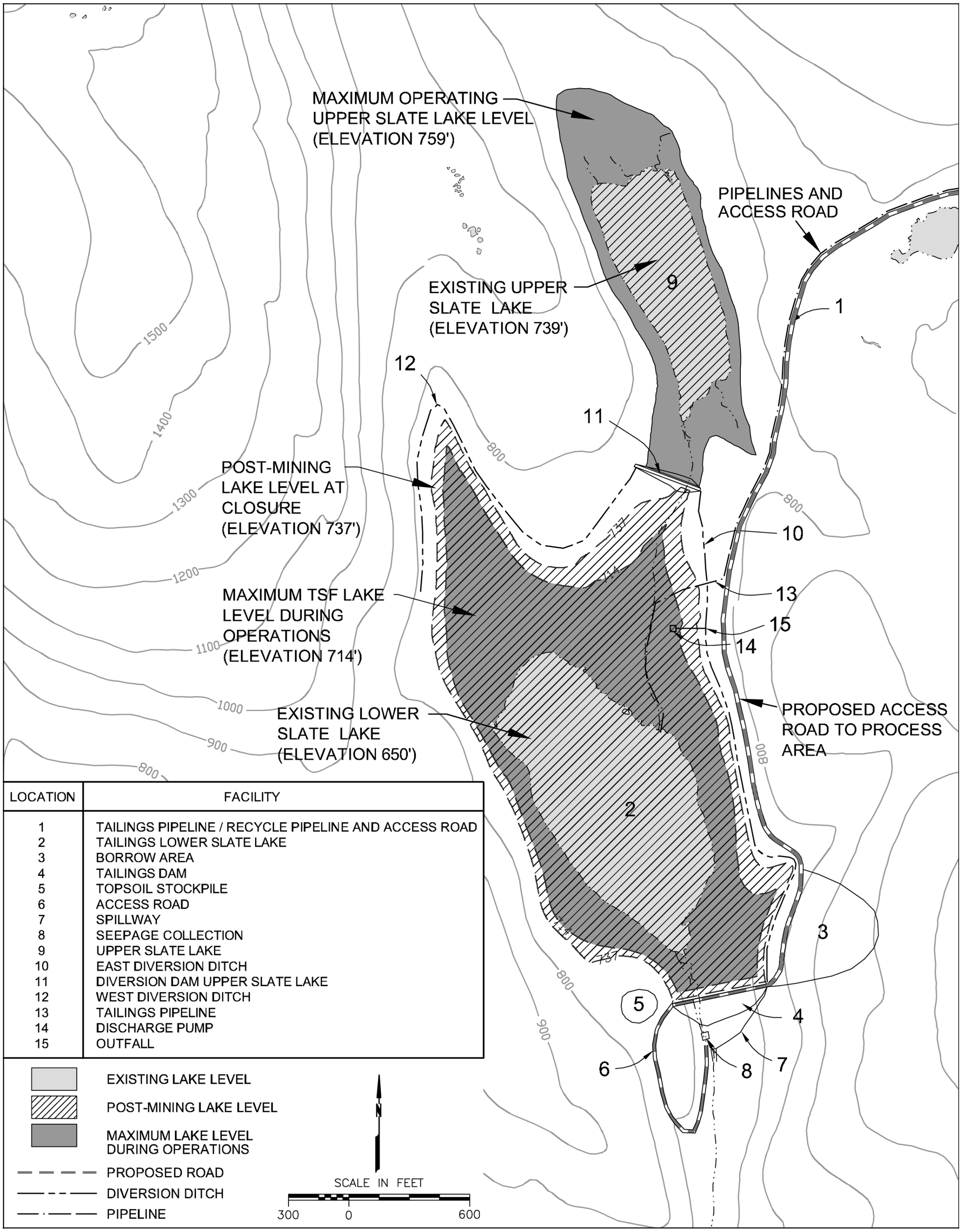


FIGURE 2-9. ALTERNATIVE C, TSF AND DIVERSIONS

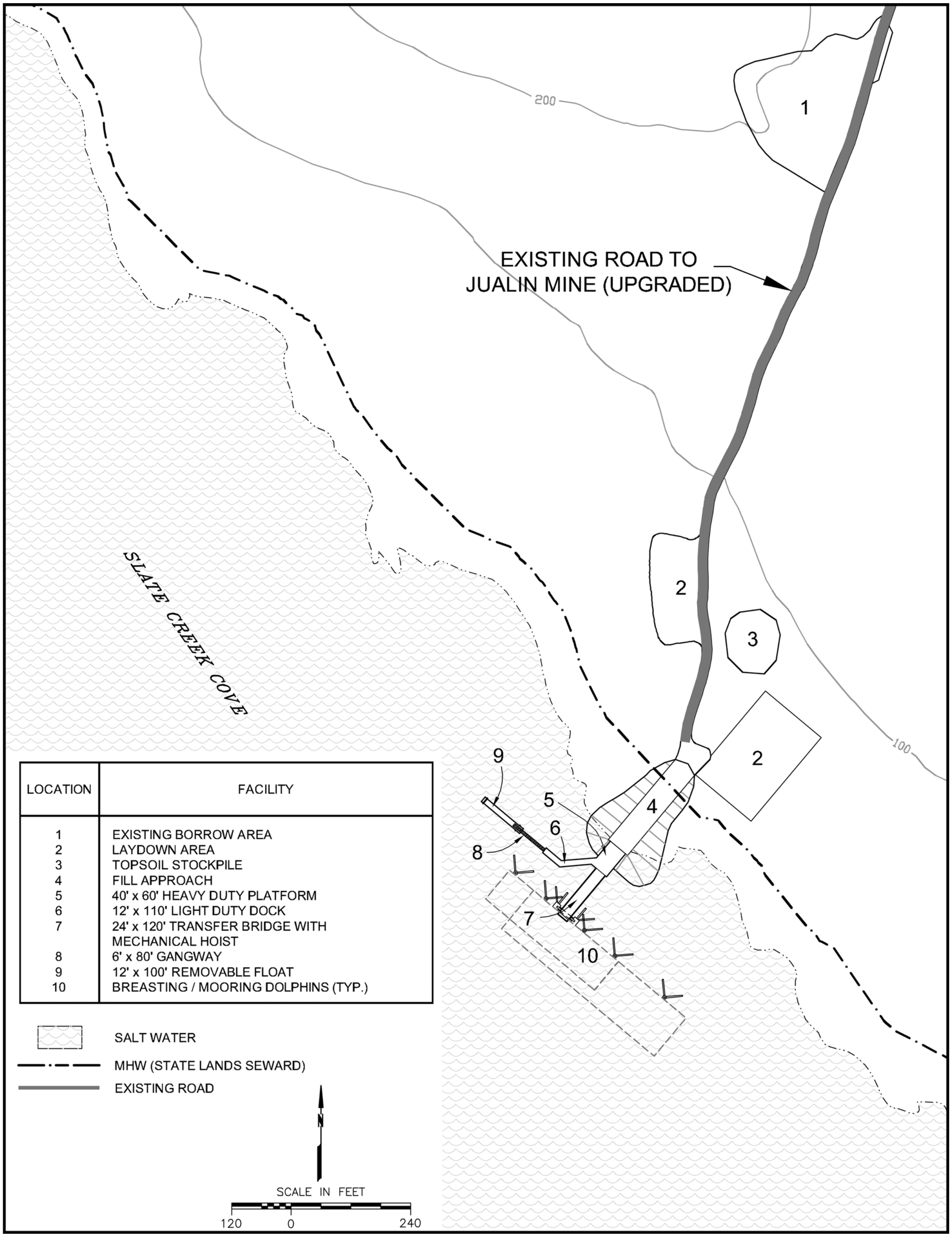


FIGURE 2-10. ALTERNATIVE C, MODIFIED SLATE CREEK COVE MARINE TERMINAL

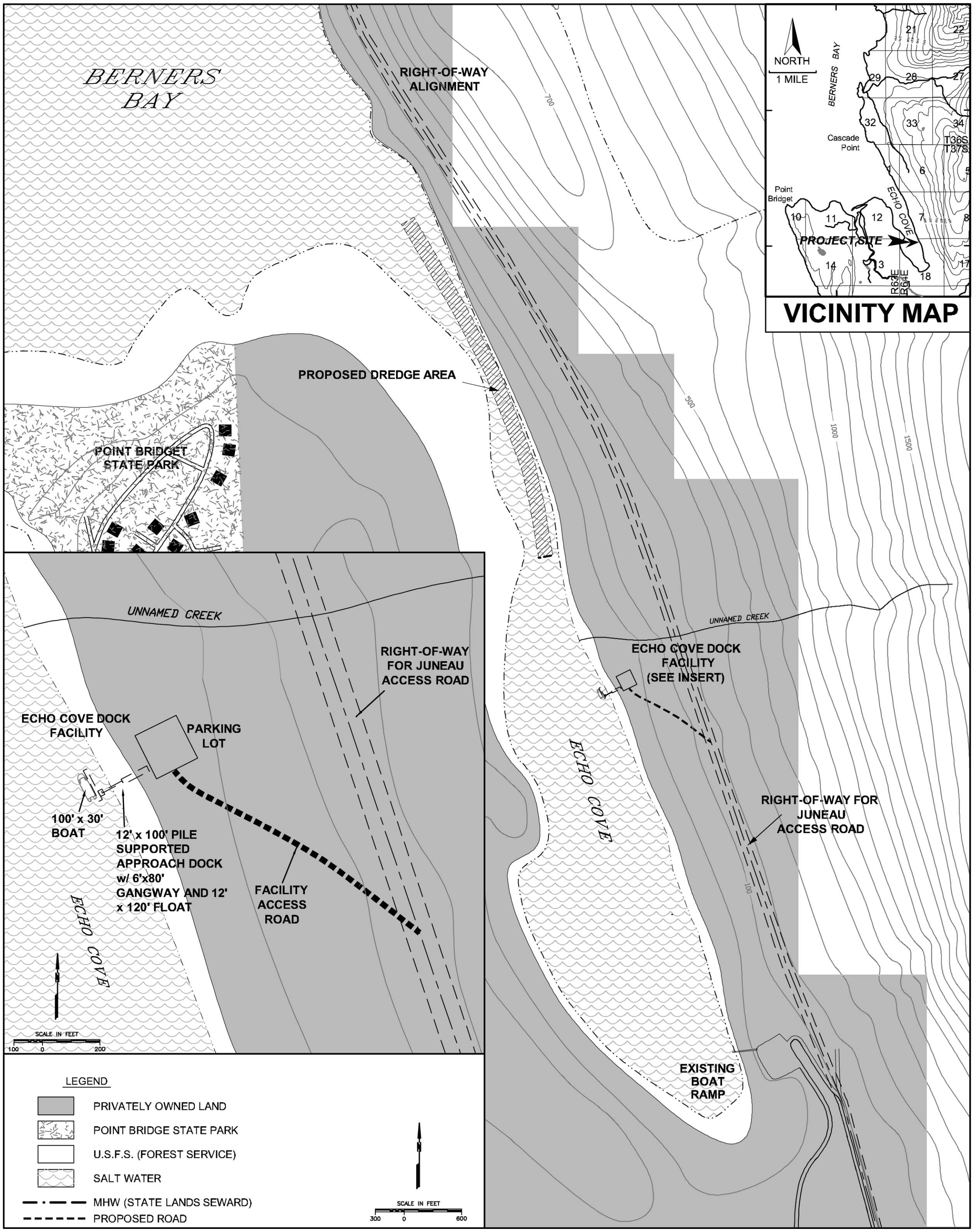


FIGURE 2-11. ALTERNATIVE C, ECHO COVE MARINE TERMINAL

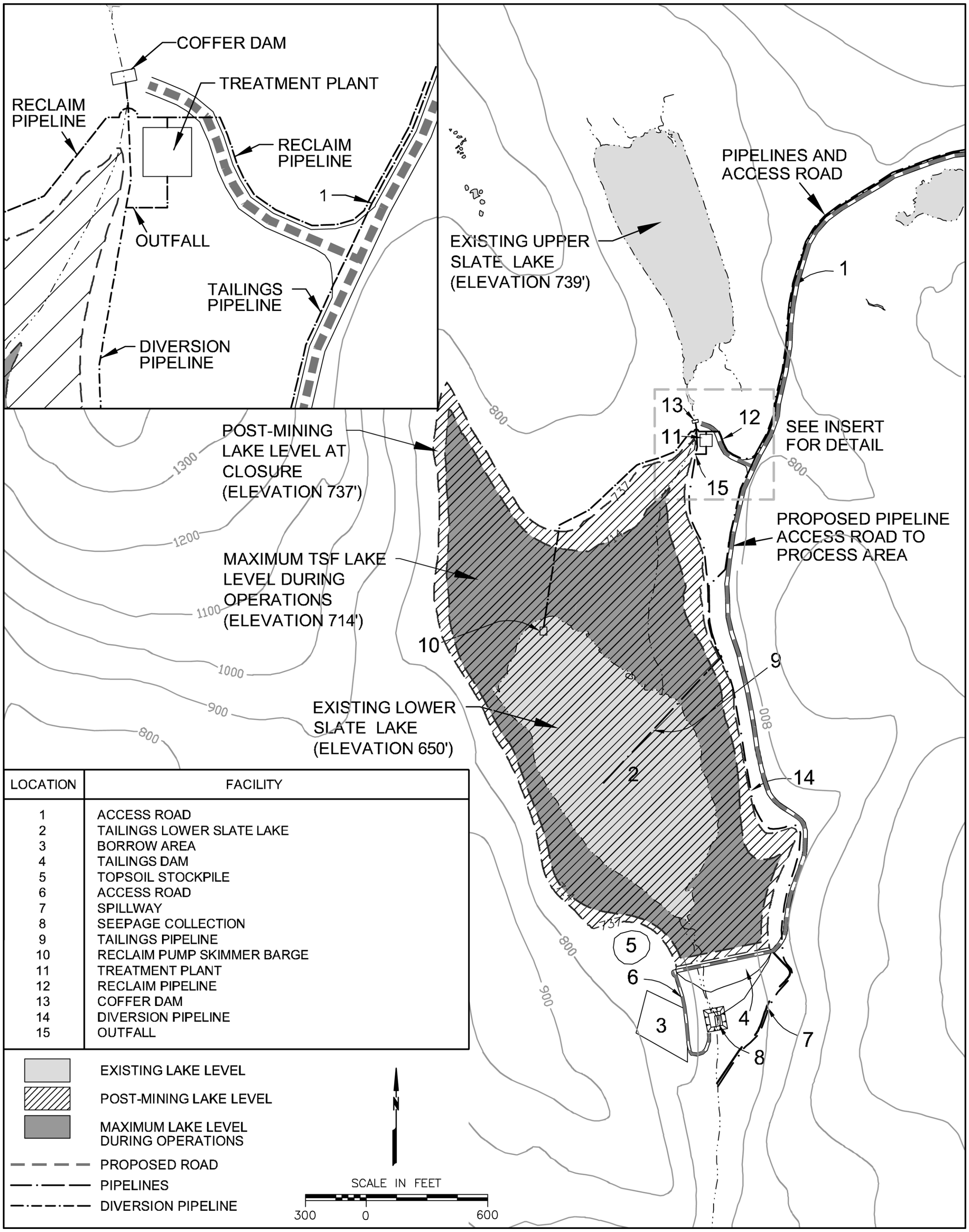


FIGURE 2-12. ALTERNATIVE D, TSF

2.2.2 Alternative A1: Reduced Mining Rate DTF

Alternative A1 represents one possible development scenario if the No Action Alternative was selected under current economic conditions. It is included to provide a mechanism for comparing all alternatives under a similar development scenario. Because Alternative A represents an approved Plan of Operations, the limited mining scenario under Alternative A1 could not be imposed on the company if the No Action Alternative was selected.

Alternative A1 would result in 4.5 million tons of tailings being placed in the DTF, assuming that 40 percent of the tailings would be backfilled. As described under the selected alternative in the 1997 ROD and as Alternative A in this analysis, the DTF would be constructed in three phases, each of which would use a separate cell within the DTF footprint. The size of the DTF under Alternative A1 is assumed to be the same as that proposed for the first cell under Alternative A (40 acres, including 6 acres for the structural berm). The analysis assumes a disturbance footprint of 50 acres during development of the DTF to allow room for staging of the dewatering operations and material stockpiles. This staging would have occurred within the full DTF footprint under Alternative A. The reduced mining rate presented under Alternative A1 would produce very limited amounts of waste rock. Because waste rock would not be available for use in DTF construction under Alternative A1, the impact analysis assumes that the same number of acres of sand and gravel borrow area as that under Alternative A would be required. The analysis also assumes that about half of the coarse and fine till borrow area would need to be developed to support construction of a smaller DTF. Other aspects of Alternative A1, including transportation of employees and materials, would be the same as those described under Alternative A. The life of the operation would be reduced to 10 years following 2 years of construction.

2.2.3 Alternative B: Proposed Action

Alternative B reflects a number of changes to the mine plan associated with the No Action Alternative. These changes include constructing an underwater TSF within Lower Slate Lake, relocating milling operations to the Johnson Creek drainage, and eliminating the personnel camp. The operation would mine a smaller amount of ore with a higher average gold concentration compared with that proposed under Alternative A. Alternative B would include the development of a tunnel to connect the Kensington and Jualin areas of the mine. Access to the site would be from marine terminals built in Slate Creek Cove and at Cascade Point. A daily crew shuttle boat service would transport employees to and from the project site. The TSF would be sized to accommodate the disposal of 4.5 million tons of tailings. Borrow areas would need to be developed for construction of the TSF dam and roads. The production rate would be approximately 2,000 tons of ore per day. This alternative includes recycling water from the TSF to the mill circuit. Alternative B would require upgrading the 5-mile-long access road, constructing a 3.5-mile pipeline access road, and constructing a 1-mile cutoff road connecting the other two roads.

2.2.4 Alternative C: Dock Location and Design/Diversion

Alternative C would include a dock in Echo Cove, approximately 0.75 mile north of the existing Echo Cove boat ramp. Mine workers would use this dock to reach the crew shuttle that would deliver them to the dock at Slate Creek Cove. The landing craft ramp at the Slate Creek Cove marine terminal would be eliminated, minimizing the amount of fill in the intertidal areas. Alternative C would not include recycling water from the TSF and the mill circuit. The “no recycle” aspect was included in Alternative C at the request of the operator to address the possibility that the operator might be granted an exemption from the regulatory requirement at 40 CFR Part 440 that process water must be recycled. This alternative would also include diversion channels to direct the flow from Mid-Lake East Fork Slate Creek and overland runoff from undisturbed areas around the TSF. The diversions would require a dam on Upper Slate Lake to maintain water levels in the diversion sufficient to reach the spillway at the TSF dam. The diversion would discharge to a spillway at the top of the TSF dam. The purpose of the diversion would be to minimize the volume of fresh water in contact with the tailings. The remaining project components, including the production rate of 2,000 tons per day of ore and the access tunnel, would be the same as those under Alternative B.

2.2.5 Alternative D: TSF Water Treatment and Pipeline Diversion

Alternative D includes a modified TSF design. A dam would be constructed in Mid-Lake East Fork Slate Creek, and it would gravity-feed a diversion pipeline. TSF water would be pumped to a reverse osmosis treatment system. The treatment plant effluent would discharge into the diversion pipeline, which would flow to East Fork Slate Creek below the TSF dam. Once tailings disposal was complete, the tailings would be capped with native material unless the operator can demonstrate that uncovered tailings would not cause toxicity throughout Lower Slate Lake after closure. The remaining components would be same as those of Alternative B.

2.3 PROJECT COMPONENTS STUDIED IN DETAIL

2.3.1 Project Location/Duration

Figure 2-1 shows the location of project facilities, which would be built on National Forest System lands as well as private land (dark shading). Under Alternative A, the facilities would be contained within watersheds draining to Lynn Canal. The process area would be near the Kensington 850-foot portal and would consist of the mill, warehouse buildings, maintenance shop, administrative offices, and laboratory. The personnel camp would be near the wastewater treatment plant, downslope of the process area. Under Alternatives B, C, and D, portions of the operation (waste rock disposal and wastewater treatment of the mine drainage) would remain within the Sherman Creek drainage; however, facilities would also be built in the Johnson Creek and Slate Creek drainages, within the Berners Bay watershed. Under Alternatives B, C, and D, the facilities mentioned above would be moved to an area above the historic Jualin Mine (Figure 2-5) consisting mostly of patented mining claims (private land). The personnel camp would be eliminated.

Under Alternative A, the active life of the project would be at least 12 years based on the existing reserve, following a 2-year construction period. Alternative A1 would have an active life of 10 years following a 2-year construction period. Mining operations lasting 10 years are projected under Alternatives B, C, and D, following an 18-month construction period.

2.3.2 Mining Methods

The proposed mining methods are similar to those presented in the 1997 Approved Plan of Operations. The following discussion provides a brief summary of mining methods based on details provided in the 1992 FEIS. The reader is referred to pages 2-5 through 2-7 of that document for additional details.

Under Alternatives A and A1, the ore body would be accessed by the existing tunnel at the Kensington 850 portal. Under Alternatives B, C, and D, the Jualin tunnel would be used as the primary access for workers and materials into the mine, as well as ore haulage between the mine and mill. The Jualin tunnel would be 18 feet wide by 15 feet high to accommodate 40-ton haul trucks. On the Jualin side, the portal would be near the mill at an elevation of 1,050 feet. From the portal, it would slope downward at a grade of 1.5 percent for 5,000 feet toward the existing Kensington tunnel, which it would intersect at an elevation of 932 feet. The tunnel would be driven from both sides to reduce the duration of the pre-production development period and to eliminate the need for a ventilation raise to the surface. The estimated schedule for completing the tunnel is about 150 days.

The Kensington ore body consists of a dense pattern of quartz veins and veinlets that extend from the surface to a depth of approximately 3,000 feet. The ore zone averages approximately 60 feet wide but ranges in width from 22 feet to more than 165 feet. The ore body is irregular in shape and erratic in the distribution of gold content. Coeur selected a mining method called the long-hole, open-stope technique on the basis of a number of factors, such as the spatial and physical characteristics of the deposit, economics, and environmental considerations.

The long-hole, open-stope technique is employed in situations where ore occurs in wide and steeply dipping vein deposits. Mining would progress throughout the ore body as dictated by mine design, stope size, backfilling sequence, and other key elements that maximize extraction of the mineral resource. The long-hole, open-stope method allows for flexibility in handling irregular ore body widths and allows efficient removal of ore. It also allows safe working conditions while using a minimal workforce. Figures 2-13 and 2-14 depict the extent of the mine workings under Alternatives A1, B, C, and D in relation to the ground surface and surface water drainages, respectively.

The operation under all the alternatives would mine the Kensington ore body. Alternative A proposes to process ore at a rate of 4,000 tons per day (tpd) and produce approximately 26 million tons of tailings over the life of the mine. The DTF would be sized to hold a maximum of 20 million tons, and 25 percent of the tailings would be backfilled. Under Alternatives A1, B, C, and D, a smaller portion of the same ore body would be mined at a rate of 2,000 tpd. The 2,000-tpd operation would target smaller quantities of higher-grade ore (ore with a higher gold content) than the operation proposed under Alternative A. Operations under Alternative A1, B, C, or D would produce a total of 7.5 million tons of tailings over the life of the mine: 4.5 million tons (60 percent) would be disposed of in the TSF (or the DTF in the case of Alternative A1), and 3 million tons (40 percent) would be backfilled.

2.3.3 Waste Rock Disposal

Waste rock is material encountered during the mining process that has a gold content less than that economically recoverable. During operations, waste rock would be hauled to the surface for storage, use, or disposal.

Under Alternative A, waste rock would be used as foundation, drainage, and berm material in construction of the DTF. A 15-acre temporary stockpile would be located near the mine opening for the first 3 to 4 years while the DTF was being developed. Once the DTF became active, the demand for waste rock would essentially equal production; that is, all waste rock would eventually be used in the DTF. Section 2.3.3 of the 1997 SEIS provides a more detailed discussion of waste rock management under Alternative A. Very little waste rock would be produced under Alternative A1.

Under Alternatives B, C, and D, most of the waste rock would be generated in the process of developing the access tunnel between the Kensington and Jualin portals. This tunnel would not be developed under Alternative A or A1. The waste rock would be hauled by truck to a 31.5-acre permanent disposal site near the Kensington 850-foot portal. There would also be capacity to store approximately 500,000 tons of waste rock on 4.8 acres in the vicinity of the process area at Jualin. Under all alternatives, waste rock could also be placed underground as part of the backfill process.

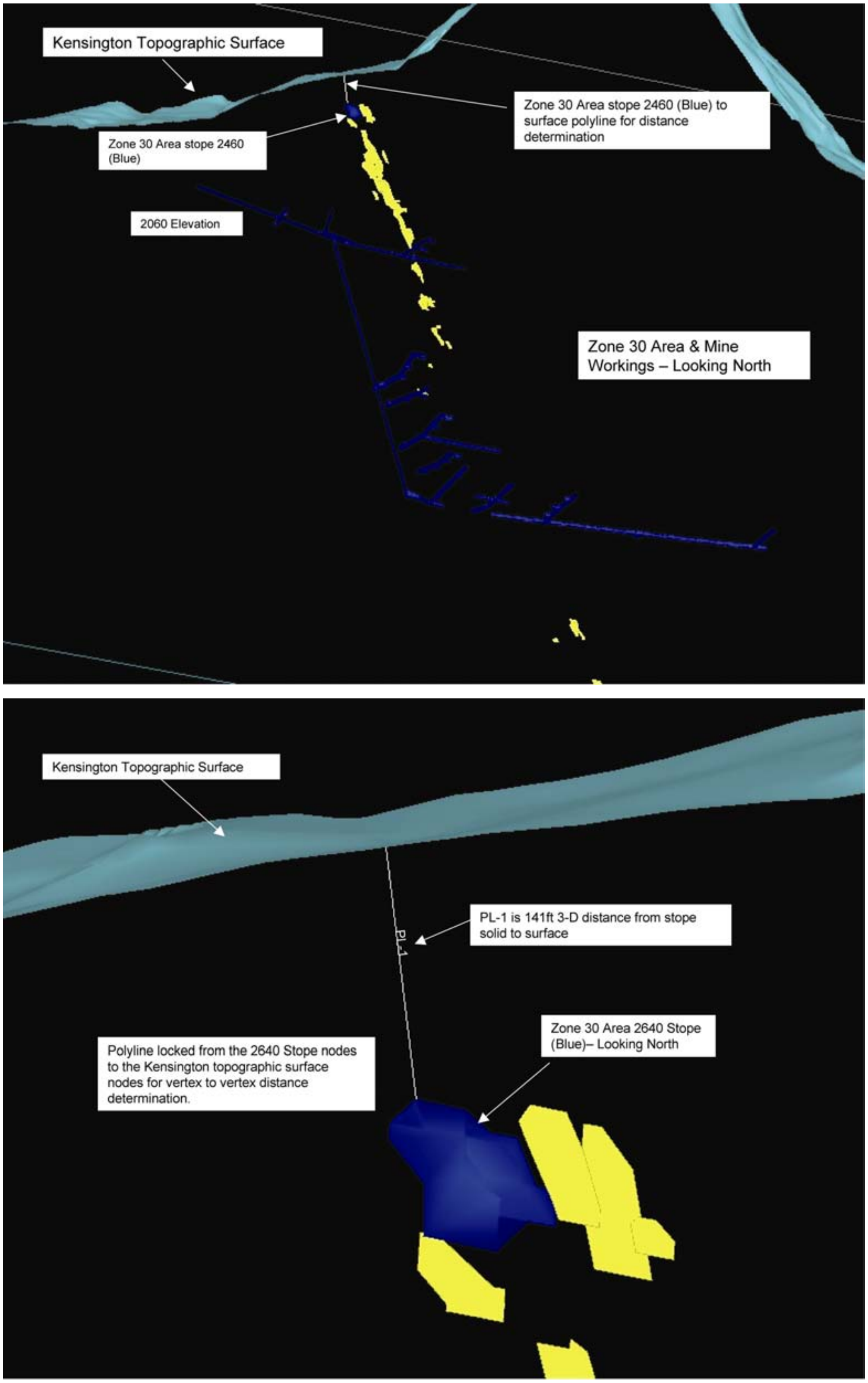


FIGURE 2-13. UNDERGROUND MINE WORKINGS UNDER ALTERNATIVES A1, B, C, AND D IN RELATION TO GROUND SURFACE

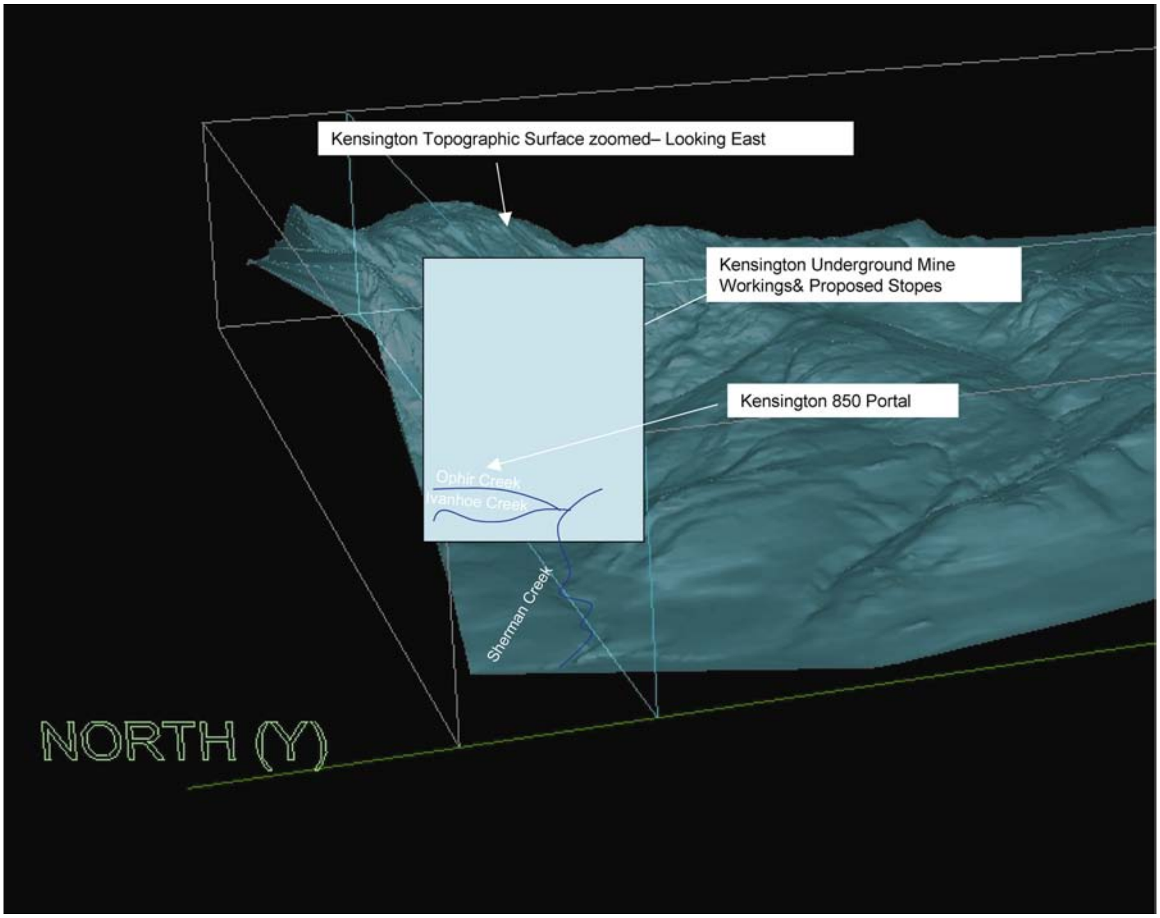


FIGURE 2-14. UNDERGROUND MINE WORKINGS UNDER ALTERNATIVES A1, B, C, AND D IN RELATION TO SURFACE WATER DRAINAGES

2.3.4 Ore Processing

Ore processing refers to the methods by which gold is separated from the surrounding material. The steps in ore processing would be nearly the same under all alternatives; the only difference would be the location of the processing facilities. Processing steps include crushing, grinding, flotation, thickening, and filtration. Under Alternatives A and A1, crushing would take place underground and all the other steps would be conducted in buildings. Under Alternatives B, C, and D, all steps would be done in buildings. Table 2-4 summarizes the chemicals and materials used in the milling process under each alternative.

The mill would be located at the Kensington process area under Alternatives A and A1 and at the Jualin process area under Alternatives B, C, and D. In each case, ore would be hauled from the active mining area and dumped down an ore chute. The material would then be sent through the primary

Table 2-4
Chemical and Material Use

Milling Process	Reagent or Material	Container (Shipping and Storage)	Approximate Daily Use (tons)	
			Alternative A	Alternatives A1, B, C, and D
Grinding	Steel balls	10-ton steel bins	5–6	4–5
Flotation	Potassium amyl xanthate	50-gallon drum	1	0.5
	MIBC (frother)	50-gallon drum	0.4	0.2
	Flocculant	1-ton Flo-bin	0.2	0.1
	Polymer	50-gallon drum	0.02	0.01
	Surfactant	50-gallon drum	0.04	0.02
	Scale inhibitor	50-gallon drum	0.1	0.05
	Lime*	1,000-lb bags	2	1

* Lime is also used in concentrate thickening.

crusher, which would reduce the size of the ore to less than 6 inches. The crushed ore would then be hauled by truck to the coarse ore stockpile at either the Kensington side (Alternatives A and A1) or Jualin side (Alternatives B, C, and D) of the operation. There, the ore would be fed into a hopper with a vibrating feeder and then onto a belt that would discharge into a semiautogenous grinding (SAG) mill.

The SAG mill would be set up in a closed circuit with a horizontal vibrating screen and a ball mill. Oversized material would be fed back into the SAG mill, while undersized material (minus 100 mesh) would be directed to hydrocyclones. Hydrocyclones use centrifugal force to separate coarse material from fine material. The heavy material (underflow) from the cyclones would be directed to a gravity concentrator used to recover coarse gold. Lighter materials from the cyclones would be fed back to the cyclone circuits, eventually overflowing from the cyclones to a conditioning tank feeding the flotation circuit.

The flotation process would involve separating the gold from the barren material in a froth flotation. A slurry would be fed from the cyclones to the conditioning tank, where conditioners (e.g., potassium amyl xanthate) and frothing agents would be added. These materials would cause the sulfide and telluride minerals (both gold-bearing) in the slurry to attach to air bubbles once air was pumped through the system. The bubbles containing the mineralized portion of the slurry, including the gold, would form a froth on top of the flotation tank. The gold-bearing froth would then be skimmed off and collected. This “concentrate” would flow through additional flotation tanks to further concentrate the gold. The flotation process would separate approximately 93 to 96 percent of the non-gold material from the ore fed into the system, leaving 160 to 280 tons (under Alternative A) or 80 to 140 tons (under Alternatives A1, B, C, and D) of flotation concentrate per day. Most of the chemicals added to the system would stay in the flotation tanks or be removed with the flotation concentrate as opposed to being discharged with the tailings. Most of the metals associated with the ore body would be removed from the system with the gold concentrate.

Following the final flotation, the concentrate would be dewatered before being placed into specialized 8-foot by 8-foot by 20-foot sealed marine transport containers for shipment to an existing, off-site processing facility outside Southeast Alaska. Under Alternative A the average production would be approximately 1,400 tons (40 containers) of concentrate per week. The production level would average approximately 700 tons (20 containers) of concentrate per week under Alternatives A1, B, C, and D.

2.3.5 Tailings Disposal

Tailings are the material that remains in the flotation tanks once the gold-bearing material has been removed. This Final SEIS evaluates two methods of tailings disposal. Under Alternatives A and A1, tailings would be placed in the DTF. Alternatives B, C, and D would employ wet (underwater or subaqueous) tailings disposal methods in the TSF constructed in Lower Slate Lake. Under all the alternatives, the operator would backfill some of the tailings to permit the maximum extraction of the resource and provide structural stability within the mine. Under Alternative A, the operator would backfill at least 25 percent of the tailings generated. Under Alternatives A1, B, C, and D, the operator proposes to, backfill at least 40 percent of the tailings generated over the life of the operation.

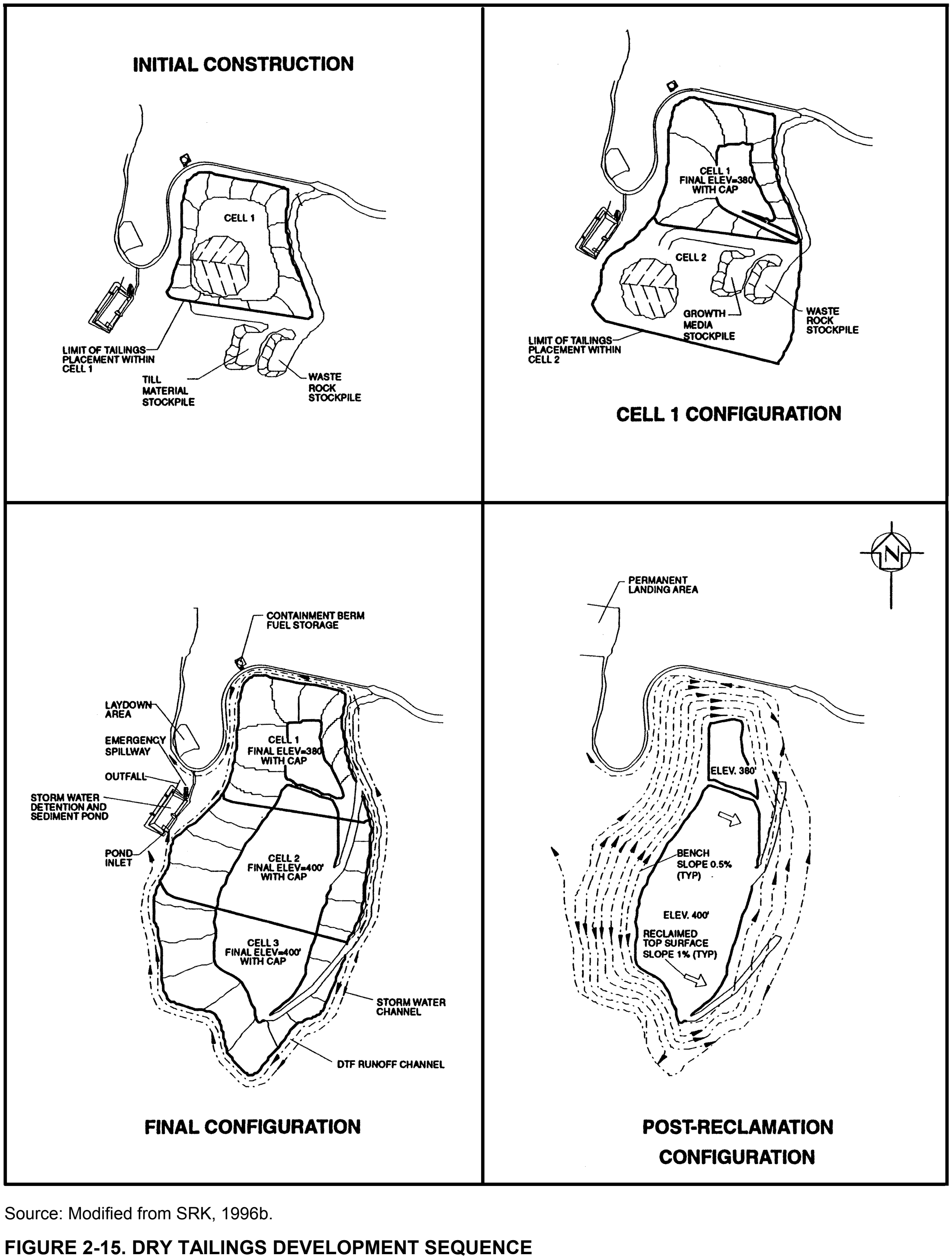
Dry Tailings Disposal

The following discussion is taken from Section 2.3.6 (pages 2-20 through 2-22) of the 1997 SEIS. Additional detail on the DTF can be found in that document. Under Alternatives A and A1, the DTF would be constructed using methods similar to the construction of landfills. The slurry would be thickened to approximately 55 percent solids. The thickened slurry would be moved from the mill to the DTF through an 8,000-foot, gravity-fed pipeline. The pipeline would be built within the footprint of the haul road for most of its length. The pipeline would be approximately 14 inches in diameter with a 20-inch casing for spill containment. At the DTF the tailings would be dewatered, using plate filters (or the design equivalent), to a moisture content of 5 to 18 percent. The filter cake would then be loaded into trucks and placed in the DTF.

The DTF would be constructed in a series of three stages or cells. Before placement of the first lift of each cell, a series of foundation drains would be installed to form the base. The drains would be laid out in a herringbone pattern and consist of gravel wrapped in geotextile material. A minimum of 2 feet of waste rock or development rock would be placed over the drains. Each cell would consist of five to seven lifts, each 28 feet high. Tailings would be placed (unconsolidated) into the 28-foot lifts followed by 1 foot of compacted, low-permeability fine till and 1 foot of waste rock to provide a cover and working surface. Stockpiles of waste rock to be used in DTF construction would be placed within the footprint of the next cell. The final cover for the facility would consist of 6 to 8 feet of coarse and fine till. The underlying fine till layer would serve as a capillary break, and the overlying coarse till would promote infiltration and drainage. Growth media would be placed on the coarse till to support revegetation.

To ensure that tailings placed into the DTF did not contain excess moisture, there would be no temporary storage at the process area or the dewatering area. Tailings would be placed directly into the DTF or backfilled. The operation would generally expose less than 5 acres of tailings to direct precipitation at any one time (before concurrent covering and revegetation), as illustrated in Figure 2-15.

An engineered structural berm would be constructed around the north, south, and west sides of each cell to increase the stability of the facility. The berm would be constructed of waste rock, compacted tailings, or other suitable material. The berm would extend to a height of approximately 100 feet along the west slope and 50 feet along the north and south slopes. Under Alternative A, the DTF, including the berm, would ultimately cover 113 acres and have a capacity of 20 million tons of tailings. Under Alternative A1, the DTF would cover approximately 40 acres and be able to store 4.5 million tons of tailings.



Source: Modified from SRK, 1996b.

FIGURE 2-15. DRY TAILINGS DEVELOPMENT SEQUENCE

Subaqueous Tailings Disposal

Under Alternatives B, C, and D, tailings would flow by gravity as a slurry from the mill facility located on private land near the Jualin Mine portal to the TSF at Lower Slate Lake through a 3.5-mile pipeline (Figures 2-5 and 2-6). The pipeline would be double-walled, high-density polyethylene (HDPE), approximately 6 inches in diameter. Flow sensors with automatic shutdown mechanisms would be used to detect any blockages or breaks in the system.

Before the slurry left the mill, a polymer and flocculant would be added to agglomerate the small particles and enhance settling once the tailings were deposited into the TSF. The polymers and flocculants are not toxic and would have no effect on water quality beyond their capability to improve the efficiency of settling out fine material. The tailings slurry would be discharged into the TSF through perforations in a portion of the tailings delivery pipeline submerged in the TSF.

A portion of the perforated segment of the pipeline would always be above the bottom of the TSF, allowing the tailings to flow freely from the pipe. The perforations would be very large in comparison to the size of the tailings particles to prevent the tailings from clogging the pipeline. Valves would be placed in the delivery pipeline to allow for maintenance or relocation of the tailings discharge point (perforated pipe). The tailings pipeline would be moved periodically to ensure equal distribution of the tailings.

Under Alternative B, water from the slurry transport of tailings and natural inflow from the drainage basin would maintain a relatively consistent lake volume and thus provide water cover for the tailings. The tailings would be deposited to a final elevation of 704 feet with a constant cover of at least 9 feet of water. Figures 2-16 and 2-17 provide an overview of biological activity in Lower Slate Lake before and after mining operations. The maximum depth of the tailings at closure would be approximately 120 feet. The operational details of the facility at the initial dam construction stage (705 feet) have yet to be determined. Water would be recycled from the TSF for reuse in the process facilities at an average rate of 100 gallons per minute (gpm).

Under Alternative C, all natural inflows from the channel between the two lakes (Mid-Lake East Fork Slate Creek; see Figure 3-3) and the drainage areas surrounding the TSF would be diverted around the TSF. In this case, natural flows would be captured in diversion ditches, carried around the north and east shores of the TSF, and discharged to a drop structure constructed at the TSF dam spillway. Water from the TSF would not be recycled under Alternative C.

Under Alternative B, a drop-structure spillway would be installed at the east abutment of the dam to direct discharge from the TSF to East Fork Slate Creek. An energy dissipater at the bottom of the spillway would allow the water to flow into East Fork Slate Creek without affecting the downstream velocity in the creek. Operationally, water would be pumped from a clear portion of the pond, away from the tailings discharge, to the spillway inlet for discharge. The operator would manage the TSF so that the water is maintained at a steady level. This approach would maintain flow-through conditions so that releases from the TSF would be roughly equivalent to the natural inflow to the lake from natural sources. Under Alternative C, the discharge from the TSF would be pumped to the diversion channel, where it would combine with the natural flows in the diversion channel before flowing into East Fork Slate Creek below the embankment. Upon completion of mining operations, the lake ecosystem would be reestablished at its new level and flows would passively discharge through the permanent embankment spillway.

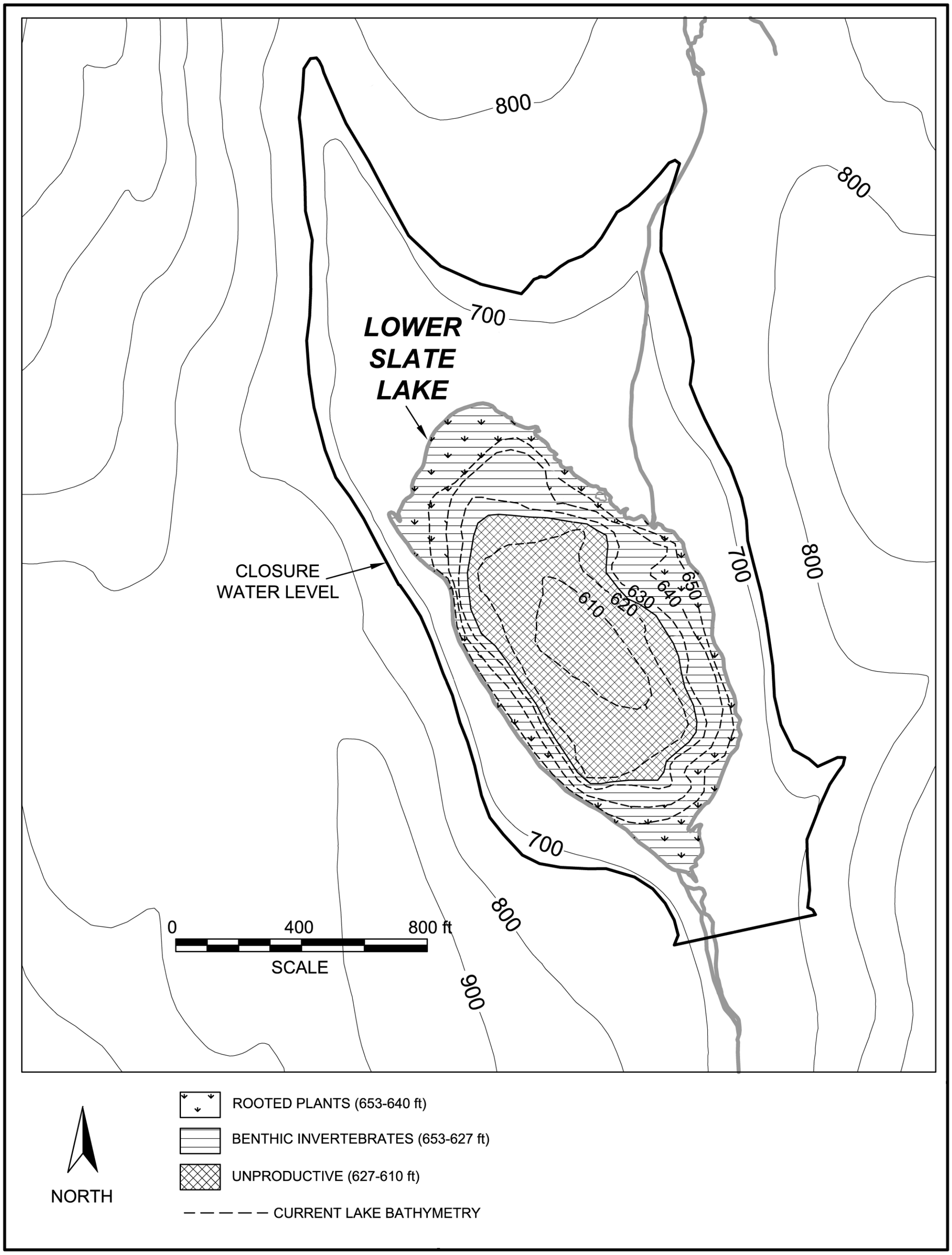


FIGURE 2-16. BIOLOGICAL ACTIVITY IN THE EXISTING LOWER SLATE LAKE

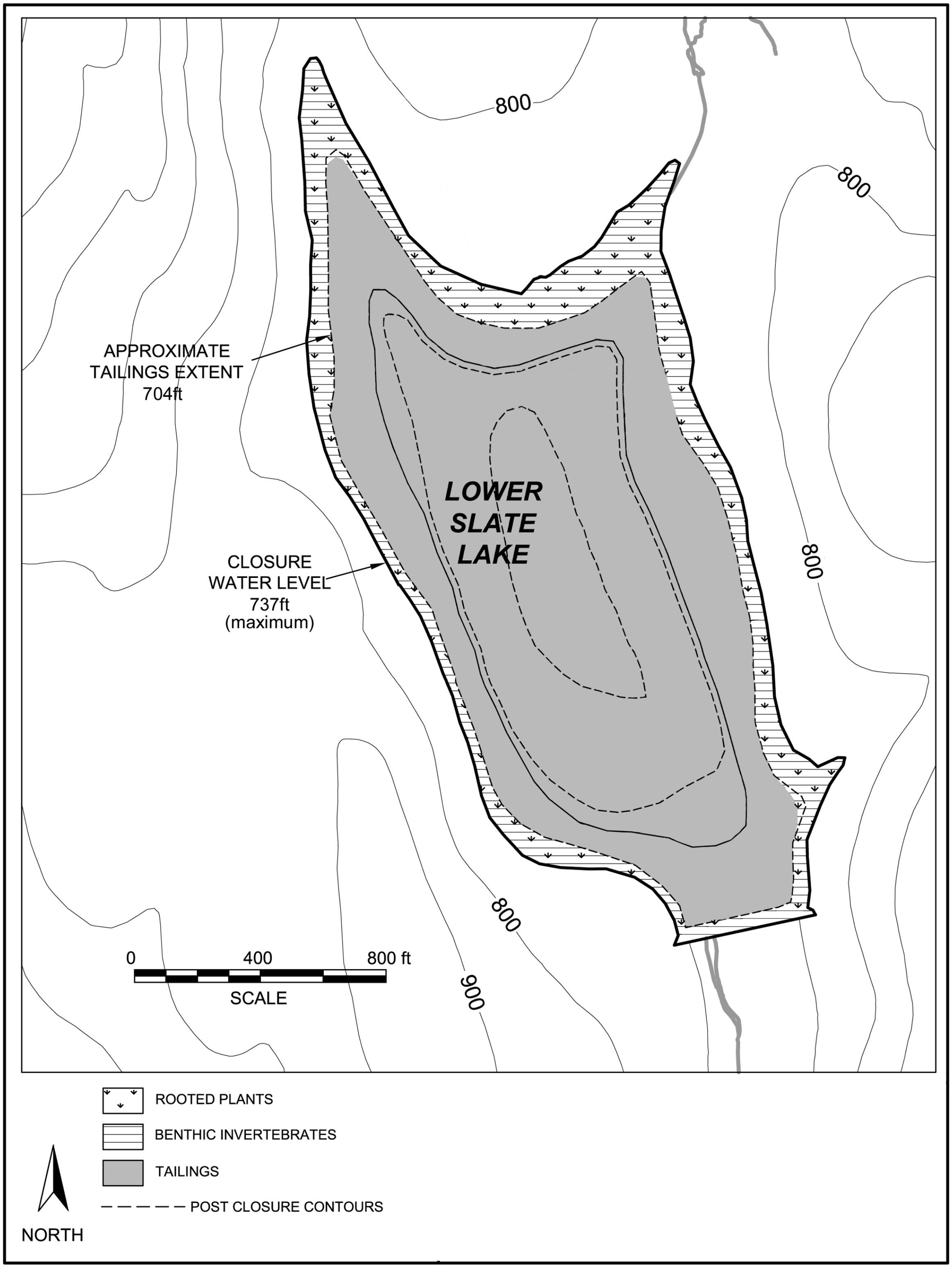


FIGURE 2-17. POTENTIAL BIOLOGICAL ACTIVITY IN THE POST-CLOSURE LOWER SLATE LAKE

Under Alternative D, Mid-Lake East Fork Slate Creek would be diverted around the TSF by a pipeline. Up to 1,300 gpm of water would be pumped from a clear portion of the TSF. Approximately 100 gpm of this flow would be recycled to the mill, while up to 1,200 gpm would flow into a reverse osmosis treatment system for additional solids and metals removal. The reverse osmosis system would involve high-pressure flow through a permeable membrane, where high-quality water would be separated from remaining impurities. A schematic of the reverse osmosis system is included as Figure 2-18. The impurities would be concentrated in a "brine" solution, which would be returned to the TSF. The ratio of high-quality water to brine is typically about 80 percent to 20 percent; for example, at the treatment plant's design capacity of 1,200 gpm, about 960 gpm of high-quality water would be produced along with 240 gpm of brine. Overall, the volume of brine produced would vary between 100 and 240 gpm. The high-quality water would be discharged to the diversion pipeline, which would flow via a spillway to East Fork Slate Creek below the TSF.

Backfilling

Backfilling tailings to mined-out areas underground would provide structural support of the underground workings and allow removal of more of the gold ore. It would also reduce the volume of tailings placed into an aboveground disposal unit (DTF or TSF). Backfilling is proposed under all the alternatives.

Under Alternative A, the operator would transport at least 25 percent of the tailings to a paste backfill plant at the 2,050-foot level of the mine. In the plant, tailings would be mixed with water and cement to form a paste, which would then be directed to open stopes (excavations) within the mine. The paste would be thick and heavy, making pumping expensive in terms of the cost of equipment. Therefore, the use of paste backfill would be limited to the areas that could be accessed by gravity flow from the backfill plant. The backfilled areas would allow the removal of additional ore that would otherwise need to be left in place to provide structural support.

Backfilling under Alternatives A1, B, C, and D would not involve creating a paste but instead would consist of pumping the coarse fraction of the tailings through an HDPE pipe from the cyclones to working areas that need backfill. On the surface, the backfill pipeline would run from the mill to the mine within a containment ditch. Because the ditch would be sized to contain the volume of tailings within the pipeline, it would provide secondary containment in the event of a pipeline failure. A decant line to pump water from the backfill area back to the processing circuit would parallel the backfill pipeline. Depending on the size and use of the area (stope) to be backfilled, cement might be mixed with the upper few inches of backfilled tailings to provide a stable working surface. At least 40 percent of the tailings would be backfilled under Alternatives A1, B, C, and D.

2.3.6 TSF Dam Construction

The TSF would be formed in part by the natural lake basin at Lower Slate Lake and a dam constructed at the outlet of the lake. The dam would be a concrete-faced rockfill dam constructed in two phases. During operations, the dam of the TSF would be 90 feet tall and approximately 500 feet long. The TSF would be sized to accommodate 4.5 million tons of tailings. Figure 2-19 shows the TSF dam. The phased approach to constructing the dam would allow tailings disposal to begin once the first stage of the dam was completed. The second stage would be built while mining operations and tailings disposal were active, likely 4 to 5 years into the process.

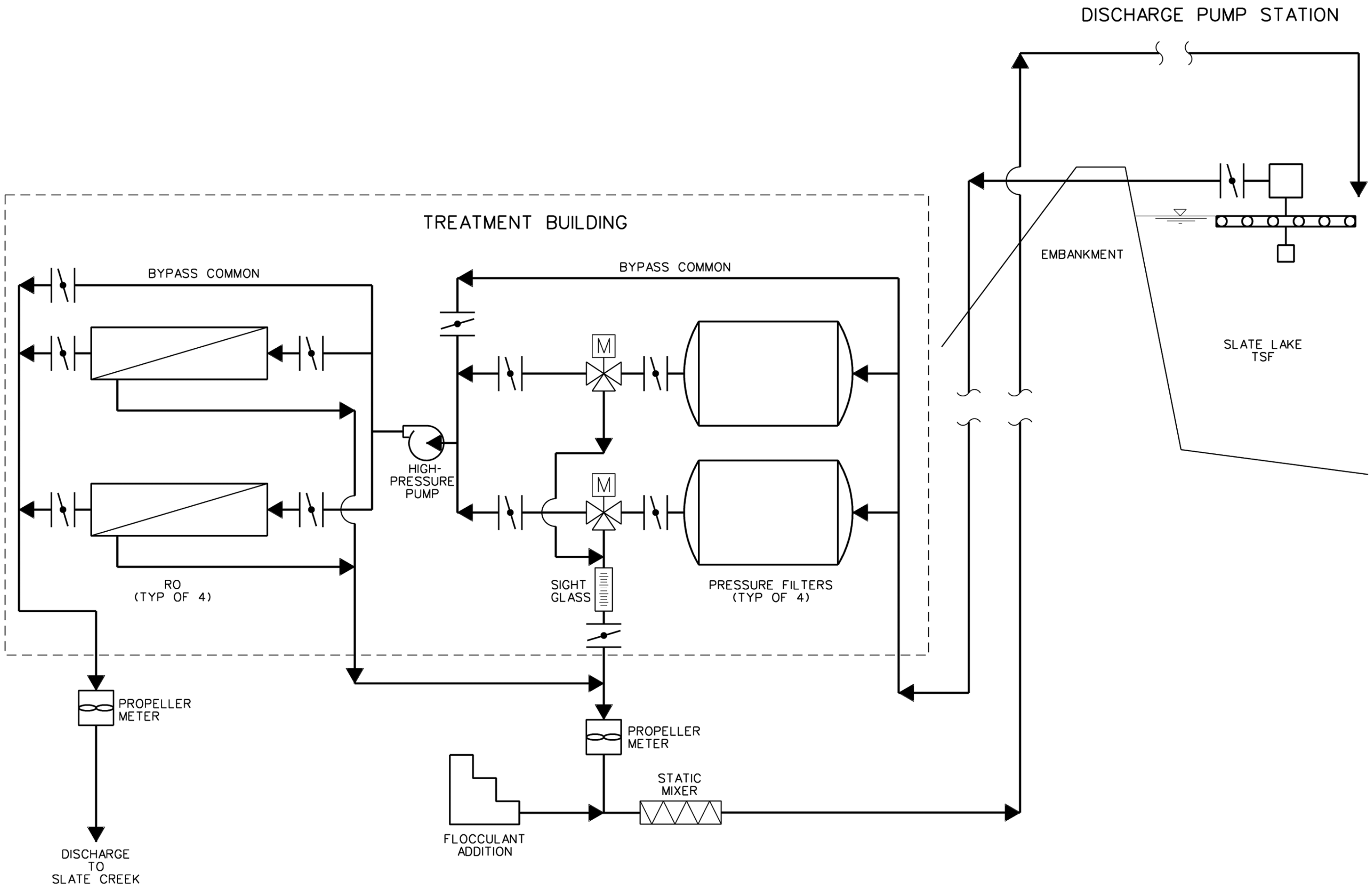


FIGURE 2-18. REVERSE OSMOSIS PROCESS DIAGRAM

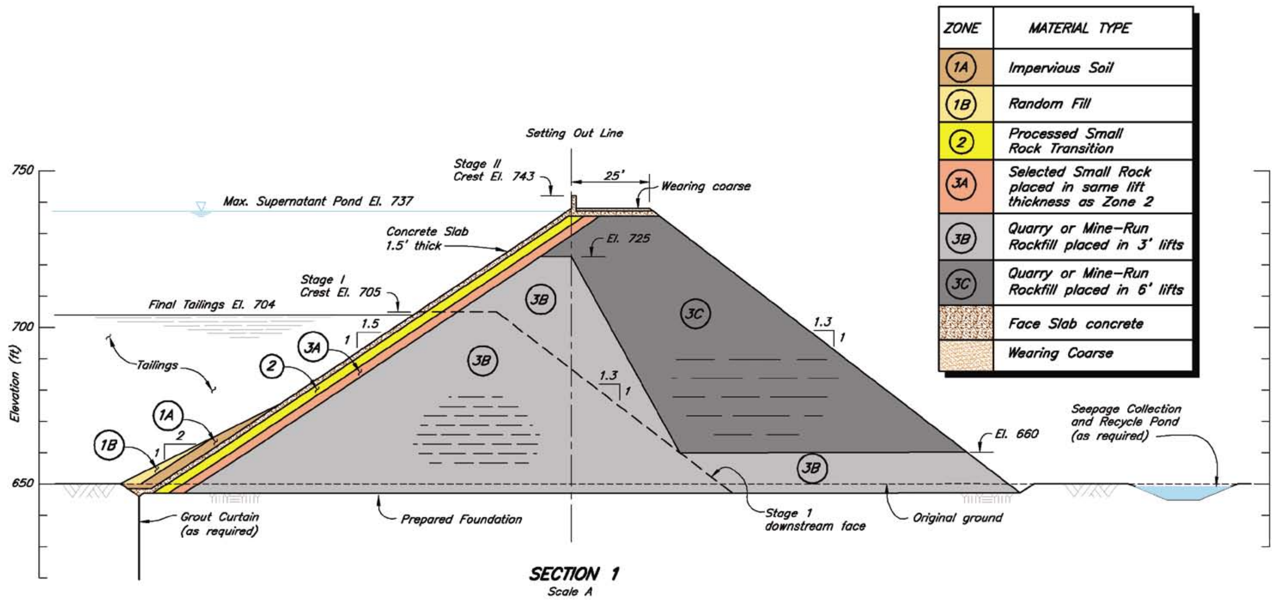


FIGURE 2-19. DETAIL OF TSF DAM

The first stage of the dam would be constructed from 55,000 cubic yards of quarry or mine-run fill placed in 3- to 6-foot lifts to an elevation of 705 feet. This stage of the dam would be 55 feet above the existing outlet of Lower Slate Lake, which is at an elevation of approximately 650 feet. Operations would begin with this initial phase. The second stage of the rockfill zone of the dam would consist of approximately 90,000 cubic yards of rock from one of the borrow areas or possibly waste rock. This stage would be constructed to an elevation of 743 feet. The final 5 feet of elevation would come from a reinforced concrete parapet wall. The dam's upstream face would be built with a slope of 1.5 horizontal to 1 vertical (1.5H:1V). This face would be covered with an 18-inch-thick layer of reinforced concrete. The downstream face would be constructed with a slope of 1.3H:1V, using coarser material than the upstream face placed in 6-foot lifts. During construction of the embankment, downstream flows in East Fork Slate Creek would be maintained using a temporary diversion such as one or more pipes. The Alaska Department of Natural Resources (ADNR) would review and approve the details of the dam design.

2.3.7 Mine Water Management

Under all alternatives, mine water would be collected and settled underground. The water would then drain via pipeline to the water treatment facility, where it would undergo precipitation and filtration as required to meet permit limits. Under Alternatives A and A1, the treated water would flow from the Kensington portal to a series of settling ponds. There it would be combined with runoff from the Kensington mill site, temporary waste rock pile, north sand and gravel borrow area, till borrow access road, and personnel camp. This combined water would be discharged from the ponds to Sherman Creek. Under Alternatives B, C, and D, mine water would drain to the treatment ponds in the same location as under Alternatives A and A1 and would be combined with runoff from the waste rock disposal area. The discharge from the settling ponds would also be to Sherman Creek.

In the 1997 SEIS, Alternative D (now Alternative A) provided for sulfide precipitation treatment in the settling ponds to ensure compliance with permit limits for metals. This system was used for several years after permit issuance but was discontinued after long-term monitoring showed that the limits could be met without treatment other than settling. Under all alternatives, the operator is required to maintain sufficient capacity to provide sulfide precipitation of all mine water prior to discharge. Mine water quality might vary as the mine is fully developed.

2.3.8 Diversions and Stormwater

Under all the alternatives, diversions would be placed upstream of the process areas to keep runoff from undisturbed areas from flowing into the mining facilities. Under Alternatives A and A1, diversions would be located around the process area and the DTF. Process area diversions would route runoff from an area totaling 46 acres—including the mill site, temporary waste rock storage area, northern sand and gravel borrow area, till borrow access road, and personnel camp—into a settling pond. The pond would be designed to detain stormwater and allow settling of sediment for storms up to the 100-year, 24-hour event. Synthetic polymers would be added upstream of the pond as necessary to enhance settling. A variety of polymers could be used, but all would be used in quantities nontoxic to aquatic life. As previously discussed, mine water would be pumped to this pond prior to discharging to Sherman Creek. Ophir Creek would also need to be diverted in the vicinity of the process area for the life of the operation.

Diversions constructed around the DTF under Alternative A would total approximately 8,500 feet. The diversions under Alternative A1 would be proportionally smaller. DTF runoff would be routed to settling ponds, where it would be combined with collected drainage from the DTF underdrain and coarse till cover material. The ponds would be designed to detain stormwater and allow settling of sediment for storms up to the 100-year, 24-hour event, and polymers would be added to enhance settling. The pond would discharge to Camp Creek. All diversion channels would be lined with riprap or constructed in blasted bedrock. Runoff from roads would be managed using best management practices (BMPs) and discharged to wetland areas at National Pollutant Discharge Elimination System (NPDES)-permitted stormwater outfalls.

Diversions under Alternative B would be constructed above the Kensington 850-foot portal and waste rock disposal area. These diversions would be sized to handle the 100-year, 24-hour event and discharge to adjacent undisturbed areas. A 0.5-mile diversion would also be constructed above the Jualin process area and mine portal (in bedrock or as a riprap channel). This channel would also be designed to handle the 100-year, 24-hour event and would direct flow into Johnson Creek below the process area. Runoff from roads would be managed using BMPs and discharged to adjacent undisturbed areas. The stormwater discharge points would be covered under an NPDES permit. Under Alternative B, diversions would not be constructed around the TSF.

Alternative C would involve diversions constructed around most of the TSF, as well as the diversions described under Alternative B. The TSF diversions would be built to minimize contact between the tailings and fresh water and to enhance conditions for settling within the facility. The diversions would direct surface water flows around the TSF and would require the damming of Upper Slate Lake to provide sufficient elevation for the diversions to flow by gravity around the TSF (Figure 2-9). The west diversion segment would be approximately 2,550 feet long, and it would route overland flow from undisturbed areas above the northern end of the TSF into Upper Slate Lake. Upper Slate Lake would then discharge out the eastern diversion channel. This channel would carry outflow from Upper Slate Lake and intercept overland flows from undisturbed areas above the eastern side of the TSF. The diversion would also capture flows from drains under the tailings pipeline access road. The eastern diversion would also be approximately 2,550 feet long. Details on the width and depth of the channels are presented in Figures 2-20 and 2-21. The diversion would discharge near the face of the dam via a

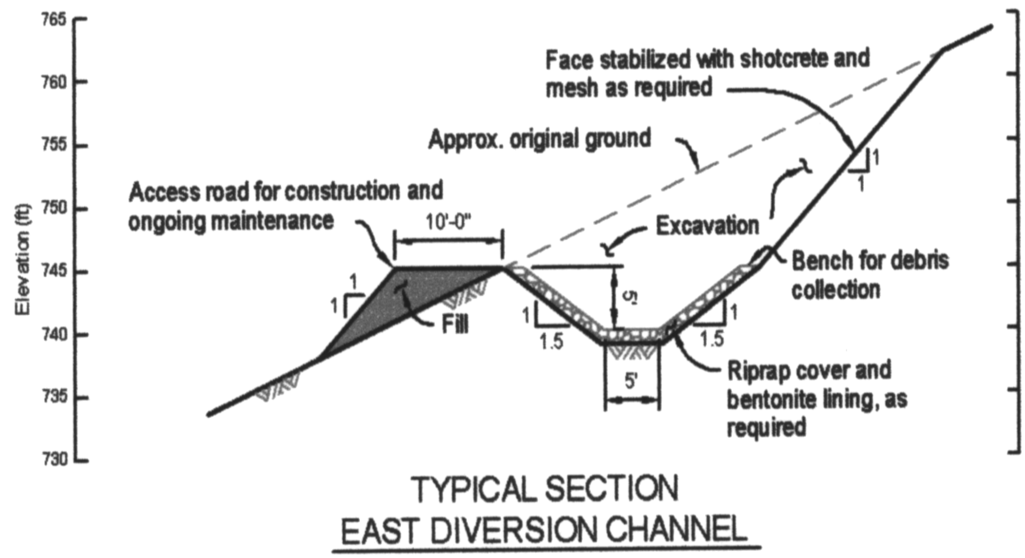


FIGURE 2-20. EAST DIVERSION CHANNEL (ALTERNATIVE C)

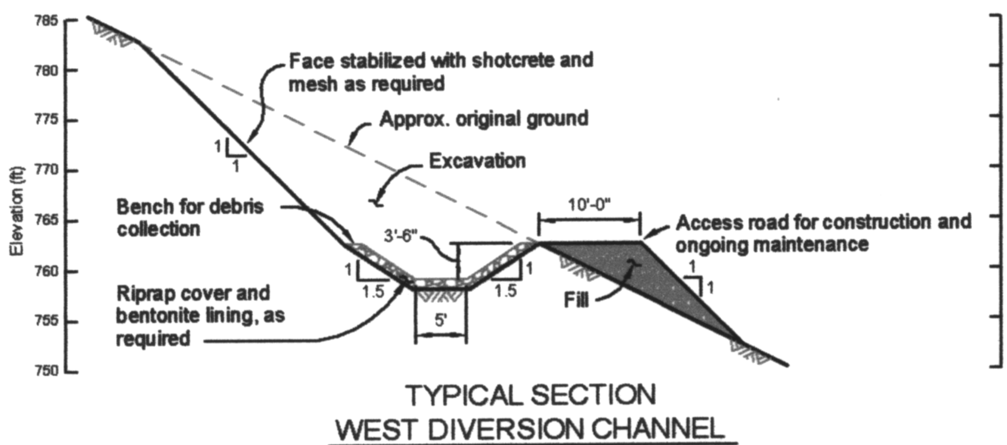


FIGURE 2-21. WEST DIVERSION CHANNEL (ALTERNATIVE C)

concrete spillway. The bottom of the diversion channels would be approximately 5 feet wide, although the cut-and-fill slopes would result in a disturbance nearly 60 feet wide. The dam on Upper Slate Lake would need to be approximately 20 feet high and would result in expansion of the surface area of the lake from approximately 12 acres to more than 23 acres. At the completion of mining activities, the diversions and dam in Upper Slate Lake would be removed and the disturbances reclaimed. The size of the lake would return to 12 acres.

Under Alternative D, the coffer dam shown in Figure 2-22 would be constructed in Mid-Lake East Fork Slate Creek. Up to 3,800 gpm of water would gravity feed to a 20-inch-diameter HPDE pipeline that would extend approximate 3,500 feet to a spillway below the TSF dam (Figure 2-12). The dam would not affect Upper Slate Lake. Any flows above 3,800 gpm would flow over the dam and into the TSF.

2.3.9 Sanitary Wastewater

The operator maintains a permitted sanitary wastewater treatment plant near the camp facilities at Comet Beach. Although the camp is using a septic system to dispose of domestic wastewater, the operator has received approval to upgrade the wastewater treatment facility. The Comet Beach wastewater treatment facility would be used during construction under Alternatives B, C, and D. Under Alternatives A and A1, a leach field would be constructed in the vicinity of the personnel camp near the Kensington process area to handle domestic wastewater. Under Alternatives B, C, and D, sewage would be collected from the process area complex and disposed of in a central septic system that discharges to a leach field near the borrow area and the topsoil stockpile at the southern end of the process area.

2.3.10 Water Supply

Operations would require fresh water (makeup water) for the milling process, domestic uses, and power supply/mining operations. Under all alternatives, water supply demands for the project would average 234 gpm, which is equivalent to 0.52 cubic foot per second (cfs). Specific requirements would be 84 gpm (0.19 cfs) for the milling circuit, 50 gpm (0.11 cfs) for domestic use, and 100 gpm (0.22 cfs) for power supply/mining operations. Under Alternatives A and A1, an infiltration gallery would be constructed in Upper Sherman Creek to collect water, which would be pumped to a 300,000-gallon storage tank. The operator has received a permit from ADNR granting the right to remove up to 0.7 cfs from Sherman Creek. Under Alternatives B, C, and D, an infiltration gallery would be constructed in Johnson Creek near the Jualin area. Water would be pumped from the infiltration gallery to a 300,000-gallon tank at the process area. Alternatives B and D include a pipeline that would recycle water from the TSF. The recycling loop would supply approximately 100 gpm (0.22 cfs) back to the mill, reducing the demand for water withdrawal during operations. Therefore, during operations under Alternatives B and D, approximately 0.3 cfs would be withdrawn from Johnson Creek; under Alternative C, 0.52 cfs would be withdrawn. The operator has applied for a 0.68-cfs water right in Johnson Creek.

2.3.11 Employee Housing and Transportation

Alternatives A and A1 would involve constructing a 250-person camp early in the project construction process. The camp would occupy approximately 5 acres immediately west of the process area. Once the camp was completed, construction workers would be housed on-site. Workers would be transported to the site by a 15- to 20-passenger helicopter for weekly rotations. The helipad would be located in the marine terminal area shown in Figure 2-2. Workers would be transported to the site by helicopter from the Juneau Airport. Approximately 12 helicopter round trips per week would be required to change shifts (3 trips daily Monday and Friday; 2 trips daily Tuesday through Thursday). Once the mine became operational, approximately 200 workers would be housed on-site for 7-day rotations, with two mill shifts and three mine shifts per day. The personnel camp would be west of and adjacent to the process area.

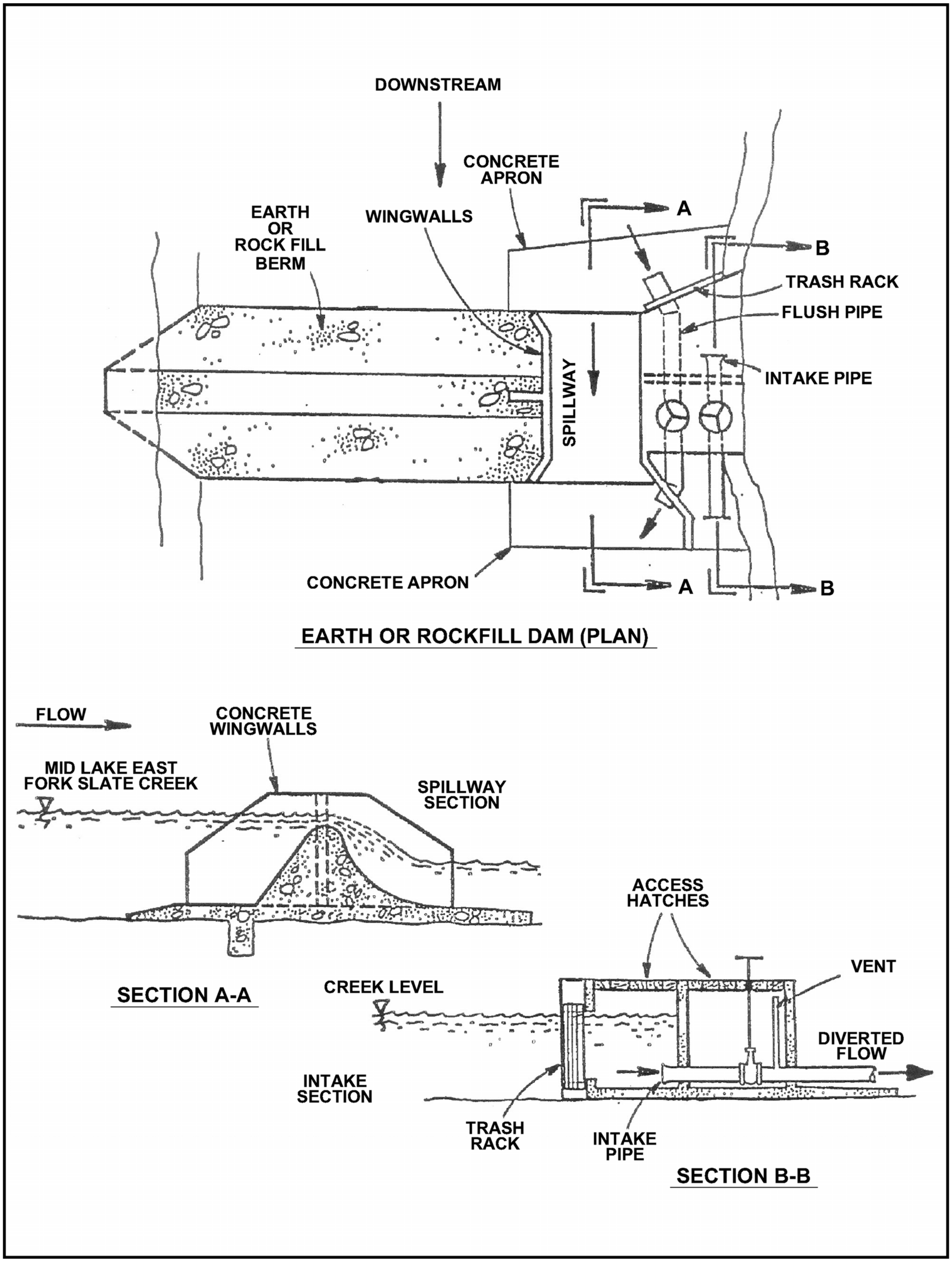


FIGURE 2-22. ALTERNATIVE D, MID-LAKE EAST SLATE CREEK COFFER DAM

Under Alternatives B, C, and D, some interim on-site housing would be provided during the construction phase, primarily for workers driving the tunnel between Kensington and Jualin and completing mine development work. Up to 160 of these workers (80 at a time) would be housed at the camp at Comet Beach. These workers would be shuttled by helicopter at a rate of 12 to 14 trips per month. The helicopter landing pad would be on private land in the vicinity of the process area. Temporary workers building the marine terminal at Slate Creek Cove would likely be housed in a self-contained work camp on a barge during the brief construction period. Once the Slate Creek Cove facility was built, up to an additional 325 workers would shuttle back and forth daily to the site by boat for construction of the TSF and process area. After operations began, there would be no employee housing on-site.

Operations under Alternatives B, C, and D would include transporting employees to the site in a crew shuttle boat that would run five round trips daily between Slate Creek Cove and Cascade Point on weekdays and three round trips on weekends. During the eulachon spawning period each spring, the operator would reduce shuttle traffic to no more than two to three trips per day as well as minimize barge traffic at Slate Creek Cove. Under Alternative C, the same crew shuttle boat would be used to transport workers, but the dock would be located within Echo Cove, approximately 0.75 mile north of the existing boat ramp. The number of trips would be the same as that under Alternatives B and D, but some flexibility in the schedules would be needed to allow for low tides when shuttle boat operations could be precluded. As required by the City and Borough of Juneau's (CBJ) Allowable Use Permit, the operator must provide bus transportation for employees from an as-yet-undesignated location in the Mendenhall Valley to Cascade Point. This permit further requires the operator to establish a corporate policy requiring employees to use only bus transportation.

2.3.12 *Power Supply*

Under Alternatives A and A1, the operator would employ four 3.33-megawatt (MW) diesel generators to provide power to the process area. A 275-kilowatt (kW) "containerized" unit would be located near Comet Beach. Underground lines would be used to supply power from the process area to the DTF to drive the plate filters used to dewater the tailings.

Alternatives B, C, and D would operate three 3.33-MW diesel generators in the Jualin process area. A power line would be constructed along the tailings pipeline route to the TSF, and it would provide power to the discharge pumps and the reverse osmosis system under Alternative D. The reverse osmosis system would require about 180 kW of additional power on an annual basis compared to Alternative B. A 275-kW generator would be located at the Slate Creek Cove marine terminal. An additional 275-kW generator would be located at the TSF as a backup power supply.

A selective catalytic reduction system or similar best available technology would be included in the design for the diesel generators, as required by the Alaska Department of Environmental Conservation (ADEC) air quality permit. The power supplies would be operated and emission sources controlled according to ADEC's air quality permit requirements.

2.3.13 *Fuel Use and Storage*

Under all alternatives, diesel, aviation fuel, and gasoline would be stored on-site within secondary containment. The secondary containment would consist of concrete-lined, bermed areas or double-walled tanks. Diesel would be used as fuel for the vehicles, mobile equipment, and generators. Aviation fuel for helicopters would be available in small quantities. Gasoline would be limited to use in small-engine equipment such as chainsaws. All alternatives would be subject to a Spill Prevention, Control and Countermeasures (SPCC) plan prepared for the specific operation.

Alternative A would require an estimated 6.5 million gallons of diesel fuel annually. One 300,000-gallon tank would be located at Comet Beach and a second in the laydown area. Two additional 300,000-gallon tanks would be located near the generators in the process area. Two 20,000-gallon tanks would be located near the Kensington portal. A 5,000-gallon fuel truck would transport fuel from the laydown area to the process area. The tank in the laydown area would be filled through a pipeline from the tank at Comet Beach. A 5,000-gallon tank of aviation fuel for helicopter use would be located at Comet Beach within the secondary containment provided for the 300,000-gallon tank. Barges would deliver diesel fuel to the site. Transfers would be conducted using a shore-based platform raft that would include spill control materials and secondary containment. Hoses would connect the barge to the raft and then to the 300,000-gallon tank at Comet Beach. Alternative A1 would use proportionally less fuel than Alternative A although storage requirements would remain the same.

Alternatives B and C would require approximately 3.0 million gallons of diesel fuel annually. Alternative D would require an additional 200,000 gallons of diesel annually to produce the additional power associated with the reverse osmosis treatment system required for the TSF effluent.

Under Alternatives B, C, and D, diesel fuel would be delivered to the site in 6,500-gallon isotainers, off-loaded from the barge, and initially stored in the laydown area near the Slate Creek Cove marine terminal. The isotainers would be moved by truck to the power plant and fueling areas where they would be connected to pipe headers, such that they would function as storage tanks. Consequently, there would be no diesel fuel tanks. All isotainers would be stored in HDPE-lined and bermed storage areas at the Slate Creek Cove laydown area, the power plant, and the mine portal on the Jualin side. The Slate Creek Cove laydown area would have the capacity to store up to 16 isotainers; at the power plant near the process area, up to 4 isotainers could be stored and used at any time; and at the mine portal, 2 isotainers could be stored and used at any time. All fuel transfers would take place within lined, bermed areas. Aviation fuel would also be delivered to the site in 6,500-gallon isotainers. Approximately 6,500 gallons of aviation fuel would be stored on-site at any time. Gasoline would be brought to the site in 55-gallon drums or isotainers.

The crew shuttle boat would be fueled at Cascade Point under Alternatives B and D and at Echo Cove under Alternative C. A fuel truck would meet the crew shuttle approximately once a week and be parked within a contained area during the fueling operation. Under Alternatives B and D, CBJ's Allowable Use Permit would place restrictions on fueling, including surrounding the crew shuttle with a boom during fueling operations between April 15 and June 15 each year. An additional stipulation would require fueling to take place at a U.S. Coast Guard-approved facility outside Berners Bay between April 15 and May 15 each year when herring are observed within 250 meters of the marine terminal. The BMPs described in Appendix E would be employed to reduce the likelihood of spills or leaks associated with fueling.

2.3.14 Handling and Storage of Hazardous Materials and Chemicals

The operator would purchase chemicals and reagents from vendors in the lower 48 states and Alaska. Table 2-4 presents a list of chemicals and reagents required for milling and processing. Materials would be shipped by rail to Seattle, Washington, where they would be consolidated and shipped by barge to the project site. Shipping would be done in accordance with U.S. Department of Transportation shipping regulations. Under Alternatives A and A1, material handling would occur at Comet Beach on the Kensington side of the site. Material handling under Alternatives B, C, and D would occur on the Jualin side of the site at Slate Creek Cove. Personnel handling these materials would be trained and certified. Personnel transporting the materials would be trained in emergency procedures and would carry emergency response plans during transport.

2.3.15 Nonprocess Waste Disposal

Nonprocess waste disposal would be similar for all the alternatives. The only difference would be the placement of the receptacles and the location of the incinerator (Alternatives A and A1, Kensington side; Alternatives B, C, and D, Jualin side). Bear-proof dumpsters would be placed at centralized locations throughout the site, including the marine terminal and process area. The dumpsters would be constructed with two bins, one for combustible waste and the other for noncombustible waste. Combustible waste would be collected daily and disposed of in a fenced, bear-proof incinerator. Ash from the incinerator would be placed underground in dry portions of the mine. Noncombustible waste would be disposed of on private land in a manner consistent with ADEC requirements. Used oil would be collected and burned to provide heat in approved used oil heaters or removed from the site by an approved used oil contractor. Construction and demolition waste would be salvaged as appropriate, and some would be managed in privately owned portions of the mine workings in accordance with ADEC's solid waste management requirements.

2.3.16 Borrow Areas

Alternative A would require three sand and gravel borrow areas (16.5 acres) and a till borrow area (38.2 acres). Under Alternative A1, the sand and gravel borrow areas would be the same size while the till borrow area would be reduced to 20.1 acres. All of these areas would be on the Kensington side of the project area. Alternatives B, C, and D would require two new sand and gravel borrow areas, as well as the expansion of two existing borrow areas, which would disturb a total of approximately 7.1 acres. In each case, the material would be used for general fill, facility foundations, and other construction needs, including the DTF (Alternatives A and A1) and TSF embankment (Alternatives B, C, and D). The borrow areas would be developed as open pits and configured based on the type and quantity of material required. Under any of the alternatives, the borrow areas would be reclaimed at the end of mining operations. Reclamation would include grading the areas to blend with existing topography and, where practical, encouraging the development of wetland habitat.

2.3.17 Roads and Bridges

Roads are currently present from Comet Beach to the Kensington 850-foot portal and from Slate Creek Cove to the historic Jualin Mine site. Under Alternatives A and A1, the 2-mile road to the Kensington 850-foot portal would be upgraded to handle the increase in truck traffic moving fuel and supplies from Comet Beach to the process area and moving concentrate from the process area to Comet Beach. Haul trucks would be used to move waste rock and material from the borrow areas to the DTF. Two new bridges would be constructed, one over Ivanhoe Creek and one over Sherman Creek west of the process area. Two existing bridges, one over South Fork Sherman Creek and one over Sherman Creek south of the process area, would be upgraded. A culvert would be used to cross an unnamed, intermittent tributary to Sherman Creek about halfway between Comet Beach and the process area.

Under Alternatives B, C, and D, the 5-mile access road between Slate Creek Cove and the process area at Jualin would also be upgraded. The upgrade would consist of improving the surface of the road, reducing the grade in some segments, and adding turnouts every 1,500 feet. Two existing bridges crossing Johnson Creek would also be upgraded. The bridge upgrades would be completed during periods of low flow to minimize the extent of construction activities within the creek. Construction would meet requirements outlined in a memorandum of understanding between the Forest Service and ADNR regarding activities in fish streams. A 3.5-mile pipeline access road between the process area and the TSF would be built, as would a 1-mile-long cutoff road between the pipeline access road and the main access road. The pipeline access road would be reinforced with a structural berm at the Snowslide Gulch crossing. Construction and upgrading of the roads and bridges under all alternatives, as well as the borrow sites on National Forest System lands, would be subject to Forest Service standards and guidelines.

The existing Jualin access road is subject to Revised Statute (RS) 2477, which means that it is a public right-of-way managed by ADNR with input from the landowners. ADNR would need to authorize any improvements to this road and might, for public safety, need to control public access during the life of mining.

2.3.18 Marine Terminals

Each alternative includes at least one marine terminal to access the site. Alternatives A and A1 would involve construction of a marine terminal at Comet Beach. Alternatives B, C, and D would require marine terminals at Slate Creek Cove and either Cascade Point or Echo Cove. The marine terminals in all cases would be built within state tidelands and require a tidelands lease from ADNR. The lands above the mean high tide line at Slate Creek Cove are National Forest System lands. The lands above the mean high tide line at Comet Beach, Cascade Point, and Echo Cove are all private property. The following subsections provide greater detail on each of the proposed facilities.

Comet Beach

The Comet Beach marine terminal would be exposed to the rough weather and high tides in Lynn Canal. A breakwater would not be feasible, and therefore deliveries of fuel and supplies would be limited to times when seas were less than 3 feet high. The facility would consist of a ramp constructed of precast concrete along a slope of approximately 10 percent (Figure 2-3). Barges would be accessed via a ramp and materials unloaded by forklift. Mooring dolphins would be used to stabilize barges during unloading. The 2.1-acre mooring area would require the removal of 75,000 cubic yards of material in dredging to a depth of 10 feet below mean lower low water (MLLW).

Slate Creek Cove

The Slate Creek Cove marine terminal used under Alternative B, C, or D would consist of a ramp, a fixed dock (platform), a movable ramp, and a floating dock. No dredging would be required. Barges would be attached to pile-anchored mooring dolphins during the transfer of materials. Loading and unloading would be done using a roll-on/roll-off forklift transfer system. The floating dock would be used to allow personnel to move between the shuttle boat and the shore. Under Alternatives B and D, a landing craft ramp would be included in the design of the facility (Figure 2-7). The landing craft ramp and corresponding fill material would be eliminated under Alternative C (Figure 2-10). Under Alternatives B and D, approximately 29,000 cubic yards of fill material covering 3.6 acres would be placed in intertidal and subtidal habitats. Elimination of the landing craft ramp under Alternative C would eliminate approximately 10,000 cubic yards of fill in the intertidal zone. The landing craft ramp would not be the main method for offloading barges, but it would provide additional flexibility in loading and unloading operations. To access the barge, the movable ramp would be lowered from the fixed platform onto the deck of the barge.

Cascade Point

Under Alternatives B and D, the marine terminal at Cascade Point would be constructed on state tidelands (Figure 2-8). Goldbelt, Inc., owns the surrounding uplands and would ultimately be responsible for the development associated with the facility. The dock would include a rock-filled breakwater and a dredged area containing a floating dock. A parking area and turnaround would be built in uplands on Goldbelt's property.

The marine terminal would consist of a breakwater, pedestrian access dock, aluminum gangway, and removable float. The breakwater would affect approximately 1.3 acres of beach and intertidal habitat and require approximately 33,000 cubic yards of fill. The dredged area would encompass an additional 1.4 acres of disturbance. Dredging would remove material to 10 feet below MLLW. Ten galvanized steel pilings placed below the MLLW level would support the float portion of the facility. The float would be constructed of timbers over a galvanized steel pipe float frame.

In 1999 the U.S. Army Corps of Engineers (USACE) denied a Clean Water Act (CWA) Section 404 permit application submitted by Goldbelt for a marine terminal at the same location as that proposed for the Kensington Gold Project's marine terminal. The facility has undergone design changes since the USACE's permit denial, specifically to address some of the issues identified in the environmental review process. These changes include creating a breach at the high tide line by removing the fill along the upper beach area. This modification would allow flushing flows to move around the facility during periods of high tides, facilitating passage for juvenile salmon and reducing the possibility of predation. The breakwater also includes a dogleg that curves to the east to avoid placing fill on top of kelp, which herring use for spawning. The USACE is considering the revised 404 permit application for Cascade Point at the same time it is considering the application for the revised Kensington Gold Project.

Echo Cove

The dock at Echo Cove under Alternative C would be of simple design, consisting of a pile-supported deck and float (Figure 2-11). Crew shuttle operations from Echo Cove would require dredging of the entrance of the cove from its current depth of approximately 6.5 feet below MLLW to a depth of 16 feet below MLLW to ensure crew shuttle access. Dredging would require the removal of approximately 150,000 cubic yards of material from the sand spit toward the north end of the cove. Occasional maintenance dredging would also be required. Navigation lights would need to be placed along both sides of the cove to address safety issues related to the operation. Construction of the dock itself would not require any dredging or fill.

2.3.19 Reclamation and Closure

Because an approved Plan of Operations exists, reclamation objectives and activities would be consistent with that plan under Alternative A or A1. If Alternative B, C, or D was selected, the reclamation plan would be revised to encompass the activities described in the Final Plan of Operations. The operator has submitted conceptual plans for reclamation and restoration of the TSF as part of the supporting documents describing the Proposed Action (see Appendix D). This section discusses the existing reclamation plan, how that plan would be applied to facilities on the Jualin side of the project area, and the reclamation and restoration concepts proposed for the TSF following operations.

Reclamation applies not only to the activities that would be undertaken following the completion of mining activities but also to the measures undertaken on an interim basis. Interim reclamation would be done to reduce the potential for erosion by stabilizing road cuts and stockpiles and other disturbances that result from exploration, construction, and operational activities. Interim reclamation measures could include seeding, fertilizing, and mulching in accordance with the Forest Service BMPs included in the *Soil and Water Conservation Handbook* (Forest Service, 1996b).

The first step in final reclamation would involve the removal and storage of growth media from all areas to be disturbed. (The reclamation plan refers to growth media interchangeably with topsoil in describing substrate that supports plant growth.) Stockpiled growth media would be seeded to reduce the potential for erosion during storage.

Under all alternatives, final reclamation would begin at the final stages of mining operations. Facilities not necessary for the reclamation process, including storage tanks and buildings, would be decommissioned and either salvaged or demolished. These materials would be removed from the site. After facilities were removed, concrete pads would be broken into pieces and covered with fill material. Compacted areas (excluding the buried concrete pads) would be ripped, and all areas would be graded to blend with the surrounding natural topography. Roads would remain in place as long as required to conduct monitoring activities. Closure and reclamation of all roads on the Kensington side and the tailings pipeline access road (Alternatives B, C, and D) would include removing culverts, ripping the road surface, and contouring the cut-and-fill slopes to blend with the surrounding terrain. Stream crossings would be returned to their original condition, and bridges and culverts would be removed if they were determined not to be necessary for post-closure access. The access road from Slate Creek Cove to the Jualin Mine site could remain in place under RS 2477. The road would be maintained through an agreement between the state and the landowners. All piers, decking, and pilings would be removed from the Slate Creek Cove marine terminal. The fill would be removed and placed in a borrow area at the end of mining operations unless the landowners and ADNR agreed otherwise later in the life of the facility, as described in the tidelands permit. If the facility was to be removed and regraded, the regrading would focus on upland areas, although, if necessary, the operator could apply for a Section 404 permit (with subsequent NEPA action) if any of the regrading activity needed to be conducted below the ordinary high water mark. Such an action would not require action by the Forest Service because it would occur on state tidelands. The Cascade Point or Echo Cove marine terminal could also remain in place.

Later stages of final reclamation would include the removal of stormwater diversions and sedimentation ponds, followed by regrading and revegetation. The final stages of reclamation would include removal of the remaining structures and sealing of the mine portals. Growth media would be spread over regraded areas to a minimum depth of 1 foot followed by seeding. The depth of growth media, plant species, and seed mixtures, as well as the use of fertilizer and amendments (e.g., lime or gypsum), would be determined through the use of test plots developed during the life of the operation. Mulch and other BMPs would be used to minimize erosion until vegetation became established. A monitoring program would be established to track reclamation success.

Under Alternatives A and A1, the Ophir Creek diversion would be removed, allowing the creek to return to its original channel. The diversion channels around the DTF would remain in place and be redesigned to carry a 500-year, 24-hour storm event. Reclamation of the DTF would be conducted as the cells were developed, reducing the extent of disturbance over the life of the project. The process area ponds and the DTF settling ponds would be blended with existing topography and left as ponds. The borrow areas would be graded so that water flowed through them, although the grading would be such that the development of wetland vegetation would be encouraged. The DTF would be reclaimed as an upland.

Under Alternatives B, C, and D, the tailings pipeline access road would be reclaimed as described above. The cutoff road would remain as long as necessary for maintenance and monitoring at the TSF. If the state and the landowners determined that the Jualin access road should be removed, the reclamation measures described above would be employed.

The surface area of Lower Slate Lake remaining at the end of tailings disposal operations would be over twice the size of the original surface area (56 acres versus 20 acres). The maximum depth of tailings would be approximately 120 feet from the original bottom of Lower Slate Lake. As currently planned, the surface of the tailings would be level to the extent practicable. The tailings might not provide suitable habitat for some aquatic macroinvertebrate species (see Section 4 and Appendix C). As discussed in Section 2.3.5, the tailings would be deposited to an elevation of 704 feet with a water cover of at least 9 feet. At closure, the lake level would be raised to an elevation at which the TSF would create or inundate at least the same acreage of natural sediment in shallow areas that support plant life and macroinvertebrates (Figures 2-16 and 2-17) as was present in Lower Slate Lake before mining. Organic material could also be added to certain areas to encourage the establishment of wetland vegetation.

Under Alternative D, the reverse osmosis treatment system and diversion pipeline would continue to be operated until the operator demonstrated that downsteam water quality can be protected without the need for treatment. Once this was demonstrated to USEPA, ADEC, and the Forest Service, the treatment system and pipeline would be removed. Under Alternative D, the operator would also be required to construct a cover over the tailings unless it could demonstrate to the Forest Service, ADNR, USACE, and USEPA, through operational monitoring, that the tailings are not toxic. To address toxicity, a cover of approximately 4 inches of native soil would be required.

Under Alternatives B, C, and D, the time required to implement the reclamation plan for the TSF, including establishing the final lake level, would vary depending on upstream flows and precipitation. The operator would be required to continue to comply with minimum instream flows established by ADNR throughout the reclamation period.

The TSF reclamation would focus on restoring resident fish populations and would include a large littoral zone, as well as areas deep enough for overwintering. The discharge from the reclaimed lake would occur through a spillway constructed in bedrock. The spillway would be designed to handle runoff conditions and storm events as required by the State Dam Safety Engineer. A reconstructed channel from the spillway would be designed so that fish would be able to safely move down the system and into East Fork Slate Creek. The project operator would be required to establish a funding mechanism to ensure the stability of the dam in perpetuity. The details of the funding and long-term plan would be established with the permit from the state. A separate financial assurance would also be established to ensure that the other aspects of the reclamation program were carried out to completion.

2.3.20 Summary

Table 2-5 provides a summary of the project components of each alternative. These components were discussed in detail in the previous sections.

Table 2-5
Comparison of Alternatives by Project Component

Component	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Project location and duration	Sherman Creek drainage basin. Projected 12 years of operation following 2-year construction period.	Same as Alternative A except 10 years of operation.	Facilities located in Sherman Creek, Johnson Creek, and Slate Creek drainage basins. Projected 10 years of operation following 18 months of construction.	Same as Alternative B.	Same as Alternative B.
Mining methods	Long-hole, open-stope mining.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Waste rock disposal	Temporary storage only; waste rock used in DTF construction.	Same as Alternative A.	31-acre disposal facility near Kensington 850-foot portal. A small (5-acre) site near the Jualin process area could also hold up to 1.8 million tons.	Same as Alternative B.	Same as Alternative B.
Ore processing	4,000 tons per day from Kensington deposit.	2,000 tons per day from Kensington deposit, representing a smaller volume of high-value ore compared with Alternative A.	Same as Alternative A1.	Same as Alternative A1.	Same as Alternative A1.
Tailings disposal	DTF sized to hold up to 20 million tons of tailings; 25 percent of tailings backfilled.	DTF sized to hold 4.5 million tons of tailings; 40 percent of tailings backfilled.	TSF in Lower Slate Lake sized to hold 4.5 million tons of tailings; 40 percent of tailings backfilled. Lower Slate Lake increased from 20 acres to 56 acres.	Same as Alternative B.	Same as Alternative B except reverse osmosis treatment of TSF effluent prior to discharge. Tailings cover required at closure unless no toxicity is shown.
Mine water management	Mine drainage treated in settling ponds near Kensington 850-foot portal. Enhanced settling in ponds; precipitation/filtration of mine drainage. Effluent discharged to Sherman Creek (outfall 001).	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

Table 2-5
Comparison of Alternatives by Project Component (continued)

Component	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Sanitary waste	Existing wastewater treatment plant at Comet Beach upgraded to handle construction activities. Leach field built near process area (Kensington) would be used during operations.	Same as Alternative A.	Wastewater treatment plant at Comet Beach would be used during construction. Leach field built near process area (Jualin) would be used during operations.	Same as Alternative B.	Same as Alternative B.
Employee housing and transportation	On-site housing in personnel camp; workers transported by helicopter (12 round trips per week)	Same as Alternative A.	No on-site housing; daily crew shuttle service between Cascade Point and Slate Creek Cove (three round trips on weekends and five round trips on weekdays).	Same as Alternative B except daily crew shuttle service between Echo Cove and Slate Creek Cove.	Same as Alternative B.
Diversions and stormwater	Stormwater diversions upstream of the process area discharge to adjacent undisturbed areas. Stormwater diversions around DTF. Process area runoff combined with mine water and treated in settling ponds near process area; discharged to Sherman Creek. DTF runoff collected in settling pond near DTF with enhanced settling; discharged to Camp Creek. Ophir Creek diverted for 2,450 feet.	Same as Alternative A.	Stormwater diversion constructed above the process area diverting flows to Johnson Creek. Stormwater from facility collected in settling pond and pumped to mill circuit. Stormwater from roads managed with BMPs and discharged to undisturbed adjacent areas pursuant to NPDES permit.	Process area stormwater diversions same as Alternative B. Diversions constructed around the TSF to divert overland flow and Mid-Lake East Fork/Slate Creek. Diversions would require damming of Upper Slate Lake and raising water level 20 feet to allow gravity flow over TSF spillway. Upper Slate Lake increased from 12 to 23 acres during operations.	Process area stormwater diversions same as Alternative B. Dam constructed in Mid-lake East Fork Slate Creek to feed diversion pipeline around TSF.
Power supply	Four 3.3-MW diesel-powered generators plus one 275-kW generator.	Same as Alternative A.	Three 3.3-MW diesel-powered generators plus two smaller generators.	Same as Alternative B.	Same as Alternative B.
Fuel use and storage	Diesel stored in 300,000-gallon tanks.	Same as Alternative A.	Diesel delivered to the site and stored in 6,500-gallon isotainers. Power plant and fueling stations fed directly from isotainers. One 60,000-gallon tank at Comet Beach during construction.	Same as Alternative B.	Same as Alternative B.

Table 2-5
Comparison of Alternatives by Project Component (continued)

Component	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Handling, storage, and disposal of hazardous chemicals	Storage of reagents and solvents consistent with hazardous materials handling plan; disposal under small-quantity generator permit.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Nonprocess waste disposal	Nonprocess waste placed in bear-proof containers at marine terminal and process area. Combustible waste incinerated on-site; noncombustible waste disposed of per ADEC requirements. Used oil burned in approved heaters or taken off-site.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Borrow areas	Three sand and gravel borrow areas near the process area (total 16 acres); till borrow area (38.2 acres) northwest of rock quarry.	Same as Alternative A except till borrow area reduced to 20.1 acres.	Enlargement of two existing borrow areas and development of two new areas totaling approximately 7 acres.	Same as Alternative B.	Same as Alternative B.
Roads and bridges	Two-mile access road from Comet Beach to Kensington Mine upgraded, including two culverts over unnamed drainages, three bridges over Sherman Creek, and one bridge over Ivanhoe Creek.	Same as Alternative A.	Five-mile access road between Slate Creek Cove and Jualin Mine upgraded. Tailings pipeline access road (3.5 miles) constructed from process area to TSF. Bypass road between main access road and pipeline access road constructed (1 mile). Two existing bridges over Johnson Creek upgraded.	Same as Alternative B.	Same as Alternative B.
Marine terminals	Comet Beach.	Same as Alternative A.	Slate Creek Cove and use of a marine terminal built on state tidelands adjacent to private property at Cascade Point.	Slate Creek Cove with smaller footprint than under Alternative B. Dock facility without breakwater built on state tidelands adjacent to private property in Echo Cove.	Same as Alternative B.

Table 2-5
Comparison of Alternatives by Project Component (continued)

Component	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Reclamation and closure	All structures removed except diversions upgradient of DTF and settling ponds. Settling ponds retained as wetlands; surfaces regraded to blend with surrounding topography and revegetated; Ophir Creek restored to natural drainage. DTF covered with growth material on an ongoing basis and seeded.	Same as Alternative A.	Similar to Alternative A. All structures removed except TSF. Settling ponds retained as wetlands; surfaces regraded to blend with surrounding topography and revegetated. TSF reclaimed with wetlands in periphery; bathymetry modified to support a littoral zone with natural sediment covering the same area as before mining and adequate overwintering habitat to support a fishery the same size as that under the predisturbance condition.	Same as Alternative B.	Same as Alternative B except a tailing cover would be required unless the operator demonstrates that the tailings would not cause toxicity throughout Lower Slate Lake after closure.
Total acres of disturbance	268 acres.	187 acres.	195 acres.	215 acres.	197 acres.

2.4 PROJECT ALTERNATIVES AND COMPONENTS CONSIDERED BUT NOT STUDIED IN DETAIL

A number of project components were studied under the previous NEPA analyses and are not considered further in this document. The reader is referred to the 1992 FEIS and the 1997 SEIS for greater detail. These components include submarine tailings disposal, marine discharge of wastewater, wet tailings disposal in the Sherman Creek drainage, use of liquefied petroleum gas in the generators, and on-site cyanidation. Additional components and alternatives were also considered in association with the current Proposed Action and within the context of the significant issues. Those components and alternatives are described below.

2.4.1 Upper Slate Lake Disposal Alternative

The use of Upper Slate Lake as a disposal site, combined with withdrawing water from Upper Slate Lake rather than Johnson Creek, would isolate impacts in one portion of a single drainage and prevent the transfer of water from one drainage (Johnson Creek) to another (Slate Creek). The tailings dam in Upper Slate Lake would be approximately 1,600 feet long and 90 feet tall to contain the same volume of tailings as that proposed in Lower Slate Lake. This dam would be three times longer and present a greater liability over the long term than the dam described under the Proposed Action. The topography of the area where the dam would need to be constructed would also require some undesirable features in the dam design. Using the information available and the significant issues identified during scoping, it was determined that the Upper Slate Lake disposal option would not be carried forward for detailed review. After considering that recycling of process water is part of the Proposed Action and that ADNR would require that minimum instream flows be maintained in Johnson Creek, it was also determined that withdrawing water from Upper Slate Lake did not need to be included as a component considered in detail.

2.4.2 Other Tailings Disposal Options

The operator and the Forest Service evaluated the potential for other dry and wet tailings disposal options. As discussed in Section 1.1, a Sherman Creek tailings impoundment was considered in the 1992 FEIS and 1997 SEIS. This disposal option was rejected from further consideration in this SEIS because a geotechnically stable DTF was determined to best address the significant issues by limiting tailings disposal to the Kensington side of the project. On the Jualin side, other tailings disposal options included storing tailings in Spectacle Lake and in the Upper and Lower Johnson Creek drainages. Storing tailings in Spectacle Lake would cause the same types of water quality concerns as those associated with using Lower Slate Lake. In addition, Spectacle Lake has capacity for only about 2.5 million tons of tailings, necessitating another disposal site. In Upper Johnson Creek, the topography is very steep and the creek has higher peak stream flows than East Fork Slate Creek. As a result, any locations would require a much more extensive dam, more stream disturbance, and very large diversions. As discussed in Section 3.8, Upper Slate Creek and Upper Johnson Creek also support similar fish populations. In Lower Johnson Creek, a wet or dry tailings facility could be constructed but the potential sites near the mouth of the creek present major water management concerns (e.g., very high flows and large diversions). Any tailings disposal options in Lower Johnson Creek could also affect the anadromous species of concern found below the fish barrier. Furthermore, facilities would be visible from Berners Bay. In summary, none of the alternative sites would address the significant issues while meeting the purpose and need, and therefore these alternative locations were not considered further.

2.4.3 French Drain Diversion Component

The use of a French drain to maintain the flow of Mid-Lake East Fork Slate Creek below the impoundment was considered. The design would have directed the flow of the creek under the TSF through a pipe that would discharge from the base of the TSF dam. This possibility was dropped from further consideration because of the difficulties in maintaining such a system combined with the potential long-term effects that culverts through the dam could have on its structural integrity.

2.4.4 Use of Tailings in Juneau Access Road Construction

Several methods to reduce the volume of tailings stored in Lower Slate Lake were considered, including one incorporating tailings as fill material in appropriate areas (non-wetlands) during construction of the Juneau Access Road. This option was dismissed because of the complexity of coordinating the timing of the mine operating life and the time frame for environmental review, design, and construction of the Juneau Access Road. Furthermore, the grain size of the tailings (fine sand) would make them unsuitable for fill material without expensive additives such as cement. There is a possibility that the waste rock could be used in highway construction.

2.4.5 Helicopter Access During Eulachon and Herring Run

The pre-spawning activity of eulachon in the spring brings Steller sea lions, humpback whales, and large concentrations of birds into Berners Bay and Slate Creek Cove for 4 to 6 weeks each year. Concerns over crew shuttle traffic affecting these species prompted the consideration of potential alternative means of transportation during this critical period. Daily crew shuttle operations would have to conform to National Marine Fisheries Service (NMFS) guidelines for vessels operating in the vicinity of marine mammals and threatened and endangered species. Crew shuttle operations would need to comply with regulations related to "taking" of threatened and endangered species, marine mammals, and migratory birds. Barge traffic would also need to comply with these guidelines and regulations.

Under Alternative A, the operator would purchase or contract the use of a helicopter with the capacity to carry up to 20 passengers for use over the life of the project. As documented in Section 2.3.11, 12 trips per week would be required, with workers living on-site and working extended shifts. Under Alternatives B, C, and D, which do not include on-site housing, obtaining a similar helicopter for short-term use during the eulachon run would be very costly. Moving the workforce using the smaller helicopters currently available locally would be impractical in addition to being costly. Assuming 4 passengers per helicopter, a minimum of 20 trips per work shift would be required. The use of helicopters would also disturb Steller sea lions, birds, and recreational users of Berners Bay during periods of heavy use.

2.4.6 Relocating the Slate Creek Cove Marine Terminal Within Slate Creek Cove

The Slate Creek Cove marine terminal as proposed would be visible from a number of points within Berners Bay and Slate Creek Cove. Relocating the marine terminal closer to the head of Slate Creek Cove was considered in an effort to address visual impacts. The topography of Slate Creek Cove is such that no areas would provide better shielding of the terminal than the proposed location. Furthermore, the presence of a crew shuttle or barge closer to the head of the Cove could exacerbate a visual impact on users in the area and would likely be more disruptive to wildlife. Therefore, this component was not considered in detail.

2.4.7 Alternative Locations or Designs for the Cascade Point Marine Terminal

Goldbelt, Inc., submitted a CWA Section 404 permit application to the USACE for the marine terminal at Cascade Point in 1999. When Goldbelt initially submitted the application, the USACE conducted an alternatives analysis that included an alternative location for the dock and alternative designs for the large breakwater.

The USACE's alternatives analyses included Yankee Cove as a potential alternative location for the dock facilities. The USACE evaluated the Yankee Cove option because the site had been used for docking and pilings were present; however, these pilings have been removed. The Yankee Cove site is private property. Goldbelt is willing to construct a dock on its property, which is reflected in the Section 404 permit application. Whether the owners of the lands surrounding Yankee Cove would be willing to construct a dock is unknown. Even if construction of a facility at Yankee Cove were possible, it would only partially address the significant issues. The crew shuttle would need to cross Berners Bay to serve the Slate Creek Cove facility and operate in areas regularly used for recreation. The design limitations in terms of a year-round, all-weather facility in Yankee Cove are also unknown.

The USACE also suggested alternative dock designs at Cascade Point during the review of the 1999 Section 404 permit application. A pile-supported facility and a captured barge were two of the potential alternatives suggested. Goldbelt conducted a feasibility study of these alternatives and determined that the expense of a pile-supported facility was prohibitive. The engineering involved in securing a barge for all-season use would have required significant in-water activity to adequately secure anchors for the barge, if the barge could be safely secured at all.

The design under consideration in this Final SEIS represents a modification from the original design described in Goldbelt's 2003 Section 404 permit application. The design modifications are intended to address two issues identified by the USACE and other agencies in 1999. The dogleg in the breakwater fill is intended to avoid the kelp bed that has been documented in the vicinity of Cascade Point. The facility has been designed to allow the migration of juvenile fish and to encourage flushing of the water behind the breakwater. These modifications are discussed in the analysis presented in Section 4.

2.4.8 Cascade Point-to-Comet Beach Crew Shuttle Access

Relocating site access from Slate Creek Cove to Comet Beach would redirect marine traffic occurring within Berners Bay away from some of the areas used by birds, fish, and marine mammals and eliminate the noise from overhead helicopter flights. The 1992 FEIS considered daily access to Comet Beach and indicated that such access would require the construction of a large breakwater (Forest Service, 1992). The analysis noted that the breakwater could interfere with migrating salmon and the commercial fishing fleet that operates in Lynn Canal. The breakwater was also determined not to be economically feasible. Because daily access to Comet Beach was previously found to be impractical and there is no additional technology available to warrant reassessment, such access is not considered further in the analysis.

2.5 MITIGATION AND MONITORING

The severity of impacts associated with any particular alternative depends to some extent on the mitigation that would be implemented. Monitoring can be used to evaluate the success of a particular mitigation measure or the impacts on a particular resource and can allow adjustments to be made if the results are not within an expected range.

2.5.1 Mitigation

The Council on Environmental Quality (CEQ) defines *mitigation* as avoidance, minimization, and reduction of impacts and compensation for unavoidable impacts (40 CFR 1508.20). Table 2-6 presents a summary of mitigation and control measures by resource for each alternative. These mitigation and control measures generally address the significant issues identified during scoping. Many of the mitigation measures have been incorporated into the Amended Plan of Operations or will become permit requirements. The following paragraphs further describe specific mitigation requirements that the Forest Service would require. Note that mitigation measures for Alternative A1 are not discussed because it is not an alternative that may be selected. Mitigation measures for Alternative A would apply to any modifications of the mining and operations should that alternative be selected.

Table 2-6
Summary of Mitigation and Control Measures

Resource	Mitigation and Control Measure	Authority[a]
Air quality	Use selective catalytic reduction to control emissions from generators.	ADEC – Draft Air Quality Permit
	Use water sprays and baghouses on crushing, screening, and transfer facilities.	ADEC – Draft Air Quality Permit
	Use water sprays to provide dust control on roads.	Forest Service – Final Plan of Operations
	Use a baghouse on cement and lime silos (Alternative A).	ADEC – Draft Air Quality Permit
	Cover and reclaim dry tailings as soon as possible (Alternative A).	Forest Service – Final Plan of Operations
Water quality and hydrology	Construct mine water treatment facility (precipitation and filtration).	USEPA/ADEC – NPDES Permit
	Have DTF effluent treatment similar to mine water treatment available as a contingency if necessary to meet water quality standards (see discussion in text; Alternative A).	USEPA/ADEC – NPDES Permit
	Use BMPs to enhance settling in TSF (Alternatives B, C, and D).	USEPA/ADEC – NPDES Permit
	Construct reverse osmosis treatment system for TSF effluent. (Alternative D)	USEPA/ADEC – NPDES Permit
	Implement blasting BMPs for ammonia and nitrate control.	USEPA/ADEC – NPDES Permit
	Design sediment ponds for 100-year, 24-hour storm event and construct polymer addition systems for high-flow events.	USEPA/ADEC – NPDES Permit
	Install temporary covers and conduct concurrent reclamation of DTF to minimize infiltration and contact with tailings (Alternative A).	Forest Service – Final Plan of Operations
	Provide secondary treatment of sanitary wastewater from Comet Beach area.	USEPA/ADEC – NPDES Permit
	Ship flotation concentrate off-site for processing.	Forest Service – Final Plan of Operations
	Follow Forest Service BMPs for construction and nonpoint source pollution (BMPs 14.9, 14.15, 14.17, 14.18, and 14.20); see Section 2.5.	Forest Service – Final Plan of Operations; USEPA/ADEC – NPDES Permit
	Develop BMP and stormwater pollution prevention plans.	USEPA/ADEC – NPDES Permits for Process and Stormwater Discharges
	Develop erosion control plan for construction and operations at the mine site and dock facilities.	Forest Service – Plan of Operations; USEPA/ADEC – NPDES Permit

Table 2-6
Summary of Mitigation and Control Measures (continued)

Resource	Mitigation and Control Measure	Authority[a]
Water quality and hydrology (continued)	Divert upland runoff around process area (all alternatives) and DTF (Alternative A) and TSF (Alternative C) in 100-year, 24-hour diversions; divert Mid-Lake East Fork Slate Creek around TSF (Alternatives C and D); expand DTF diversion to 500-year, 24-hour diversion at closure (Alternative A). Regrade diversion behind process area to establish natural drainage at closure.	Forest Service – Final Plan of Operations
	Maintain a pump/hose system capable of maintaining flows in East Fork Slate Creek in the event of an upset in the TSF (Alternative B).	Forest Service – Final Plan of Operations
Aquatic resources: marine	Limit dock construction activities to avoid in-water work during critical times of the year (e.g., eulachon run, herring spawning), generally March 15–June 15 (Alternatives B, C, and D).	CBJ-Special Use Permit; USACE – 404/ Section 10 Permit; ADNR – Tideland Leases
	Limit dock construction activities when marine mammals are within 1,000 feet.	ADNR – Tideland Leases
	Develop Spill Prevention, Containment, and Countermeasures (SPCC) Plan, Facility Response Plan (FRP), and Oil Discharge Prevention and Contingency Plan (C-Plan) to address worst-case spill event. Include drill plans and response training in all plans (C-Plan under Alternative A only).	USEPA – FRP/SPCC plans; ADEC/Coast Guard – C-Plan
	Avoid fuel deliveries during fish openings and seas greater than 3 feet whenever practicable (Alternative A).	ADEC/Coast Guard – C-Plan
	Have deployment boat with attached booms available at Comet Beach during all fuel transfers (Alternative A). Have spill response equipment readily available (all alternatives).	ADEC/Coast Guard – C-Plan; USEPA – FRP/SPCC plans
	Provide annual inspections and predelivery checks of transfer equipment (Alternative A).	ADEC/Coast Guard – C-Plan
	Station personnel at both ends of fuel lines; provide check valves (Alternative A).	ADEC/Coast Guard C-Plan
	Use isotainers for fuel delivery and transport (Alternatives B, C, and D).	Forest Service – Final Plan of Operations
	Use galvanized steel for pilings in dock construction.	USACE – 404/Section 10 Permit
	Use vibratory hammers to maximum extent practicable; use a block of wood between hammer and pile or air bubble curtain to attenuate sound; drive piles during periods of reduced current.	USACE – 404/Section 10 Permit

Table 2-6
Summary of Mitigation and Control Measures (continued)

Resource	Mitigation and Control Measure	Authority[a]
Aquatic resources: marine (continued)	During construction, place fill material during low tides.	USACE – 404/Section 10 Permit
	Ensure that all wooden surfaces contacting the water are not painted or otherwise treated with creosote or preservatives with pentachlorophenol.	USACE – 404/Section 10 Permit
	Use metal grating to the extent practicable for dock surfaces to maximize light penetration.	USACE – 404/Section 10 Permit
	Maintain a distance of at least 100 yards between vessels and humpback whales at all times and other mammals to the extent practicable (Alternatives B, C, and D).	ADNR – Tidelands Lease
	Develop and implement a Route Operational Manual based on ADEC's established Geographic Response Strategies for sensitive coastal environments.	ADNR – Tidelands Lease
	Limit crew shuttle boats to a maximum speed of 12-13 knots during the eulachon spawning period (Alternatives B, C, and D).	ADNR – Tidelands Lease
	Implement a traffic plan that minimizes vessel traffic as practicable during eulachon and herring spawning periods (Alternatives B, C, and D).	ADNR – Tidelands Lease
	Use truck fueling at Cascade Point, with no on-site fuel storage (Alternatives B and D). Fueling at Slate Creek Cove prohibited.	CBJ – Allowable Use Permit
	Avoid use of Cascade Point dock facility during herring spawning (Alternatives B and D).[b]	ADNR – Tidelands Lease
	Avoid fueling at Cascade Point from beginning of herring spawning through sensitive life stages (Alternatives B and D).[b]	ADNR – Tidelands Lease
	Reduce crew shuttle use during the eulachon run and minimize barge deliveries.	ADNR – Tidelands Lease
	Avoid in-water construction from March 15 to June 15, ADNR Tidelands Lease expected to extend until June 30 (Alternatives B, C, and D).[b]	CBJ – Allowed Use Permit, ADNR – Tidelands Lease

Table 2-6
Summary of Mitigation and Control Measures (continued)

Resource	Mitigation and Control Measure	Authority[a]
Aquatic resources: freshwater	Provide secondary containment around all fuel storage and transfer points.	USEPA – FRP; ADEC C-Plan (Alt A)
	Provide double-walled tailings pipeline with safety valve from mill to backfill plant (Alternative A); provide double-walled tailings slurry pipeline between process area and DTF (Alternative A) or TSF (Alternatives B, C, and D); provide double-walled diesel fuel pipelines with check valves (Alternative A).	USEPA – FRP; ADEC C-Plan (Alt A)
	Provide oil-water separation for runoff collected within secondary containment.	USEPA – SPCC plan
	Store spill cleanup equipment at Comet Beach (Alternative A), at Slate Creek Cove (Alternatives B, C, and D), at process area, along access roads, and at any fueling sites.	USEPA – SPCC plan
	For instream bridge construction work, provide for bypass around construction, install silt fence, and minimize streambed traffic.	ADNR – Title 41 Permit
	For instream construction work, use fill material that is clean of silt, clays, and organic materials.	ADNR – Title 41 Permit
	Do not conduct instream construction work from May 1 through October 31.	ADNR – Title 41 Permit
	Provide 300 feet of armoring incorporating the use of large woody debris for streambanks below Ophir Creek (Alternative A).	Forest Service – Final Plan of Operations; ADNR Title 41 Permit
	Develop mitigation measures to provide safe and efficient downstream fish passage from above the TSF dam to East Fork Slate Creek (Alternatives B, C, and D).	ADNR – Title 41 Permit
	Meet instream flow requirements in all streams; limit intake as necessary; and use mine water and reclaimed tailings water as primary water supply when feasible.	ADNR – Water Rights Permits
	Reestablish Ophir Creek at closure and repopulate with Dolly Varden char (Alternative A); develop fish passage (at least one-way) past TSF at reclamation (Alternatives B, C, and D); reestablish benthic and fish populations in Lower Slate Lake after closure. (Alternatives B, C, and D).	ADNR – Title 41 Permit Forest Service Final Plan of Operations

Table 2-6
Summary of Mitigation and Control Measures (continued)

Resource	Mitigation and Control Measure	Authority[a]
Aquatic resources: freshwater (continued)	Develop and implement a reclamation plan to restore Dolly Varden char and other aquatic resources in Lower State Lake after closure (Alternatives B, C, and D).	Forest Service – Final Plan of Operations
	Install a tailings cover unless tailings shown not to cause toxicity throughout the lake after closure (Alternative D).	Forest Service – Final Plan of Operations
Geotechnical Stability	Provide cleanup equipment on-site with response plans for avalanche control.	Forest Service – Final Plan of Operations
	Perform routine inspections and monitoring of TSF dam and of tailings pipeline access road through Snowslide Gulch (Alternatives B, C, and D) for stability.	Forest Service – Final Plan of Operations Alaska Dam Safety Engineer
	Monitor geotechnical stability of DTF. Install temporary and permanent covers as quickly as feasible to minimize infiltration (Alternative A).	Forest Service – Final Plan of Operations
	Construct structural berms around the north, south, and west sides of the DTF to prevent the most probable DTF failure scenario and establish monitoring triggers for berm construction (Alternative A).	Forest Service – Final Plan of Operations
Wildlife	Implement an employee education program in wildlife management.	Forest Service – Final Plan of Operations
	Prohibit employees from hunting, trapping, and harassing wildlife in the project area.	Forest Service – Final Plan of Operations
	Implement a disciplinary program for employees who violate fish and game regulations.	Forest Service – Final Plan of Operations
	Establish buffer zones around bald eagle and goshawk nests in consultation with the Forest Service.	Forest Service – Final Plan of Operations
	Restore mountain goat herd (by reintroduction after mine closure) if monitoring indicates that the goat population significantly declined during operations.	Forest Service – Final Plan of Operations
	Implement a garbage management plan (to limit bears' access).	Forest Service – Final Plan of Operations
	Use helicopter flight paths that avoid bald eagle nest sites and mountain goat habitat when weather and safety permit (Alternative A).	Forest Service – Final Plan of Operations
	Develop flight guidelines for helicopter use near sensitive mountain goat habitat (Alternative A).	Forest Service – Final Plan of Operations

Table 2-6
Summary of Mitigation and Control Measures (continued)

Resource	Mitigation and Control Measure	Authority[a]
Wildlife (continued)	Implement nesting season timing restrictions for helicopter use and blasting near bald eagle sites.	Forest Service – Final Plan of Operations
	Establish vegetation test plots to evaluate the most effective means of reclaiming wildlife habitat after project closure.	Forest Service – Final Plan of Operations
	Develop long-term revegetation measures to improve wildlife habitat, such as the thinning of second-growth forest in reclaimed areas.	Forest Service – Final Plan of Operations
Soils, vegetation, wetlands	Prohibit the collection of plants and plant parts except by permit issued by the Forest Supervisor for scientific or educational purposes.	Forest Service – Final Plan of Operations
	Use plants native to the area and originating near the project area for reclamation to the extent possible.	Forest Service – Final Plan of Operations
	Maintain drainage patterns, water quality, and water quantity to the extent possible to support aquatic plant populations and habitats.	USACE – Final 404 Permit
	Maintain sediment ponds as open water at closure, and retain any shallow water remaining in borrow areas as open water wetlands.	USACE – Final 404 Permit
	Remove fill material from roads built in waters of the U.S. and reclaim to natural conditions.	Forest Service – Final Plan of Operations
	Side slopes revegetated concurrently with placement of fill materials.	Forest Service – Final Plan of Operations
	Reclaim vegetative cover to 75 percent.	Forest Service – Final Plan of Operations
Socioeconomics	Maximize hiring within Southeast Alaska, as practicable.	Forest Service – Final Plan of Operations

Table 2-6
Summary of Mitigation and Control Measures (continued)

Resource	Mitigation and Control Measure	Authority[a]
Visual resources	Locate roads to minimize impacts visible from the Alaska Marine Highway and tour ship travel routes in Lynn Canal (Alternative A) and to recreational users in Berners Bay (Alternatives B, C, and D).	Forest Service – Final Plan of Operations
	Use full bench cuts and end-hauled material where slopes are too steep to hold material or where residual trees do not provide enough screen to permit the road to meet visual quality objectives.	Forest Service – Final Plan of Operations
	Minimize right-of-way clearing as fill-and-cut slopes permit.	Forest Service – Final Plan of Operations
	Mitigate the effects of sidecast slash within 30 feet of road shoulders by the most appropriate method: (1) end-haul slash to a central approved area or (2) pile slash in areas not visible from visual priority travel routes or use areas. Slash should be consolidated as much as practical, covered with soil, and shaped into natural contours.	Forest Service – Final Plan of Operations
	Apply seed and fertilizer (as necessary) to all disturbed areas to be reclaimed, including cut-and-fill embankments and roadways. Seed mixtures should reflect the vegetation and growth characteristics of Southeast Alaska.	Forest Service – Final Plan of Operations
	Locate and design tree plantings where necessary to meet the visual quality objectives.	Forest Service – Final Plan of Operations
	Locate and design borrow pits to minimize visual impacts, and retain screen trees where necessary to meet the visual quality objectives.	Forest Service – Final Plan of Operations
	Use earth-toned colors on all building exteriors to blend with the surrounding landscape.	Forest Service – Final Plan of Operations
	Design structures to repeat forms, lines, and textures that occur frequently in the surrounding landscape.	Forest Service – Final Plan of Operations
	Revegetate the external tailings slopes and borrow areas as soon as practicable.	Forest Service – Final Plan of Operations
	Direct exterior lighting inward, where possible, to reduce glare and visual impacts.	Forest Service – Final Plan of Operations
	Use water to control fugitive dust.	Forest Service – Final Plan of Operations
	Conduct concurrent reclamation of the DTF (Alternative A).	Forest Service – Final Plan of Operations

Table 2-6
Summary of Mitigation and Control Measures (continued)

Resource	Mitigation and Control Measure	Authority[a]
Cultural resources	Minimize or avoid all adverse impacts on significant archaeological sites to the extent practicable.	Forest Service – Final Plan of Operations
	Implement monitoring and mitigation measures included in MOA among the operator, Forest Service and SHPO.	Forest Service – Final Plan of Operations

[a] ADEC = Alaska Department of Environmental Conservation; USEPA = U.S. Environmental Protection Agency; USACE = U.S. Army Corps of Engineers; ADNR = Alaska Department of Natural Resources; ACMP = Alaska Coastal Management Program; NMFS = National Marine Fisheries Service; SHPO = State Historic Preservation Officer.

[b] These provisions of the Tidelands leases are still under consideration.

Water Quality

A number of mitigation measures have already been incorporated into Alternative A because it reflects an approved plan. These measures are described in Table 2-2 of the 1997 SEIS. Under Alternative A, additional treatment of DTF effluent (beyond enhanced settling) would be required as a contingency should the effluent not meet discharge limits. The chemistry of the influent to the DTF pond, the existing tailings characterization data, and the projected effluent composition suggest that additional treatment would be required for aluminum. Sulfide precipitation, filtration, and reverse osmosis are three additional treatment options that could be required to achieve permit compliance.

Under Alternatives B, C, and D, mitigation measures to enhance settling, including polymer addition, have been incorporated into the TSF design. Under Alternative D, reverse osmosis treatment of the effluent has also been incorporated into the TSF design.

The Forest Service requires BMPs for nonpoint source- and construction-related discharges to surface water. The BMPs are designed to protect water quality and abate or mitigate water quality impacts. There are three types of BMPs: administrative, preventive, and corrective. Administrative BMPs are implemented as organizational controls. Preventive BMPs are designed to minimize the effects of an activity on water quality. Corrective BMPs are applied to address a particular problem once it has occurred.

Freshwater Resources

Under all Alternatives, the operator would be required to meet instream flows established by ADNR to protect aquatic life in potentially affected drainages. Under Alternatives B, C, and D, additional mitigation would focus on restoring the Lower Slate Lakes fish population after closure. The operator would inundate an area of natural soil at the bottom of the lake equivalent to the pre-mining condition. This soil would support immediate macroinvertebrate recolonization. Furthermore, under Alternatives B, C, and D, the operator would provide for downstream fish passage around the TSF during operations and downstream passage through the TSF after closure. Alternative D further provides for Lower Slate Lake restoration through installation of the tailings cover.

Marine Resources

Under Alternative A, mitigation would focus on minimizing potential for and impacts from spills, including avoiding fuel deliveries when waves are greater than 3 feet, installing automatic shutoff valves for fuel transfer equipment at Comet Beach, and having booms ready for deployment during transfer. Under Alternatives B, C, and D, mitigation is designed to specifically avoid effects on marine mammals and herring in Berners Bay. These measures are described in detail in the Biological Assessment/ Evaluation (BA/BE) included as Appendix J. They are included in the operator's transportation plan, required by the CBJ's Allowable Use Permits for the Slate Creek Cove and Cascade Point marine terminals, and are expected to be included in ADNR's Tidelands Leases for the marine terminals. Key measures provide for the following:

- Avoiding in water construction during the eulachon and herring spawning periods.
- Reducing the number of crew shuttles and minimizing barge traffic during the eulachon run.
- Keeping a distance of at least 100 yards from marine mammals.
- Maintaining a maximum boat speed of 12-13 knots during the eulachon run.
- Avoiding use of Cascade Point during herring spawning and prohibiting fueling from the beginning of spawning through sensitive life stages.

Soils, Vegetation, and Wetlands

The following mitigation measures would apply to vegetation during construction and as part of reclamation:

- Plants native to the area and originating near the project area would be used for reclamation to the extent possible.
- Drainage patterns, water quality, and water quantity would be maintained to the extent possible to support aquatic plant populations and habitats.

If Alternative B, C, or D was selected, the reclamation plan would be modified to reflect that reclamation objectives and bond release would be met by establishing 75 percent live vegetation cover on reclaimed areas, and that water quality criteria would be met. The reclamation plan would also reflect that growth media would be placed at a depth of at least 1 foot over all disturbed areas, excluding rock faces, riprap, and other locations where placement of growth media would be impractical. These stipulations are already in place for the reclamation plan associated with Alternative A.

No Alaska Region-listed sensitive plant species have been identified on the project site to date. If a listed sensitive plant species were identified at the site, however, the following mitigation measures would be required:

- The collection of sensitive, listed plants or plant parts would be prohibited except by permit issued by the Forest Supervisor for scientific or educational purposes.
- The area would be closed to off-road vehicle use.

Cultural Resources

A Memorandum of Agreement (MOA) among the operator, the State Historic Preservation Officer (SHPO), and the Forest Supervisor has been signed. The agreement has a detailed Mitigation and Monitoring Plan that outlines details regarding mitigation of the adverse effects on historic properties. Mitigation includes making an effort to avoid impacts on cultural features when possible and providing an on-site archaeological monitor during mine construction to record historic properties, as well as efforts to complete data recovery through archaeological excavation. Additional mitigation includes an educational training component for employees at the mine during its operation and historic interpretive signs at the mine upon closure. The training component provides for education of project personnel to reduce the potential for secondary effects of increased visitation on cultural resource sites. This training will also address the steps to be followed in the event of inadvertent discovery of cultural resources. The provisions in the MOA are subject to revision to protect any significant cultural resources that might be discovered during project construction, operation, and reclamation. Revisions would be initiated and proposed by the Forest Service Archaeologist or the SHPO (Forest Service, 2004a).

Visual Resources

The following mitigation measures would be implemented under any alternative selected to address visual resources:

- Locate roads to minimize impacts visible from the Alaska Marine Highway, tour ship travel routes in Lynn Canal, and visual priority routes in Berners Bay.
- Use full bench cuts and end-hauled material where slopes are too steep to hold material or where residual trees do not provide enough screen to permit the road to meet visual quality objectives.

- Minimize right-of-way clearing as cut-and-fill slopes permit.
- Mitigate the effects of the sidecast slash within 30 feet of road shoulders by the most appropriate method: (1) end-haul slash to a central approved area, or (2) pile slash in areas not visible from visual priority travel routes and use areas. Slash should be consolidated as much as practical, covered with soil, and shaped into a natural contour.
- Apply seed and fertilizer (as necessary) to all disturbed areas to be reclaimed, including cut-and-fill embankments and roadways. Typical seed mixtures should reflect the vegetation and growth characteristics of Southeast Alaska. Appropriate grasses, for example, would include Alyeska polargrass (*Arctagrostis latifolia*), Arctared red fescue (*Festuca rubra*), Norcoast Bering hairgrass (*Dechampsia beringensis*), and Gruening alpine bluegrass (*Poa alpina*).
- Locate and design borrow pits to minimize visual impacts, and retain screen trees where necessary to meet the visual quality objectives.
- Use earth-toned colors on all building exteriors to blend with the surrounding natural landscape.
- Design structures to repeat forms, lines, and textures that occur frequently in the surrounding landscape.
- Direct exterior lighting inward whenever possible.
- Use water to control fugitive dust.

2.5.2 Monitoring

The monitoring program provides a means to assess the effectiveness of mitigation measures. Monitoring requirements are established in the Final Plan of Operations, permits, and approvals. Table 2-7 summarizes the monitoring requirements and authority for each resource.

2.6 COMPARISON OF ALTERNATIVES

The alternatives for the Kensington Gold Project were developed and evaluated by project component on the basis of the issues identified as part of the public scoping process. Table 2-5 summarized and compared the alternatives according to the project components discussed in Section 2.3. The Forest Service, USEPA, USACE, and ADNR reviewed all the issues for significance. The significant issues identified were used to develop the project alternatives and to compare the potential effects of all alternatives. Table 2-6 summarized the mitigation measures. Table 2-7 presents monitoring requirements by resource area. Tables 2-8 and 2-9 summarize the potential impacts of each alternative by significant issue and by resource, respectively, based on the analyses presented in Section 4.

Table 2-7
Monitoring Requirements by Resource Area

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Construction, Operation, and Reclamation Specifications						
Construction, operation, and reclamation according to Plan of Operations and permit requirements	Document, report, and inspect	Ongoing	Nonconformance with approved design specifications	To be determined by individual agencies	Forest Service ROD, Final Plan of Operations, NPDES permit, Section 404 permit, ADNR Title 41 permit	Forest Service, USEPA, USACE, and ADNR
Air Quality						
Air emissions and compliance with air quality permit	Implement methods according to air quality permit	Frequency indicated in air quality permit	Threshold at air quality permit limits	Notify as required by air quality permit, implement measures to correct noncompliance	Air quality permit	The operator with ADEC review
Water Quality and Hydrology						
Effluent treatment measures	Inspect implementation of design and mitigation measures outlined in Final Plan of Operations and Final SEIS	Ongoing	Operability of measures at all times	May not discharge effluent to receiving waters until measures are implemented	Forest Service ROD, NPDES permit	The operator with Forest Service, ADEC, and USEPA review
Implementation of BMPs to control pollution from sediment, petroleum products, and hazardous or toxic waste (including metals) during construction and operation	Review site-specific BMP plans and inspect implementation of plans	During construction – ongoing During operation – monthly	Evidence that BMPs are not designed and implemented correctly	Require additional or improved pollution control measures	Forest Service ROD, Final Plan of Operations, SPCC Plan, NPDES permit	Forest Service, ADEC, USEPA, and Coeur Alaska
Effluent compliance with NPDES permit	Implement methods according to NPDES permit	Frequency indicated in NPDES permit	Thresholds at NPDES permit limits	Notify as required by NPDES permit and final Plan of Operations; implement additional measures to correct the noncompliance	NPDES permit	The operator with USEPA review

Table 2-7
Monitoring Requirements by Resource Area (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Surface water quality	Implement methods according to NPDES permit and monitoring program in Final Plan of Operations	Frequency indicated in NPDES permit and Final Plan of Operations	Trend showing effects on water quality	Per NPDES permit and Final Plan of Operations	NPDES permit and Final Plan of Operations	The operator with USEPA and Forest Service review
Effectiveness of BMPs in controlling nonpoint source pollution during construction and operation	Collect and evaluate data on relevant water quality constituents from sites above and below mine activity	During construction and operation; varies from weekly to quarterly	Evidence that nonpoint source pollution control measures are not installed correctly, maintained operationally, or effective; noncompliance with water quality criteria or changes in water quality trends	Require additional or improved pollution control measures	Forest Service ROD, Final Plan of Operations	The operator with Forest Service review
Groundwater quality effects of DTF (Alternative A)	Sample groundwater upgradient and downgradient of DTF	According to solid waste permit	Per solid waste permit	Per solid waste permit	Solid waste permit	The operator with ADEC review
Maintenance of instream flows in Sherman Creek, Johnson Creek, and East Fork State Creek	Monitor (by gauging) stream flows immediately below intake (all alternatives) and below TSF (Alternatives B, C, and D)	As established by ADNR water rights	Instream flow levels set by ADNR water rights	Limit water withdrawal; adjust TSF discharge flows	Forest Service ROD, ADNR water rights	The operator with Forest Service and ADNR review
Compliance with stormwater regulations	Sample and inspect according to general NPDES permit	According to general NPDES permit	Exceedance of benchmark values	Reevaluate BMPs and add additional BMPs as necessary	General NPDES permit	The operator with USEPA and ADEC review
Effectiveness of reclamation measures in maintaining water quality at the mine site	Monitor process area and DTF site (Alternative A) and process area and TSF sites (Alternatives B, C, and D)	Varies with time after reclamation	Background levels and trends, including seasonal influences	Implement additional reclamation efforts	Forest Service ROD, Final Plan of Operations	The operator with Forest Service review

Table 2-7
Monitoring Requirements by Resource Area (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Effectiveness of reclamation in maintaining stable, self-maintaining stream channels	Monitor reclaimed channels for stability	Varies with time after reclamation	Self-maintaining, productive channels	Implement additional reclamation efforts	Forest Service ROD, Final Plan of Operations	The operator with Forest Service and ADNR review
Impacts of spills and effects of response measures	See SPCC Plan	Post-spill as required in SPCC Plan	Spill occurs	Clean up, report, and monitor as necessary	SPCC Plan	The operator with ADEC and USEPA review
Aquatic Resources: Freshwater						
Discharge effect on aquatic organisms below discharges/facility operations	Perform bioassays of discharges to surface water; fish surveys above and below Sherman Creek discharges (all alternatives); and above and below TSF in East Fork State Creek and process area in Johnson Creek(Alternatives B, C, and D)	Per NPDES permit	Per NPDES permit	Per NPDES permit	NPDES permit and Final Plan of Operations	The operator with ADEC/ADNR and USEPA review
Aquatic life in TSF during operations and after closure	Perform invertebrate, fish, and aquatic plant sampling/surveys in TSF during operations and closure (Alternatives B, C, and D)	During operations: Yearly until sufficient for characterization After closure: Twice yearly until productive, sustainable community established	During operations: No specific threshold After closure: Benthic organism reestablishment does not meet density or diversity of reclamation objectives	Amendments to reclamation plan	Final Plan of Operations	The operator with Forest Service and ADNR review
Dolly Varden char spawning surveys in Upper Slate Lake	Survey for redds and distribution of mature Dolly Varden char to determine preferred spawning habitat	Yearly during spawning period to determine preferred spawning areas	No specific threshold; data collected to better define system and impacts and refine reclamation plan	Meet with Forest Service and state to refine long-term TSF reclamation approach, as appropriate	Final Plan of Operations and Title 41 permit with ADNR review	The operator, Forest Service, and ADNR

Table 2-7
Monitoring Requirements by Resource Area (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Spawning salmon escapement survey	Conduct pink, chum, and coho spawning counts as appropriate, in intertidal zone and 90-foot sections of Sherman Creek (all alternatives), Slate Creek (Alternatives B, C, and D), and Johnson Creek (Alternatives B, C, and D) from mouth to fish barrier with same methods used by Konopacky in 1995	Yearly survey; weekly counts during spawning period	When results of this monitoring, in addition to other information, indicate habitat capabilities are changing as a result of mine activities	Meet with Forest Service to discuss potential problem; could result in change in construction or operating practices and mitigation in nearby streams	Final Plan of Operations	The operator with Forest Service and ADNR and NMFS review
Benthic macroinvertebrate community composition	Sample from sites above and below disturbances in Sherman Creek (all alternatives), Johnson Creek (Alternatives B, C, and D), and Slate Creek (Alternatives B, C, and D)	Yearly	Trend showing effects on benthic community composition (changes in density/species diversity)	Submit results in Annual Report; discuss follow-up actions with USEPA, ADNR, and Forest Service	NPDES permit Final Plan of Operations	The operator with USEPA, ADNR, and Forest Service review
Spawning gravel composition and embryo survival in Lower Sherman, Johnson, and Slate creeks	Sample using established procedures in Sherman Creek (all alternatives), Johnson Creek (Alternatives B, C, and D), and Slate Creek (Alternatives B, C, and D)	Yearly	Trend showing effects on gravel composition and embryo survival	Submit results in Annual Report; discuss follow-up actions with USEPA, state, and Forest Service	NPDES permit Final Plan of Operations	The operator with USEPA, ADNR, and Forest Service review

Table 2-7
Monitoring Requirements by Resource Area (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Sediment quality (metals toxicity and other characteristics)	Sample using established procedures at background locations, below discharges, and at mouths of Sherman Creek (all alternatives) and Slate Creek (Alternatives B, C, and D), and above and below process area in Johnson Creek (Alternatives B, C, and D)	Yearly	Trend showing increased toxicity or metals levels	Submit results in Annual Report; discuss follow-up actions with USEPA, state, and Forest Service	NPDES permit Final Plan of Operations	The operator with USEPA, state, and Forest Service review
Aquatic habitat characteristics	Observe and photograph habitat type (e.g., riffle, pool), substrate size, and vegetation/woody debris in Sherman Creek (all alternatives), Johnson Creek (Alternatives B, C, and D), and Slate Creek (Alternatives B, C, and D)	Yearly in Sherman Creek, Slate Creek, and Johnson Creek	Trend showing habitat change from baseline	Meet with Forest Service to discuss potential sources of impacts; could result in change in construction or operation practices and mitigation in nearby streams	Final Plan of Operations	The operator with Forest Service and ADNR review
Aquatic Resources: Marine						
Marine water quality – Polycyclic aromatic hydrocarbon (PAH) concentrations around Berners Bay (Alternatives B, C, and D)	Use polyethylene membrane devices (PEMDs)	Twice annually, once in April and once in July	Changes in baseline conditions	Per Tidelands lease	Tidelands lease	The operator with ADNR and NMFS review
Marine water quality	Take grab sample (extract)	Once annually coinciding with May recovery of PEMD noted above	Changes in baseline conditions	Per Tidelands lease	Tidelands lease	The operator with ADNR and NMFS review

Table 2-7
Monitoring Requirements by Resource Area (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Sediment quality	Conduct sediment sampling	Once annually coinciding with May recovery of PEMD noted above	Changes in baseline conditions	Per Tidelands lease	Tidelands lease	The operator with ADNR and NMFS review
Mussel tissue PAH concentrations	Conduct tissue sampling	Once annually coinciding with May recovery of PEMD noted above	Changes in baseline conditions	Per Tidelands lease	Tidelands lease	The operator with ADNR and NMFS review
Steller seal lions, marine mammals (seals)	Observe known haulout sites	Annually while activities are occurring; during times when haulouts are occupied	Evidence of harassment of marine mammals as direct result of mining-related activities	Enforce Marine Mammal Protection Act and Endangered Species Act. Avoid or modify activities causing impacts.	Marine Mammal Protection Act, Endangered Species Act	NMFS
Marine mammal and seabird (sea duck) observations	Observe species activities from vessels. Log presence or absence and direction of movement.	Daylight hours (may be done during certain periods based on results)	Evidence of changes from baseline	Meet with agencies to discuss impacts and potential changes to transportation plan	Tidelands Lease	The operator with Forest Service and U.S. Fish and Wildlife Service (USFWS) and NMFS review
Wildlife						
Eagle and goshawk nest management	Observe nest sites	During years 1 and 2 of project development, every month May–August; after second year, annually	A change (e.g., a change in the occupancy status of a nest) due to mining-related activity	Consult with USFWS for eagles, and Forest Service to modify if activity is deemed to be influencing the observed change (e.g., nest abandonment)	Bald and Golden Eagle Protection Act, Final Plan of Operations	Forest Service and USFWS
Wildlife use of Slate and Spectacle lakes	Document occurrence of waterfowl and other wildlife and associated habitat in Upper Slate and Spectacle lakes during operations and at TSF after closure	During operations: Continual in association with other studies until sufficient for characterization After closure: Twice yearly until productive, sustainable community is established	During operations: No specific threshold After closure: Failure to meet anticipated reclamation schedule	During operations; Incorporate findings into reclamation plan After closure; amend reclamation plan	Final Plan of Operations	The operator with Forest Service, USFWS, and ADNR/ADF&G review

Table 2-7
Monitoring Requirements by Resource Area (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Heron rookery and raptor nest protection	Pre-development surveys	Annually if active rookery/nests discovered during initial survey	Presence of nest/rookery within 600-foot buffer of project activity	Eliminate disturbances during nesting season (March 1–July 31)	Final Plan of Operations	Forest Service
Mountain goat monitoring	Conduct population surveys, track radio-collared goats	Several flights per year	Evidence of extreme adverse reaction to mining-related activities causing abandonment of habitat	Consult to minimize disturbance; if disturbance cannot be minimized, causing loss of mountain goat population, mitigation could involve reintroduction	Agreement with the operator	ADF&G and Forest Service
Vegetation						
Compliance with timber sale contract provisions (sale administration)	Conduct onsite inspections	Before, during, and after harvest activities	Compliance with contract clauses	Return to compliance	36 CFR Part 223	Forest Service
Visual Resources						
Operations monitoring; compliance with visual quality objectives	Conduct field observation and document with photos taken from established viewpoints	After construction, during operations, and after project completion	Determine whether visual impacts exceed anticipated impacts	Consider additional mitigation	Forest Service Handbook (FSH) 2309.22	Forest Service
Reclamation monitoring; compliance with visual quality objectives	Conduct field observation and document with photos taken from established viewpoints	Once every 5 years for 15 years after reclamation	Determine whether visual impacts exceed anticipated impacts	Use photos as reference in determining impacts and achieving visual quality objectives in future planning; implement additional planting or treatments as appropriate	Forest Service Handbook 2309.22	Forest Service
Geotechnical Stability						
Tailings structures: construction materials	Conduct visual inspection and gradation testing of materials	Continuous during construction	Per design documents	Remove non-conforming materials	Final Plan of Operations and Dam Safety Permit	The operator with Forest Service and ADNR review

Table 2-7
Monitoring Requirements by Resource Area (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Tailings structures: construction methods	Perform compaction and moisture tests along with other standard engineering practices	As dictated by selected design needs during construction	Per design documents	Remove non-conforming materials or apply additional effort to installation	Final Plan of Operations and Dam Safety Permit	The operator with Forest Service and ADNR review
Tailing structures: ongoing performance	Perform visual inspections, measure saturation	At minimum monthly, more frequent as dictated by selected design; after large earthquakes and other natural events	Per design documents	Per analysis of variance	Final Plan of Operations and Dam Safety Permit	The operator with Forest Service and ADNR review
Waste rock pile stability	Perform visual inspection	Annually	Visible movement	As dictated by findings	Final Plan of Operations	The operator with Forest Service review
Cultural Resources						
Ground disturbance	Monitor for discovery of cultural resources by qualified archaeologist according to MOA approved by Forest Service and SHPO	During initial ground disturbance	Per MOA	Per MOA	Per MOA	The operator with Forest Service and SHPO review

Table 2-8
Summary of Potential Impacts of Each Alternative by Significant Issue

Alternative	Summary of Potential Impact
Mine-related transportation would adversely affect users of, and resources in, Berners Bay	
Alternative A – No Action Alternative A1 – Reduced Mining Rate, DTF	Twelve round-trip helicopter flights each week (M–F) crossing the mouth of Berners Bay to transport workers to helipad at Comet Beach. Noise audible to some Berners Bay users.
Alternative B – Proposed Action	Five round-trip crew shuttle trips daily on weekdays and three round-trip crew shuttle trips on weekends between facilities at Cascade Point and Slate Creek Cove. Approximately four barge trips per week delivering supplies and fuel/removing concentrate from Slate Creek Cove facility. Visual impacts for users in Berners Bay; noise impacts for users in Berners Bay, depending on distance from operations. Fill at Cascade Point could affect herring habitat.
Alternative C – Revised Dock Design/Diversions	Similar to Alternative B except five round-trip crew shuttle trips daily on weekdays and three round-trip crew shuttle trips on weekends between facilities at Echo Cove and Slate Creek Cove. Dock in Echo Cove would not affect herring spawning.
Alternative D – Modified TSF Design	Same as Alternative B.
Construction and operation of the TSF and other mine facilities would adversely affect aquatic resources from Slate and Johnson creeks to Slate Creek Cove and Berners Bay	
Alternative A – No Action Alternative A1– Reduced Mining Rate, DTF	None of the project facilities occur in the Berners Bay watershed.
Alternative B – Proposed Action	Fresh water: TSF effluent quality would not always allow discharges, which could cause minimum instream flow requirements not to be met; construction impacts, including the potential for sediment deposition, would be addressed through BMPs. Lower Slate Lake aquatic habitat would be adversely affected for the life of mining operations, resulting in the elimination of an estimated 1,000 Dolly Varden char. Marine: Fuel shipments in 6,500-gallon isotainers would reduce the potential size and likelihood of a fuel spill; barges and crew shuttles could affect humpback whales and Steller sea lions; small amounts of fill in intertidal water at Slate Creek Cove and approximately 29,000 cy of fill below high tide line (24,500 cy below mean high water) at Cascade Point. Breakwater could affect herring spawning habitat. Fueling operations and leaks at Cascade Point could expose marine organisms to hydrocarbons.
Alternative C – Revised Dock Design/Diversions	Similar to Alternative B except that the dock in Echo Cove would not affect herring spawning habitat. Echo Cove would be dredged (approximately 150,000 cy) to allow crew shuttle access. Fueling operations and leaks from Echo Cove could subject marine organisms to hydrocarbon exposure.
Alternative D – Modified TSF Design	Same as Alternative B for marine impacts; provides for TSF effluent treatment to ensure compliance with water quality standards and protection of downstream aquatic life, and tailings cover to ensure habitat restored at closure.
The Lower Slate Lake TSF, docks, access road, and other mine facilities would affect the scenic character of Berners Bay for recreationists	
Alternative A – No Action Alternative A1– Reduced Mining Rate, DTF	None of the project facilities occur within the Berners Bay viewshed.
Alternative B – Proposed Action	Portions of the tailings access road might be visible from locations in Berners Bay; a small portion of the topsoil stockpile near the process area and the mill building might also be visible from the head of Berners Bay and the Forest Service Berners Bay cabin. The Slate Creek Cove marine terminal would be visible from portions of Berners Bay, as would barges and the crew shuttle.
Alternative C – Revised Dock Design/Diversions	Similar to Alternative B. The Echo Cove dock would be located more directly within the travel routes of recreational users in the vicinity, but would result in a smaller visual impact than siting the facility at Cascade Point.
Alternative D – Modified TSF Design	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Air quality	Air quality	Predicted pollutant emissions less than state and federal standards. Fugitive Sources: DTF – more than 100 acres, although concurrent reclamation would occur Waste rock storage – 15 acres used temporarily prior to incorporation in the DTF Borrow areas – 54.7 acres Access roads – 3 miles Stationary Sources: Four 3.3-MW generators plus one 275-kW generator	Predicted pollutant emissions less than state and federal standards. Fugitive Sources: DTF – less than 50 acres disturbance No waste rock storage – any available backfilled or incorporated into the DTF Borrow areas – 36.6 acres Access roads – 3 miles Stationary Sources: Four 3.3-MW generators plus one 275-kW generator	Predicted pollutant emissions less than Alternative A and less than state and federal standards Fugitive Sources: TSF – none Waste rock storage – 36.3 acres Borrow areas – 7.2 acres Access roads – 10 miles Stationary Sources: Three 3.3-MW generators plus two smaller generators.	Same as Alternative B with the deletion of a small generator from the TSF because there would be no recycling system.	Same as Alternative B, except approximately 2.0 percent greater emissions due to reverse osmosis system; still below state and federal air quality standards.
Geology	Waste rock generated	All waste rock generated incorporated into construction of DTF.	Small amount of waste rock generated used in DTF construction.	Waste rock disposal at Kensington 850-foot portal (31.5 acres) and Jualin process area (4.8 acres). Most waste rock generated from Kensington-to-Jualin access tunnel.	Same as Alternative B.	Same as Alternative B.
	Tailings generated	20 million tons stored in DTF; 6.0 million tons backfilled	4.5 million tons stored in DTF; 3.0 million tons backfilled.	4.5 million tons stored in TSF; 3.0 million tons backfilled.	Same as Alternative B.	Same as Alternative B.
Geotechnical stability	Probability of DTF/TSF failure	Very low probability of failure due to construction of berm around DTF.	Same as Alternative A.	Very low probability of dam failure.	Same as Alternative B.	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Surface water hydrology	Water withdrawals	Up to 0.52 cfs from infiltration gallery in upper Sherman Creek.	Same as Alternative A.	0.3 cfs from infiltration gallery in Johnson Creek (demand reduced because of recycling).	0.52 cfs from infiltration gallery in Johnson Creek.	Same as Alternative B.
	Diversions	Four diversions totaling 2.3 miles. Only Ophir Creek diversion would directly affect stream flow. All diversions except around DTF removed at closure. Potential impact on Ivanhoe Creek because of increased flows from Ophir Creek diversion.	Same as Alternative A with smaller diversion around the smaller DTF.	One 1,500-foot diversion above the waste rock disposal/850-foot adit area on the Kensington side and 2,500-foot diversion around the process area on the Jualin side. 0.75 mile total diversions.	Same as Alternative B plus two 2,550-foot diversions constructed around the northern and eastern portions of the TSF. 1.75 miles total diversions.	Same as Alternative B plus a 3,500-foot pipeline diversion around the TSF. 1.5 miles total diversions.
	Stream flow	Potential impact on instream flows during critical flow period in Sherman Creek between withdrawal and discharge point. Mitigated by state requirements for maintaining instream flows necessary to maintain fish habitat. Mine drainage would provide alternative water supply. Discharge of mine drainage to Sherman Creek would increase average stream flow 1.3 cfs.	Same as Alternative A.	Potential impact on instream flows in Johnson Creek drainage from the infiltration gallery (water supply) and in East Fork Slate Creek as a result of the TSF. Mitigated by state requirements for maintaining instream flows necessary to maintain fish habitat. Discharge of mine drainage to Sherman Creek increases average stream flow 1.3 cfs. Potential impacts on flows in East Fork Slate Creek below TSF if discharges prohibited by noncompliance with NPDES permit limits.	Same as Alternative B, except no impacts on flow below the TSF.	Same as Alternative C.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Surface water quality	Sedimentation	Highest potential for sediment loading to Sherman Creek would be during construction. Sediment controlled through polymer added to sediment ponds and BMPs. With proper construction and maintenance, sediment loadings should be consistent with natural conditions. Potential effects of crossings reduced by use of bridges instead of conduits.	Same as Alternative A.	Highest potential for sediment loading in Slate and Johnson creeks would be during construction. BMPs implemented to control erosion. With proper construction and maintenance, sediment loadings should be consistent with natural conditions.	Same as Alternative B.	Same as Alternative B.
	Effluent quality	No impacts; effluent would comply with water quality-based NPDES permit limits at the discharge points. Negligible on-site acid generation potential.	Same as Alternative A.	Same as Alternative A for mine drainage. TSF water quality may not meet NPDES permit limits necessitating additional treatment.	Same as Alternative B.	Same as Alternative A.
	Spills	Access road parallels Sherman Creek. Low potential for spills of diesel, concentrate, and supplies. Potential for water quality impacts from spills at Comet Beach dock facility.	Same as Alternative A.	Portions of access road parallel Johnson Creek. Low potential for spills of concentrate and supplies. Isotainers further reduce risk of diesel spills compared to Alternative A.	Same as Alternative B	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Groundwater hydrology	Groundwater flow	Underground mine drainage would create a localized cone of depression. Projected flow of mine drainage of 4 cfs during initial operations, declining to a steady state of 1 cfs. Minimal impacts on overall sitewide hydrology and hydrogeology. DTF would have limited effects in the terrace area. Infiltration gallery would remove 0.52 cfs from alluvium adjacent to Sherman Creek; limited by ADNR water rights permit.	Similar to Alternative A with potentially a smaller cone of depression corresponding to a smaller portion of the deposit being mined.	Similar to Alternative A without affecting terrace area. Some potential for addition of mine discharge from the tunnel connecting Jualin and Kensington sides. Discharge would ultimately be to Sherman Creek. Overall, minimal impacts on site hydrology and hydrogeology. Infiltration gallery would remove 0.3 cfs from alluvium adjacent to Johnson Creek; limited by ADNR water rights permit.	Same as Alternative B except the withdrawal of 0.52 from alluvium in Johnson Creek. The diversions around the TSF would intercept shallow groundwater and discharge to Slate Creek downstream of the TSF. Would result in no effect on overall hydrologic balance in system.	Same as Alternative B.
Groundwater quality	Groundwater quality	No effects from the mine workings. Infiltration through waste rock and DTF consistent with background groundwater quality. Negligible acid generation potential.	Same as Alternative A.	Same as Alternative A. Generally, infiltration from TSF consistent with background groundwater quality.	Same as Alternative B.	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Aquatic resources: freshwater	Habitat loss (linear feet)	2,450-foot temporary loss in Ophir Creek during operations; channel restored during closure.	Same as Alternative A.	Lake: Loss of all habitat (20 acres) in Lower Slate Lake during operations. Streams: Loss of habitat in Mid-Lake East Fork (approximately 1,200 feet) due to inundation as TSF water levels rise and in East Fork Slate Creek (200 feet) due to construction of dam.	Same as Alternative B plus inundation of additional habitat around Upper Slate Lake.	Same as Alternative B.
	Stream crossings	Five crossings within Sherman Creek drainage. Upgrading of crossings would have minimal impact on habitat.	Same as Alternative A.	Five crossings (three in Sherman Creek, two in Johnson Creek drainage). Upgrading of crossings would have minimal impact on habitat.	Same as Alternative B.	Same as Alternative B.
	Fish mortality	Potential loss of approximately 100–200 Dolly Varden char resulting from Ophir and Ivanhoe creek diversions.	Same as Alternative A.	100 percent mortality (estimated at 996 individual Dolly Varden char) in Lower Slate Lake during operation of the TSF. Three-spine sticklebacks and benthic organisms also eliminated during operations. Likely impacts on fish below the TSF due to discharge limited by compliance with NPDES permit limits.	Same as Alternative B, except no impacts downstream of TSF.	Same as Alternative C.
	Water withdrawals	0.52 cfs withdrawn from alluvium in Sherman Creek.	Same as Alternative A.	0.3 cfs withdrawn from alluvium in Johnson Creek.	0.52 cfs withdrawn from alluvium in Johnson Creek.	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Aquatic resources: marine	Water quality	*Construction:* Temporary increases in sediment and turbidity resulting from dredging. The cobble beach limits the extent of fine materials that could be disturbed.	Same as Alternative A.	Temporary increases in sediment and turbidity at Slate Creek Cove and Cascade Point from fill (both locations) and dredging (Cascade Point).	Temporary increases in sediment and turbidity at Slate Creek Cove and Echo Cove. Dredging activity in Echo Cove greater than in other locations.	Same as Alternative B.
		Operations: No anticipated impact under normal operations	Same as Alternative A.	Same as Alternative A.	Occasional (yearly) maintenance dredging in Echo Cove.	Same as Alternative A.
		Spills: Maximum potential spill 880 gallons based on design of ship-to-shore transfers, excluding catastrophic spill (e.g., vessel grounding). Spill would elevate concentrations of hydrocarbons in the water column on a localized basis.	Same as Alternative A.	Leaks from the crew shuttle boat and barges more likely at Slate Creek Cove than large-scale spills because of use of isotainers. At Cascade Point, the possibility of fueling-related spills exists, as well as leakage from the crew shuttle boat. Potential increase in low levels of hydrocarbons in the water column at Slate Creek Cove and Cascade Point minimized by the use of BMPs.	Same as Alternatives B and D for Slate Creek Cove. The possibility of fueling-related spills exists, as well as leakage from the crew shuttle boat. Potential increase in low levels of hydrocarbons in water column at Slate Creek Cove and Echo Cove minimized by the use of BMPs.	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Aquatic resources: marine (continued)	Nearshore marine organisms	*Construction:* Some mortality or displacement of non-mobile organisms during dredging operations. Recolonization of dredged area within a few years.	Same as Alternative A.	Fill at Slate Creek Cove and Cascade Point would permanently eliminate some intertidal and subtidal habitat. Dredging at Cascade Point would result in some mortality or displacement of non-mobile organisms. Recolonization of dredged area within a few years.	Less fill at Slate Creek Cove would reduce the loss of intertidal and subtidal habitat compared to Alternatives B and D. Some mortality or displacement of non-mobile organisms during dredging within Echo Cove. Recolonization of dredged area limited because of maintenance dredging.	Same as Alternative B.
		Operations: Minimal effects.	Minimal effects.	Minimal effects.	Some potential effect from maintenance dredging in Echo Cove.	Minimal effects.
		Spills: Potential contamination of intertidal and subtidal organisms depending on size and distribution of spill. Spilled material would be short-lived due to high-energy nature of Comet Beach.	Same as Alternative A.	Contaminants spilled at Cascade Point would dissipate quickly due to wave action and flushing. Likelihood of a spill would be small. Diesel spills in Slate Creek Cove unlikely due to the use of isotainers. Spills of process chemicals could have short-term acute effects in vicinity of spill.	Due to calm waters within Echo Cove, organisms in the vicinity of the Echo Cove dock could have a longer exposure to chronic levels of contaminants that persisted in the environment if a spill was not adequately cleaned up. Likelihood of a spill would be small. Slate Creek Cove same as Alternatives B and D.	Same as Alternative B.
	Marine mammals	*Construction:* Minimal effects.	Same as Alternative A.	Activities including pile driving at Slate Creek Cove could affect marine mammals during construction. Effects minimized by prohibition on construction during the eulachon run.	Same as Alternative B.	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Aquatic resources: marine (continued)		*Operations:* Minimal effects.	Same as Alternative A.	Potential vessel strikes to humpback whales from crew shuttle boat and barges minimized by reducing vessel speed at peak use time. Underwater noise from and general presence of crew shuttle could affect behavior of Steller sea lions and seals in vicinity of Slate Creek Cove.	Same as Alternative B.	Same as Alternative B.
		Spills: Minimal effects due to the relatively infrequent use of the area by marine mammals.	Same as Alternative A.	Leaks from crew shuttle or barges unlikely to affect marine mammals. Catastrophic spill, although highly unlikely, could affect sea lions, seals, and whales, depending on timing.	Same as Alternative B.	Same as Alternative B.
	Fish	*Construction:* Temporary displacement during dredging. Pile driving could affect individual fish in the immediate vicinity of the activity.	Same as Alternative A.	Permanent displacement in filled areas of Slate Creek Cove and Cascade Point. Temporary displacement during dredging at Cascade Point. Pile driving could affect individual fish in the immediate vicinity of the activity. Construction would be prohibited during herring spawning.	Permanent displacement in filled areas of Slate Creek Cove. Temporary impacts during initial and maintenance dredging of Echo Cove. Pile driving could affect individual fish in the immediate vicinity of the activities at Slate Creek Cove and Echo Cove.	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Aquatic resources: marine (continued)		*Operations:* Minimal impacts. Acute and chronic exposure of sensitive life stages to petroleum hydrocarbons from fuel transfers at Comet Beach.	Same as Alternative A.	Potential short-term (minutes) displacement of schooling fish as crew shuttle passes over. Noise and lights associated with dock activity could affect herring spawning but would be avoided by expected ADNR prohibition of dock use during critical period.	Same as Alternative B.	Same as Alternative B.
		Spills: A spill of 880 gallons could expose fish to elevated hydrocarbon concentrations. Juvenile pink salmon present along the shoreline could suffer mortality depending on timing and size of a spill.	Same as Alternative A.	Very low potential for acute or chronic exposure of sensitive life history stages to hydrocarbons from vessel leaks at Cascade Point and Slate Creek Cove, further minimized by using BMPs. Fueling operations expected to be prohibited at Cascade Point from herring spawning through egg hatching.	Very low potential for acute or chronic exposure of sensitive life stages to hydrocarbons from vessel leaks at Echo Cove and Slate Creek Cove.	Same as Alternative B.
	Commercial fisheries	*Construction:* None if construction completed outside fishing openings.	Same as Alternative A.	None.	None.	None.
		Operations: Potential conflicts between fishing vessels and delivery barges during fishing openings.	Same as Alternative A.	Minimal effects.	Minimal effects.	Minimal effects.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Aquatic resources: marine (continued)		*Spills:* A spill occurring during a fishing opening could result in at least the perception of a contaminated catch. Potential impacts on juvenile pink salmon near shoreline.	Same as Alternative A.	Indirect impacts based on effects on larval/juvenile commercial species or prey species (herring/eulachon).	Same as Alternatives B and D plus a fuel spill in Echo Cove could affect the commercial and recreational harvest of Dungeness crab.	Same as Alternative B.
Wildlife	Habitat affected	268 acres affected from construction through operations, including 268 acres of wetlands and 134 acres of old growth.	187 acres affected from construction through operations, including 187 acres of wetlands and 104.3 acres of old growth.	195.5 acres affected from construction through operations, including 94 acres of wetlands and 140.6 acres of old growth.	215.5 acres affected from construction through operations, including 114 acres of wetlands and 149.3 acres of old growth.	197.5 acres affected from construction through operations, including 94 acres of wetlands and 141.7 acres of old growth.
Soils	Total disturbance	268 acres affected from construction through operations.	187 acres affected from construction through operations.	113 acres affected from construction through operations.	133 acres affected from construction through operations.	115 acres affected from construction through operations.
Vegetation	Total disturbance	268 acres.	187 acres.	118 acres.	134 acres.	120 acres.
	Impacts on productive old growth	135 acres.	104 acres.	141 acres.	149 acres.	142 acres.
Wetlands	Short-term loss	268 acres.	187 acres.	94 acres.	118.4 acres.	98.6 acres.
	Long-term loss	164 acres.	124 acres.	Wetland restoration figures not provided. Inundated areas would become aquatic habitat permanently. Reclamation should restore areas affected by fill placement and diversions.	Similar to Alternative B.	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Wetlands (continued)	Type of wetlands lost (majority)	Forested.	Forested.	Forested.	Forested.	Forested.
	Loss of function/ value	Temporary or permanent loss of hydrologic control (moderate to high value), sediment retention (low to high value), and riparian support (moderate to high value).	Temporary or permanent loss of hydrologic control (moderate to high value), sediment retention (low to high values), and riparian support (moderate to high values).	Temporary and permanent losses of carbon/detrital production export values (high value), wildlife habitat (moderate to high), and surface water control (moderate) primarily within the Slate Creek drainage.	Similar to Alternative B with the addition of the forested and muskeg wetlands affected by the diversion (1.2 acres) and expansion (11.2 acres) of Upper Slate Lake.	Same as Alternative B.
Land use/ recreation	Consistency with Forest Service management prescriptions	Consistent during operation and following mine closure.	Same as Alternative A.	Operations consistent with Modified Landscape LUD, but access road and TSF might not be consistent with a short section designated as Semi-primitive Non-Motorized.	Same as Alternative B.	Same as Alternative B.
	Change in land use patterns	No long-term changes anticipated. Displacement of small number of hunters during operations. Areas within mining footprint would change from a semi-primitive ROS to a Road Modified ROS until reclamation would be completed.	Same as Alternative A.	Crew shuttle and barge activity within Berners Bay might affect some recreational users. Three to five round trips per day for the crew shuttle and three to four barges per week. Areas within mining footprint would change from a semi-primitive ROS to a Road Modified ROS until reclamation was completed.	Similar to Alternative B except for presence of the crew shuttle boat in Echo Cove rather than Cascade Point.	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Visual resources	Effects on achievement of Visual Quality Objectives (VQOs)	Borrow pits, DTF, roads, and structures would probably not meet VQO (Modification) during operations. Would likely meet VQOs after reclamation.	Similar to Alternative A, although the DTF and till borrow area would be smaller.	During operations, the Slate Creek Cove facility would not conform to the Retention VQO. Other aspects of the project would meet applicable VQOs.	Same as Alternative B.	Same as Alternative B.
	Views from Visual Priority Travel Routes (VPTRs)	DTF and process area visible from Lynn Canal.	Similar to Alternative A, although DTF would be smaller.	Waste rock storage near Kensington portal visible from Lynn Canal. Cascade Point and Slate Creek Cove marine terminals would create visual impacts from VPTRs in Echo Cove and Berners Bay. Pipeline access road across Snowslide Gulch visible from portions of Berners Bay, including Berners Bay cabin. Small features of Jualin process area might be visible from northern end of Berners Bay.	Similar to Alternative B except dock in Echo Cove would create less visual impact than the breakwater at Cascade Point.	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Socioeconomic resources	Direct employment and payroll effects	Increase of 164 and 338 workers during first and second years of construction, respectively, and average of 253 workers during operations. Local hiring as high as 50 percent, including some commuters from Haines.	Same as Alternative A.	Increase of 135 and 179 workers during first and second years of construction, respectively, and average of 225 workers during operations. Local hiring as high as 50 percent, primarily from Juneau.	Same as Alternative B.	Same as Alternative B.
	Housing effects	Total housing requirement would increase by 45 units during each of the 2 years of construction and by 127 units during operations, assuming 50 percent local hire. Might cause short-term pressure on local housing market.	Same as Alternative A, although shorter operational life.	Total housing requirement would increase by 79 and 35 units during first 2 years of construction and by 240 units in Juneau during operations, assuming 50 percent local hire. Might cause short-term pressure on local housing market.	Same as Alternative B.	Same as Alternative B.
	Effects on CBJ revenues and expenditures	Increase in property tax revenues. Increase in sales tax revenues. Increase in revenues from state sources. Possible increase in workload and related cost for CBJ.	Same as Alternative A, although shorter operational life.	Similar to Alternative A1.	Similar to Alternative A1.	Same as Alternative A1.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Cultural resources	Historic properties or culturally significant sites	No impacts on traditional cultural properties. Adverse impacts on 11 sites eligible for inclusion in the National Register of Historic Places would be mitigated per the MOA.	Same as Alternative A.	No impacts on traditional cultural properties. Adverse impacts on 14 sites eligible for inclusion in the National Register of Historic Places would be mitigated per the MOA.	Same as Alternative B.	Same as Alternative B.
Noise	Locations of receivers hearing project-related noises	Blasting and loading/offloading operations could be heard by receivers in Lynn Canal (e.g., ferry, cruise ships). Helicopter flights audible in Echo Cove and western portions of Berners Bay.	Same as Alternative A.	Blasting (construction) would be heard by receivers in Berners Bay, including at the Berners Bay cabin. Barge loading/unloading operations audible at Cove Point under some conditions. Loading and truck noises potentially audible at head of Berners Bay. Crew shuttle would be audible within 2,000 feet depending on background conditions.	Same as Alternative B.	Same as Alternative B.

Table 2-9
Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Transportation	Barge traffic	Supply deliveries to and ore concentrate transport from Comet Beach; up to seven barges weekly during construction and three or four weekly during operations.	Same as Alternative A.	Supply deliveries to Comet Beach early in construction phase, after which deliveries to and ore concentrate transport from Slate Creek Cove. Numbers of barges same as Alternative A.	Same as Alternative B.	Same as Alternative B.
	Employee transportation	Two to three trips daily Monday through Friday during operations (12 trips total).	Same as Alternative A.	Five crew shuttle trips daily (M–F) between Slate Creek Cove and Cascade Point. Three round trips on weekends.	Five crew shuttle trips daily (M–F) between Slate Creek Cove and Echo Cove. Three round trips on weekends	Same as Alternative B.
	Vehicle trips/ accident risk	10,500 vehicle trips annually; accident probability 6.3 percent per year.	9,668 vehicle trips annually; accident probability 5.8 percent per year.	5,350 vehicle trips on access road annually; accident probability 9 percent per year.	Same as Alternative B.	Same as Alternative B.
	Fuel release due to accident	Risk of 5,000-gallon spill: 0.036 percent per year.	Risk of 5,000-gallon spill: 0.013 percent per year.	Risk of fuel truck accident at mine site: less than 0.04 percent per year; potential for fuel release and volume of spill very limited because of isotainer use.	Same as Alternative B.	Same as Alternative B.

The following paragraphs highlight the differences between Alternatives A and D. The focus is on these two alternatives because under Alternatives B and C, the operator could not comply with effluent limitations for the TSF discharge and, at the same time, meet the state's minimum instream flow requirements in East Fork Slate Creek below the TSF. Alternative C also provides for a marine terminal at Echo Cove rather than at Cascade Point. The expected mitigation at Cascade Point would, however, minimize effects on marine aquatic resources, while the Echo Cove location would affect existing recreational use of the cove, as well as require periodic dredging to allow crew shuttle passage.

- **Surface water quality.** The discharges to surface water under Alternatives A and D are predicted to meet applicable water quality standards protective of human health and aquatic life, although additional treatment for aluminum could have to be installed at the DTF discharge under Alternative A. Under Alternatives A and D, any sediment-related impacts on surface water would be minimized by the proper implementation of the BMPs required by Forest Service guidelines and EPA's storm water permit requirements. Alternative D presents a lower risk of fuel spills adversely affecting surface water quality because of the use of isotainers for diesel fuel transport.

- **Surface water hydrology.** Alternative A would affect the surface water hydrology by eliminating or altering the flows in the six ephemeral drainages in the DTF area. Alternative D would locally affect the hydrology in and between Upper and Lower Slate lakes. Neither Alternative A nor D would cause other surface water hydrology impacts in the drainages in the project area. This would be ensured by compliance with the minimum instream flow requirements that would be finalized in the State of Alaska's Title 41 permits.

- **Freshwater aquatic resources.** Both alternatives would cause the loss of resident fish species. Specifically, approximately 100 to 200 Dolly Varden char would be lost under Alternative A and about 1,000 Dolly Varden char would be lost under Alternative D. In each case the losses would be temporary. Under Alternative A, the diversions would be removed and the stream channels restored. Under Alternative D, the ecological risk assessment (Appendix C) reviewed by USEPA and ADNR shows that the fish populations in the TSF would be restored after closure. This would be further ensured by incorporation of the tailings cover requested by USEPA. The cover would provide a much larger area of shallow native material to support macroinvertebrate recolonization compared to existing conditions. No other impacts on resident fish are predicted in part because of ADNR's minimum instream flow requirements, as well as state and Forest Service standards and requirements for proposed construction or improvement of stream crossings. Neither Alternative A nor D would affect the segments of Sherman, Slate, and Johnson creeks used by anadromous fish.

- **Marine aquatic resources.** Alternative A has very limited predicted effects on marine resources, except impacts on nearshore organisms should a spill occur during fuel transfer at Comet Beach. Berners Bay provides important habitat for marine mammals, including threatened steller sea lions and, to a lesser extent, endangered humpback whales during the spring eulachon run. The crew shuttles and barges under Alternative D could affect individual marine mammals, particularly from vessel noise and other physical disturbance. However, as documented in the BA/BE (Appendix J), there would be no adverse impacts because of the mitigation measures expected to be required by the USACE, state, and local permits. The measures would likely include prohibitions on construction during critical times; reduced crew shuttle trips, crew shuttle speeds, and barge traffic during the eulachon run; adherence to NMFS guidelines for approach distances; prohibition on fueling at Slate Creek Cove; and the presence of an NMFS observer on the crew shuttle boats.

The Pacific herring stock in southeast Alaska has been declining over the past 20 years. The construction of the breakwater would eliminate some herring spawning habitat, although there is the potential for recreating this habitat in the future. The State of Alaska has determined that impacts on herring during operations would be minimized by the mitigation measures expected to be included in federal, state, and other permits (see Appendix K). These measures include dedicating the site to mine transportation, requiring fueling from trucks, avoiding in-water construction during herring spawning, and likely limiting use and prohibiting fueling during critical herring spawning and early life stage periods.

The likelihood of a catastrophic spill in Berners Bay associated with mining operations is negligible.

- **Wildlife.** Although there are slight differences between Alternatives A and D in terms of effects on wildlife habitat for different species, the impacts are generally comparable and small in the context of overall available habitat in the area. Under Alternative D, potential effects on birds that congregate in Berners Bay during the eulachon run would be minimized by the same mitigation measures described above for marine aquatic resources.

- **Wetlands.** During operations Alternative D would disturb approximately 197 acres, of which 99 acres are wetlands, while Alternative A would disturb 268 acres, all of which are wetlands. Following reclamation most wetlands would be restored, under Alternative D, while Alternative A would result in the permanent loss of 170 acres of forested and scrub-shrub wetlands. The wetlands in and around Lower Slate Lake that would be affected by Alternative D have important wildlife and aquatic habitat functions and values. The TSF would be restored to equivalent or better aquatic habitat after closure.

- **Recreation.** Alternative A would affect recreational use in Lynn Canal through the visual quality impacts described below. In addition, helicopter traffic and noise would affect the recreational experience both in Lynn Canal and at the mouth of Berners Bay. Alternative D would generally not preclude recreational use because of current minimal direct use of the mine area. It would, however, affect the recreational experience in the bay through both noise and visual effects. Such impacts would be limited by the relatively low number and duration of crew shuttle trips during daylight hours, as well as the CBJ's requirement to allow use of the Cascade Point facility only for mine-related transportation.

- **Visual resources.** Under Alternative D, the marine terminals at Cascade Point and Slate Creek Cove would have some visual effects on users of Berners Bay. Under Alternative A, however, the DTF, borrow areas, and roads would probably fail to meet the applicable visual quality objectives and would cause broad visual effects on the visual priority travel route in Lynn Canal. The duration of the effects would be long-term because of the extended time that would be required to complete reclamation of the DTF. In contrast, visible mine and marine terminal facilities under Alternative D are expected to be removed immediately after mine closure.

- **Transportation.** Under Alternative D, the use of Slate Creek Cove would offer more reliable conditions for marine transportation. These conditions would reduce the need to store excess fuels, chemicals, and materials on-site and would minimize the risks to personnel safety, although accident and spill risks would generally be low for both alternatives.

- **Socioeconomics.** Both Alternatives A and D would bring direct and indirect employment benefits and revenue to the CBJ. The low-migration (50 percent local hire) scenario is realistic because of the operator's commitment to hiring locally and providing job training in the community. Under this scenario, the impacts on local services would be minor, although there could be some short-term increases in housing costs.

- **Cumulative effects.** Alternative D would generally have greater cumulative effects than Alternative A because of proposed development activities in and around Berners Bay. For most of the resources for which cumulative impacts would be likely, e.g., surface water, wildlife, and aquatic life, both the incremental and combined effects would be small, especially given the limited past, current, and reasonably foreseeable future development in the area. Mine expansion would cause loss of additional aquatic life in Upper Slate Lake and extend the duration of impacts. The proposed road under the Juneau Access Improvement project would cause cumulative impacts on the recreational users of Berners Bay. As documented in the 1992 Final EIS and 1997 Final SEIS, the increased helicopter traffic under Alternative A beyond current uses would also affect the wildland character of Berners Bay.

For air quality, geotechnical engineering, ground water, soils, vegetation, and cultural resources, few or no long-term impacts are predicted for any alternatives, taking into consideration required mitigation measures.

2.7 AGENCIES' PREFERRED ALTERNATIVES

2.7.1 Forest Service's Preferred Alternative

On the basis of the analysis contained in this SEIS, the Forest Service's preferred alternative, which will provide the basis for an Amended Plan of Operations for the Kensington Mine, is Alternative D. The ROD at the beginning of this Final SEIS contains the rationale for selection of the Forest Service's preferred alternative.

2.7.2 Environmental Protection Agency's Preferred Alternative

USEPA participated as a cooperating agency in the preparation of this SEIS and has indicated its intent to adopt the SEIS to support its ROD. As required by regulations at 40 CFR 1508.14, USEPA has provided a letter to the Forest Service identifying the Agency's preferred alternative, including a discussion of the alternative USEPA considers to be environmentally preferable. The complete text of USEPA's letter is in Appendix K of the SEIS.

On the basis of current information, USEPA has concluded that Alternative A would have less adverse environmental impact than Alternative B, C, or D. Alternative A, on the basis of the current record, also appears to be a practicable and feasible alternative because it uses standard industry technology in use at other mines in Alaska and was fully permitted in 1998. For the above reasons, Alternative A is USEPA's preferred alternative.

The letter indicates that USEPA's conclusion is based on the current record without benefit of a completed Biological Opinion from NMFS or a completed Clean Water Act section 404(b)(1) analysis from the U.S. Army Corp of Engineers (USACE) evaluating the least environmentally damaging practicable alternative. As a footnote, the letter also states:

> *While EPA understands that there are some ongoing discussions among various state and federal agencies about possible measures to mitigate the*

> *ecological impacts to Berner's Bay, it is not yet clear what those measures will be because both the Alaska Department of Natural Resources and NOAA Fisheries have proposed measures, but no consensus has been reached as to which proposed measures will be implemented.*

State of Alaska's Preferred Alternative

The State of Alaska has participated as a cooperating agency in the preparation of this SEIS and has indicated its intent to use the SEIS to support decisions and certifications within its jurisdiction. The State has provided a letter to the Forest Service identifying its preferred alternative, including a discussion of the alternative it considers to be environmentally preferable. The complete text of the State's letter is in Appendix K of the SEIS.

The State concluded that, when evaluated in their entirety, with all components included and with all mitigation considered, Alternatives A and D are essentially equivalent in terms of effects on the environment. The State, after a review of cost information, also concluded that Alternative A was not a practicable or reasonable alternative from the standpoint of cost or economics. For the above reasons, Alternative D is the State of Alaska's preferred alternative.

Section 3

Affected Environment

SECTION 3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

Section 3.0 describes the baseline condition for the area affected by any of the alternatives. The extent of the area analyzed and discussed in this Final SEIS is the same as that described in the 1992 FEIS, which included alternatives or project components located in the Slate, Johnson, and Sherman creek drainages. For clarification purposes, the term *project area* is defined as the specific area within which all surface disturbance and development activities would occur. The term *study area* is defined as the larger peripheral zone around the project area within which most potential direct or indirect effects on a specific resource are likely to occur. The project area, therefore, is consistent across all resources within an alternative, whereas the study area is variable from one resource to the next.

The 1992 FEIS provided a description of the affected environment with a project area that encompassed both the Kensington and Jualin areas. Section 3.0 of the 1997 SEIS referred to Section 3.0 of the 1992 FEIS extensively, supplementing discussions only where new information was available. This document summarizes resource information presented in both the 1992 FEIS and 1997 SEIS and includes new data that have become available since those documents were completed. The discussions of individual resources identify the new or revised information.

Although Section 3.0 describes the resources in the project area individually, it is important to recognize the complexity of relationships among the various resources that as a group form the local ecosystem. The relatively undisturbed nature of many places in Southeast Alaska, including the project area, reinforces the interconnectivity and interdependence of these resources. Old-growth forests provide habitat for species such as marbled murrlets, bald eagles, marten, and deer. The forests stabilize the soil, preventing the accumulation of sediment in the streams and rivers. Water bodies such as Slate and Spectacle lakes support waterfowl and fish. Adjacent emergent and shrub wetlands provide habitat to migratory birds and moose.

Berners Bay supports a diverse range of sensitive habitats for birds, fish, and wildlife. The silt and sand deposited by the glacially fed Lace and Antler river systems form an extensive intertidal mudflat at the head of the bay and estuary where the fresh waters combine with the marine waters of Berners Bay and Lynn Canal. The Berners, Lace, and Antler rivers and Johnson and Slate creeks all support anadromous fish populations including salmon and Dolly Varden char.

Eulachon gather in the waters of Berners Bay each spring before moving into the shallows of the Lace, Berners, and Antler rivers to spawn. While in the marine environment, these fish serve as an important food source for humpback whales and Steller sea lions at a critical time prior to pupping. As the eulachon move into the freshwater tributaries to spawn, they are pursued by the sea lions and by harbor seals and also preyed upon by numerous species of birds. The annual eulachon run ultimately draws hundreds of sea lions and tens of thousands of birds to Berners Bay. A similar scene is repeated as bears and birds feed on salmon returning to rivers and streams, including Slate, Johnson, and Sherman creeks. These events are further tied to human uses, including recreation and fishing, the value of which is difficult to quantify in terms of economics.

3.2 AIR QUALITY AND CLIMATE

3.2.1 Air Quality

Air quality is regulated under the Clean Air Act using National Ambient Air Quality Standards (NAAQS). The U.S. Environmental Protection Agency (USEPA) developed the NAAQS, shown in Table 3-1, to protect public health and welfare, and the state of Alaska adopted them. The primary standards represent the air quality levels, with an adequate safety margin, that are required to protect public health. The secondary standards represent the air quality levels necessary to protect public welfare. These standards must be met outside a facility's property boundary.

In addition to the NAAQS, USEPA has developed Prevention of Significant Deterioration (PSD) increment standards that limit the incremental increase in air pollutant concentrations above the concentrations as of a specific date, called a baseline date. Baseline dates are set upon completion of a major source permit application that is deemed complete by the permitting authority. PSD increments have been set for particulate matter with a diameter of less than 10 microns (PM_{10}), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2). The Kensington Gold Project is in the Southeast Alaska Intrastate Air Quality Control Region, where baseline dates have been set for SO_2 and NO_2. Thus, the incremental increases of SO_2 and NO_2 must be below the levels set by USEPA, which are shown in Table 3-2. Like the NAAQS, the PSD increments must be met outside a facility's property boundary.

The air quality in the vicinity of the Kensington Gold Project site is good, with air pollutant concentrations well below ambient standards. The nearest stationary air pollution sources, other than those at the Kensington site, are 25 miles away at Haines. The absence of nearby air pollution sources, along with abundant rainfall, suggests that existing background pollutant concentrations at the Kensington site are low. On rare occasions, elevated PM_{10} concentrations are present in the project area when wood smoke or smoke from fires is carried south from the Yukon by northerly winds (Guay, 2003, personal communication).

Table 3-1
National and Alaska Ambient Air Quality Standards

Pollutant	**Averaging Period**	**Primary Standard ($\mu g/m^3$)[a]**	**Secondary Standard ($\mu g/m^3$)[a]**
Nitrogen dioxide	Annual arithmetic mean	100	100
Sulfur dioxide	3-hour 24-hour Annual arithmetic mean	NA 365[b] 80	1,300[b] NA NA
Particulate matter less than 10 microns in diameter (PM_{10})	24-hour Annual	150[b] 50	150[b] 50
Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$)	24-hour Annual	65 15	65 15
Carbon monoxide	1-hour 8-hour	40,000[b] 10,000[b]	NA NA
Lead	3-month	1.5	1.5
Ozone	1-hour	235[c]	235[c]

[a] Micrograms per cubic meter.
[b] Not to be exceeded more than once per calendar year.
[c] Not to be exceeded more than 1 day per calendar year.

Table 3-2
Prevention of Significant Deterioration Increments for Sulfur Dioxide and Nitrogen Dioxide

Pollutant	Averaging Period	PSD Class II Increment ($\mu g/m^3$)[a]
Nitrogen dioxide	Annual	25
Sulfur dioxide	3-hour	512[b]
	24-hour	91[b]
	Annual	20

[a] Micrograms per cubic meter.
[b] Not to be exceeded more than once per calendar year.

No air pollutant monitoring data sets are available from the Kensington site or in the immediate vicinity. However, air pollutant background data were measured in the general area of the project site and are adequate to characterize the airshed where the Kensington project is located (ADEC, 2003). These background data are given in Table 3-3. All background pollutant concentrations are below national and Alaska Ambient Air Quality Standards. The lack of existing sources of air pollutant emissions in the area and the low representative background concentrations indicate that the area is in compliance with the NAAQS. USEPA has designated the geographic region either “attainment” or “unclassifiable” for all criteria pollutants (18 AAC 50.015). This means that the region meets the ambient air quality standard for each pollutant or there are insufficient data to make a determination. Any area that does not meet the ambient air quality standard for a given pollutant is designated “non-attainment” by USEPA.

Table 3-3
Background Pollutant Concentrations

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)[a]
Nitrogen oxides	Annual	3
Sulfur dioxide	3-hour	9.8
	24-hour	7.2
	Annual	2.6
Particulate matter less than 10 microns in diameter (PM_{10})	24-hour	7.9
	Annual	1.8

[a] Micrograms per cubic meter.

3.2.2 *Climate*

The climate at the Kensington Gold Project site is similar to that of Juneau. It is a maritime climate without large diurnal and seasonal temperature variations. Temperature extremes are limited in this temperate oceanic climate because onshore winds carry the cool, maritime air inland.

Meteorological data collected at the Kensington project site and at the Jualin Mine from October 1995 through October 1997 provide information on the climate at the location of the proposed activities (Earthworks, 2002a). At each monitoring site, instrumentation (to measure wind speed, wind direction, temperature, and precipitation) was mounted on a 10-meter tower in a forest clearing near areas where proposed Kensington mining activities would occur. The temperatures at the Kensington and Jualin sites demonstrate the maritime effects: they are reasonably uniform and lack large daily variations.

The Kensington and Jualin sites had similar temperature ranges during the 2-year monitoring period. The average annual temperature was 39.0 degrees Fahrenheit (°F) for the Kensington site and 38.8 °F for the Jualin site. Winter temperatures generally ranged from lows of 20 to 30 °F to highs near 40 °F. Summer high temperatures were near 60 °F, while the lows were typically around 55 °F. The maximum recorded temperature during the period was 82 °F, and the minimum recorded temperature was –8.9 °F (TRC, 1998a, 1998b).

Eldred Rock weather station has operated over a long period (1941, and 1943 to 1973). It is the closest National Weather Service-certified weather station to the Kensington site (approximately 6 miles north). The average annual temperature for the Eldred Rock weather station was 41.4 °F. The lowest temperature recorded was –20 °F.

Rainfall is heavy and frequent at the Kensington site. Precipitation occurs at least 180 days per year. Limited precipitation data collected at on-site monitoring stations showed annual precipitation rates between 63 and 81 inches.

Based on on-site measurements, the wettest month of the year is September, which received an average monthly rainfall of 10.8 inches during the collection period. The driest month is April, which received an average of 2.3 inches. An examination of long-term precipitation data from Eldred Rock indicates that on 29 days per year precipitation amounts exceed 0.5 inch per day, on 52 days rainfall exceeds 0.25 inch per day, and on 106 days rainfall exceeds 0.1 inch per day. Based on measurements, at least 1.0 inch of snow falls approximately 48 days per year.

Precipitation, including snow, increases significantly from sea level to the top of Lions Head Mountain at 5,500 feet. Based on the long-term precipitation data for Eldred Rock, the following average annual precipitation values correspond to elevation: sea level = 47 inches; 800 feet = 58 inches; 5,000 feet = 200 inches (Knight Piesold, 1996). Table 3-4 presents the monthly distribution of precipitation at the 850-foot elevation. Approximately 40 percent of annual precipitation falls during September, October, and November. The 24-hour probable maximum precipitation event at the site is 17.26 inches (Forest Service, 1997a). Average annual evaporation at the site is approximately 17 inches, most of which occurs from April through September (Knight Piesold, 1990).

Table 3-4
Average Monthly Precipitation at 850-Foot Elevation

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Precipitation (inches)	4.1	4.8	3.3	2.6	3.0	2.2	3.1	4.5	7.5	11.0	6.8	5.4	58.3
Percentage of Annual	6.9	8.3	5.7	4.5	5.2	3.8	5.3	7.8	12.8	18.9	11.7	9.2	100.0

Note: Precipitation data were estimated by increasing values from Eldred Rock Station (1941; 1943–1973) by 25 percent to account for orographic effects.

Source: Forest Service, 1997a.

The long-term wind flow patterns are significantly different between the Kensington monitoring site and the Jualin monitoring site. Winds blow predominantly from the east through southeast at the Kensington site and from the north through northeast at the Jualin site. This difference in wind direction can be attributed to drainage flows at the two sites. Winds tend to follow the Sherman Creek canyon axis at the Kensington site, with only rare occasions of cross-canyon airflow because the wind is channeled up and down the valley. The winds at the Jualin site are channeled along the Johnson Creek drainage. Down-valley wind flow dominates at both sites because of the air density differences that develop between the top and bottom of each valley.

The project site is characterized by relatively low average wind speeds. The average wind speed is 4.3 miles per hour at the Kensington site and 2.2 miles per hour at the Jualin site. High-wind episodes are unusual at either site. The low wind speeds are caused, in part, by the sheltering effect of the trees.

The potential for dispersion of airborne pollutants at the Kensington site can be estimated by the stability class, or measure of atmospheric turbulence. Stability classes are divided into six categories, designated "A" through "F." The greatest potential for pollutant dispersion occurs during Stability Class "A" and the least is during class "F." The on-site distribution of stability class is similar to that found in all of Southeast Alaska. Stability Class "A" occurs infrequently because of the lack of strong solar insulation. Stability class "D" (neutral stability) occurs most frequently at the project site, followed by stable atmospheres ("E" and "F" classes). The moderately high frequency of stable atmospheres for the area indicates that there is a potential for elevated air pollution on-site.

Atmospheric clarity is measured by visual range, which is the average distance at which contrasting objects can be discriminated. The background visual range at the Kensington site is small, only 40 kilometers (USEPA, 1988). The small visual range is caused by clouds and water vapor, which frequently obscure the sight of distant objects.

3.3 GEOLOGY AND GEOCHEMISTRY

The Kensington gold deposit occurs within a structurally sheared portion of the regionally metamorphosed Jualin Diorite stock. It has features typical of many mesothermal gold-quartz deposits, including a simple deposit mineralogy, an apparent absence of chemical zonation, low sulfide content, and low abundances of most metals. Mineralization occurs within a north-trending, east-dipping zone of discontinuous, en echelon (parallel) veins and vein swarms. The veins are composed primarily of quartz. Pyrite is virtually the only sulfide mineral, with trace amounts of chalcopyrite. Gold occurs in the mineral calaverite ($AuTe_2$) and native gold, in pyrite inclusions and along microfractures. Trace amounts of other tellurite minerals, petzite, coloradoite, and altaite, have been detected (Coeur, 1996). The majority of sulfides are contained within the ore zone (SRK, 1996b); pyrite concentrations in the surrounding waste rock range from zero to less than 1 percent, increasing with proximity to the ore body (Apel, 1994). Gold content is directly related to the volume of pyrite (Forest Service, 1992, 1997a) because it occurs almost exclusively as very fine grains (< 50 microns) along pyrite grain boundaries (EBE Inc., 1990).

The 1992 FEIS provides a description of the geology in the Sherman Creek valley applicable to the Kensington side of the operation. This valley was formed by glaciers that deposited dense, silty clay tills, ranging from a thin layer to over 180 feet in thickness, over bedrock. In some areas, relatively clean alluvial sands and gravels overlie the till.

The proposed project modifications include the establishment of access, milling, and administrative facilities on the Jualin side, located in the Johnson Creek drainage. Geologic mapping and a geophysical seismic refraction survey conducted in 2002 in the vicinity of the TSF embankment show that slate bedrock is at or near (less than 1 foot) ground surface, with a surface material of moss and organics known as muskeg (Knight Piesold, 2002). The bedrock is heavily fractured on the surface (upper 12 to 20 inches), steeply dipping and striking north-south. Glacial deposits of till and glacio-fluvial sand and gravel likely constitute some of the terraces that form Upper and Lower Slate lakes (Knight Piesold, 2002). Overall, the regionally extensive nature of the glaciation suggests that the geology in the Johnson and Slate creek drainages is similar to that of the Sherman Creek Valley.

To characterize the geochemical environment of the project area, representative samples of ore and waste rock from exploration activities, along with tailings from pilot milling operations, have been subjected to various geochemical analyses. In addition, effluent from the existing underground mine workings has been monitored. Results of these analyses are discussed in the sections below.

3.3.1 Underground Mine Workings

Mine effluent has been sampled seasonally for a broad range of constituents in the Sherman Creek drainage at the 850- and 2,050-foot level portals (stations 101A and 108, respectively) since 1987. Water samples have also been collected from the outfall of the mine effluent sedimentation pond (station 101) and from Lower Ophir Creek downstream from the sedimentation pond (station 103) (SAIC, 1997).

As is the case at other surface water monitoring stations in the Sherman Creek drainage, water influenced by mine effluent is generally of a quality consistent with that expected in a mineralized area. Although various metals have been detected intermittently at most monitoring stations, no stations have consistently recorded elevated levels of particular constituents. However, station 101A was sampled on only five occasions. Water collected at stations 101A, 101, and 103 is characterized as a calcium sulfate type, reflecting association with sulfide minerals in the ore body; all other stations in the drainage have calcium bicarbonate-type water. Surface water in the Sherman Creek drainage is consistently neutral, with pH values ranging from 6.2 to 8.6 (Earthworks, 2003b; SAIC, 1997). Section 4.5 presents additional discussion of mine water characteristics and data.

3.3.2 Ore

The 1997 FSEIS concluded that ore material does not pose a significant risk of acid rock drainage or metal release based on ore characterization studies. These studies include static acid-base accounting (ABA) tests, whole rock trace metals analyses, kinetic humidity cell tests, a meteoric water mobility test (MWMT), and a toxicity characteristic leaching procedure (TCLP), which are described and summarized by SAIC (1997), SRK (1996b), and Geochemica Inc. and Kensington Venture (1994).

The ratio of neutralization potential to acidification potential (NP:AP) was used to predict the risk of acid rock drainage. Material with an NP:AP ratio greater than 3 poses little risk of acidification, while material with an NP:AP ratio less than 1 can potentially produce acid. Ratios between 1 and 3 are inconclusive (BLM, 1996).

Geochemica Inc. and Kensington Venture (1994) determined the NP:AP ratio of 591 ore samples collected from 39 drill holes. These determinations were somewhat conservative because potential acidity was calculated from total sulfur rather than just sulfide sulfur. On the basis of a length-weighted average of the samples from each drill hole, 1 of 39 drill holes had an NP:AP ratio less than 3 (Geochemica Inc. and Kensington Venture, 1994). SAIC (1997) evaluated the NP:AP data on an individual (non-weighted average) sample basis, excluding data from 10 of 591 samples for which only partial data were collected. On an individual basis, 39 percent had an

NP:AP greater than 10, while 21.8 percent had an NP:AP between 1 and 3 and 8.1 percent had an NP:AP of less than 1. The remaining 31.1 percent of samples had NP:AP ratios between 3 and 8. The individual drill core samples had a mean sulfur content of 1.30 percent (range from 0.01 to 22.0 percent), while length-weighted samples had a mean sulfur content of 1.27 percent (range from 0.4 to 30.8 percent).

The low acidification potential of over 90 percent of the ore tested is also supported by consistently neutral pH values measured in mine water drainage (Earthworks, 2003; SAIC, 1997) and in leachate collected during humidity cell testing of a bulk ore sample considered to have above-average (1.94 percent) sulfur content (SRK, 1996b).

Compositional analyses performed on bulk ore samples show that silica, oxygen, aluminum, calcium, iron, magnesium, manganese, phosphorus, and sodium are the major constituents of this material (SAIC, 1997). A 20-week humidity cell test of the leaching potential of a composite ore sample was performed by Lakefield Research (1995), as reported by SAIC (1997) and SRK (1996b). Effluents produced during leach testing maintained metal concentrations that, when detected, remained relatively constant after the initial flush. Sulfate levels were more variable but remained below 150 mg/L.

The extract produced during the MWMT had a pH of 7.3 and contained calcium (35.8 mg/L), potassium (49 mg/L), magnesium (11.3 mg/L), and sulfate (123 mg/L) as major constituents (SAIC, 1997). Other elements were present at trace concentrations, including iron at 0.23 mg/L. Leachate collected during TCLP testing contained arsenic (0.007 mg/L), barium (3.3 mg/L), cadmium (0.048 mg/L), lead (0.1 mg/L), mercury (0.0008 mg/L), and silver (0.015 mg/L) (SAIC, 1997). The TCLP test indicates metals that are soluble under the acidic (pH 5) conditions of the test, which are not, however, considered representative of field conditions at the Kensington site.

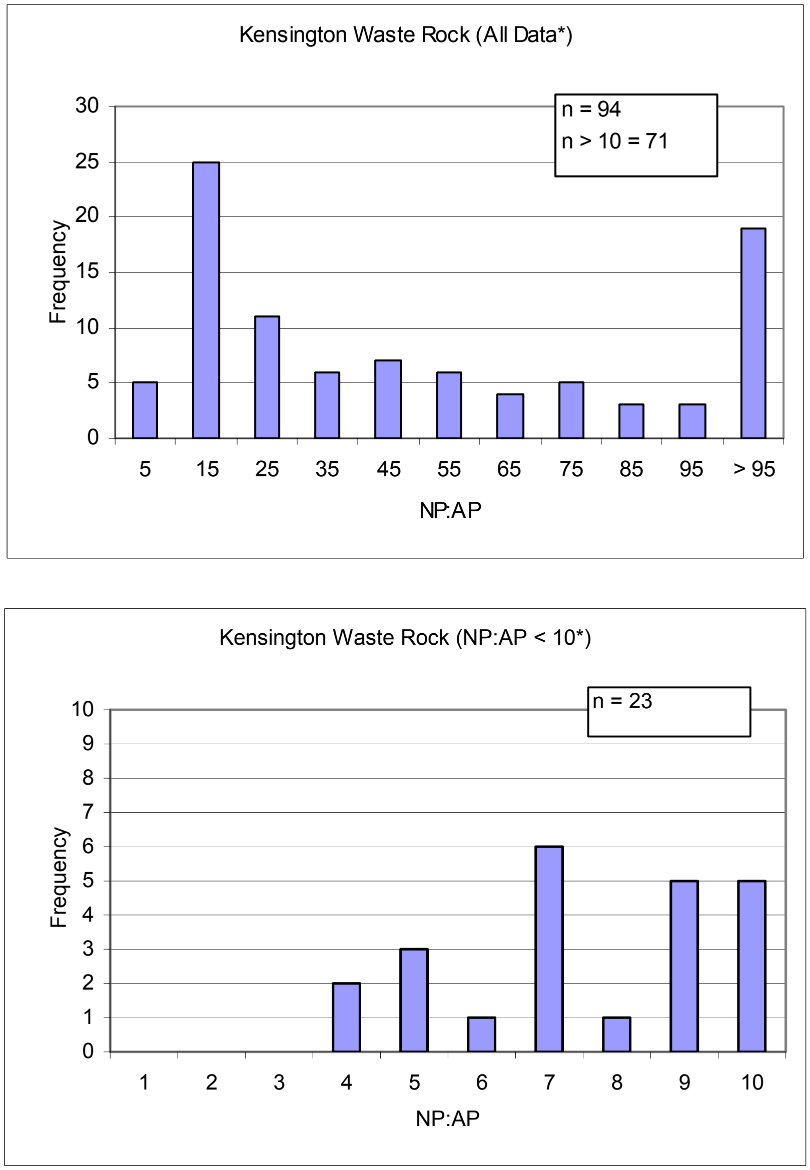
3.3.3 Waste Rock

Waste rock from the Kensington deposit is primarily slightly altered to unaltered diorite, although minor amounts (less than 5 percent) of metabasalt might also be mined (SAIC, 1997).

ABA, MWMT, TCLP, and modified synthetic leach tests have been conducted to determine the potential for acid production and metal release from waste rock material. Methods and results of acid-base accounting were originally reported by Geochemica Inc. and Kensington Venture (1994). A summary of these and the other tests is given by SRK (1996b) and SAIC (1997). Sampling focused on dioritic materials (SAIC, 1997).

SAIC (1997) compiled ABA results for 108 samples originally reported by Geochemica Inc. and Kensington Venture (1994) and SRK (1996b) (Figure 3-1). Seventy-five samples were representative of waste rock in the expected development area (Group 1A and 1B samples), while the remainder represented waste rock from nearby areas outside the expected development area (Group 2 samples). All samples had NP:AP values exceeding 3, and 42 of the 75 Group 1 samples had NP:AP values greater than 50, indicating minimal potential to generate acid rock drainage.

An MWMT was conducted on a sample of waste rock, although data regarding sample size, collection, and degree of representativeness were not reported. The leachate contained calcium (64.3 mg/L), potassium (14.0 mg/L), magnesium (69.8 mg/L), and sulfate (349.0 mg/L) as the major constituents (SAIC, 1997). Other elements, including iron (0.18 mg/L), were present in



Source: SAIC, 1997.

FIGURE 3-1. HISTOGRAMS OF ACID-BASE ACCOUNTING DATA FOR INDIVIDUAL KENSINGTON WASTE ROCK SAMPLES

trace concentrations, and the pH was 7.9. Of the constituents measured, only sulfate exceeded the applicable water quality criterion of 250 mg/L. (Note that the applicable water quality criteria are discussed in detail in Appendix A.)

Twelve waste rock samples were subjected to a modified USEPA 1312 synthetic precipitate leaching procedure (SPLP) (SRK, 1996b). Results of this testing are also reported by SAIC (1997). The primary constituents detected in the SPLP leachate were aluminum (average = 0.73 mg/L), calcium (average = 16.7 mg/L), magnesium (average = 1.14 mg/L), potassium (average = 9.75 mg/L), and sodium (average = 11 mg/L). Antimony, berylium, cadmium, chromium, cobalt, lead, mercury, nickel, selenium, silver, and thallium were not detected in any sample. Arsenic, barium, copper, iron, manganese, vanadium, and zinc were detected in some samples, usually at or slightly above the detection limit. Only aluminum was detected above the applicable water quality criterion.

No evidence of acidic drainage or adverse impacts on the environment have been observed due to weathering of historical (up to 80 years old) waste rock piles present in the district (Geochemica Inc. and Kensington Venture, 1994). However, the geologic relationship between waste rock from historical operations and that from proposed future mining operations has not been defined. Runoff from the existing Kensington mine development rock pile has been collected, routed through sediment ponds, combined with mine drainage, and discharged via outfall 001. Discharge monitoring has shown consistently neutral pH.

3.3.4 Tailings

A significant amount of work has been performed to characterize the geochemical properties of the tailings. Most of this work, however, has been performed on combined flotation (rougher) and carbon-in-leach (CIL) tailings, which would have been produced by a process no longer being considered for the project. Under all alternatives, only rougher tailings would be produced at the mine.

Montgomery Watson (1996b) described the process by which pilot-scale ore processing was performed on a 3,000-pound composite ore sample to create rougher tailing samples, which were analyzed for geochemical characteristics. An abbreviated overview of the Montgomery Watson report is available in SAIC (1997). The composite ore sample was formulated by mine geologists and was considered representative of the ore produced over the life of the mine. The ore sample had a total sulfur content of 1.83 percent and a sulfide sulfur content of 1.74 percent (SAIC, 1997). The rougher tailing solids produced from the composite ore sample were subjected to ABA, column leach tests, and total metals analysis; the tailings decant water was analyzed for total metals and other parameters (SAIC, 1997).

Acid-base accounting tests showed the tailing solids to be net-neutralizing. As sulfide is removed from the tailings during processing, this material is more strongly neutralizing than waste rock produced during project operations (SRK, 1996b). Montgomery Watson (1996b) determined the total sulfur content to be 0.04 percent, corresponding to an NP:AP of 83, while SRK (1996b) measured a total sulfur content of 0.02 percent, corresponding to an NP:AP of 166. As is the case for ore and waste rock characterization, potential acidity was conservatively determined based on total sulfur, rather than sulfide sulfur, concentration.

Two subsamples of the rougher tailings were placed into columns and leached with five pore volumes of deionized water that was adjusted to pH 4.5 with hydrochloric acid (SRK, 1996b). Thirteen of the 22 analytes had total concentrations at or below their respective detection limits by the first or second pore volume. The majority of metals of concern, including cadmium, chromium, lead, mercury, and nickel, occurred in this group. The concentration of iron was relatively constant in the first four pore volumes, ranging from below detection to 0.06 mg/L. Iron was measured at 0.19 mg/L in the fifth pore volume. This concentration, however, was thought to be an anomaly due to laboratory error because of the non-detect value in the fourth pore volume and the fact that no other analyte concentrations increased in the fifth pore volume compared to the first pore volume (SAIC, 1997). Leachate pH remained near neutral throughout the test, ranging from 6.5 to 7.6. Sulfate was measured at 640 mg/L in the first pore volume, but it decreased to 50 mg/L by the second pore volume.

Tailings slurry produced during the 1996 pilot-scale ore processing was collected and allowed to settle, after which time the decant water was collected (SAIC, 1997). Decant water samples were analyzed for metals, nonmetallic anions, pH, hardness, total dissolved solids, and conductivity. A similar pilot-scale ore processing test was conducted by the Colorado Mineral Research Institute in 1998. Tailings slurry was again allowed to settle, and decant water was analyzed. The results from both the 1996 and 1998 tailings water analyses are presented in Table 3-5. Elevated ammonia and nitrate levels in the 1996 samples were associated with the residues from blasting operations. The 1998 data reflect analyses performed after implementation of the blasting best management practice (BMP) plan required by the National Pollutant Discharge Elimination System (NPDES) permit and associated reduced ammonia and nitrate levels. The chemical differences, including hardness, between the 1996 and 1998 samples reflect the addition of lime to the 1998 samples and resulting higher pH. Some differences are also a function of the more accurate analytical methods used in 1998.

Table 3-5
1996 and 1998 Tailings Decant Water Chemistry (Total Constituent Analyses)

		Montgomery Watson, 1996a					**Colorado Mineral Research Institute (CMRI), 1998**			
		Samples					**Samples**			
Parameter	**Units**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**
Aluminum	µg/L	< 500	< 500	< 500	< 500	< 500	2,800	3,900	3,100	1,100
Antimony	µg/L	NA	NA	NA	NA	NA	< 1	8.4	5.1	< 1
Arsenic	µg/L	0.573	0.665	0.559	0.628	0.618	< 2	2.1	1.8	2.9
Barium	µg/L	< 500	< 500	< 500	< 500	< 500	93	88	89	68
Beryllium	µg/L	NA	NA	NA	NA	NA	< 1	< 1	< 1	< 1
Cadmium	µg/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.203	0.195	0.141	0.178
Chromium	µg/L	< 20	< 20	< 20	< 20	< 20	6.5	9.08	11.9	3.34
Cobalt	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	µg/L	< 2	< 2	< 2	< 2	< 2	9.97	10.2	10.7	9.05
Iron	µg/L	130	150	62	99	76	4,000	140	1,900	1,500
Lead	µg/L	< 2	< 2	< 2	< 2	< 2	1.1	3.81	4.43	2.52
Manganese	µg/L	84	90	89	82	110	210	420	165	190
Mercury	µg/L	0.0009	0.00495	0.00483	0.00324	0.00339	0.0581	0.0506	0.0725	0.0332
Molybdenum	µg/L	< 500	< 500	< 500	< 500	< 500	74	82	81	71
Nickel	µg/L	< 10	< 10	< 10	< 10	< 10	8.12	9.18	11.8	5.81
Selenium	µg/L	0.871	1.03	0.787	1.13	1.23	4.7	2.91	2.56	3.18
Silver	µg/L	< 0.008	< 0.008	0.0158	0.008	< 0.008	< 0.05	< 0.05	< 0.05	< 0.05
Strontium	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	µg/L	NA	NA	NA	NA	NA	< 5.0	< 5.0	< 5.0	< 1.0
Vanadium	µg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	µg/L	< 10	< 10	< 10	< 10	< 10	83.5	20	23.4	12.7
Ammonia	µg/L	2,800	3,800	4,100	4,500	4,600	950	900	1,050	860
Nitrate	mg/L	20	28	33	35	36	4.1	4.8	5.6	4.0
TDS	mg/L	470	650	710	730	810	1,000	900	1,160	1,000
TSS	mg/L	< 4	6	< 4	< 4	< 4	5	240	110	70
SO4	mg/L	198	280	310	330	330	710	680	770	550
pH, field	s.u.	NA	NA	NA	NA	NA	10.5	10.2	10.25	10.3
pH, lab	s.u.	8.1	8	8.1	8.2	8.1	10.7	10.5	11	11.1
Hardness	mg/L	210	260	290	310	320	658	583	654	524

Note: NA = not available; s.u. = standard units.
See Appendix A for more detailed information on sampling and analysis procedures.
Source: CMRI, 1998; Montgomery Watson, 1996a.

3.4 GEOTECHNICAL STABILITY

Studies completed for the 1992 FEIS and refined for the 1997 SEIS identified general earthquake and avalanche hazards for the area surrounding the Kensington Gold Project. These studies used published regional information, as well as site-specific information based on aerial photography and field surveys. Most of the work focused on the Kensington side of the project; however, the findings have been extrapolated to the Jualin side. The site is influenced by two noteworthy faults that have regional implications regarding seismicity and associated earthquake hazards. Thus the potential influence on the Jualin side of the property can be inferred to be equivalent to that of the Kensington side, which was documented in the 1992 FEIS. Based on this documentation, the maximum credible earthquake would be a magnitude 6.5 to 7.0 on the Richter scale, producing peak ground acceleration of 0.5 to 0.6 times gravity.

The proposed project would be located on terrain with varying degrees of avalanche hazard, which would need to be considered during design, operation, and closure of the mine. High-hazard zones such as Snowslide Gulch would require special design and operating considerations to mitigate risks associated with avalanche occurrence.

The tailings embankment would be located at the outlet of Lower Slate Lake on a terrace feature that appears to be the result of past glacial activity. Geophysical and geological reconnaissance shows that relatively shallow slate bedrock underlies the embankment site. Surficial deposits of muskeg of varying thickness occur, and there is a relatively thin layer of weathered, fractured bedrock over the intact shale (Knight Piesold, 2002).

3.5 SURFACE WATER HYDROLOGY

Watersheds that would be affected by the proposed Kensington Gold Project are Sherman Creek (Figure 3-2), Slate Creek (Figure 3-3), and Johnson Creek (Figure 3-4). The following facilities could be located in each of the three watersheds:

- Sherman Creek – Kensington Mine (underground), DTF, mine discharge, road.
- Slate Creek – TSF, slurry and reclaim pipelines, roads.
- Johnson Creek – Kensington access tunnel, access roads, surface water supply, mill and office complex.

These watersheds are at the foot of Lions Head Mountain in the Kakuhan Range of the Coast Mountains. The three primary creeks are perennial and terminate at tidewater in Lynn Canal (Sherman Creek) and Berners Bay (Johnson and Slate creeks). Many creeks in the area exhibit intermittent flow, which is common in high-mountain, steep-gradient channels. As a result, accurate and consistent measurements of stream flow are difficult to obtain.

Information about surface water hydrology for Sherman Creek is contained in the 1992 FEIS and 1997 SEIS for the Kensington Gold Project. The 1992 FEIS also includes information about Slate Creek; however, neither document includes information about Johnson Creek. Primary supporting documents for surface water information include reports by Montgomery Watson (1996a, 1996b) and the *Technical Resource Document for Water Resources, Kensington Mine Project* (SAIC, 1997). This section and the surface water quality section summarize key information on surface water quantity and quality in the project area from the two previous EISs and the supplemental information obtained since 1997.

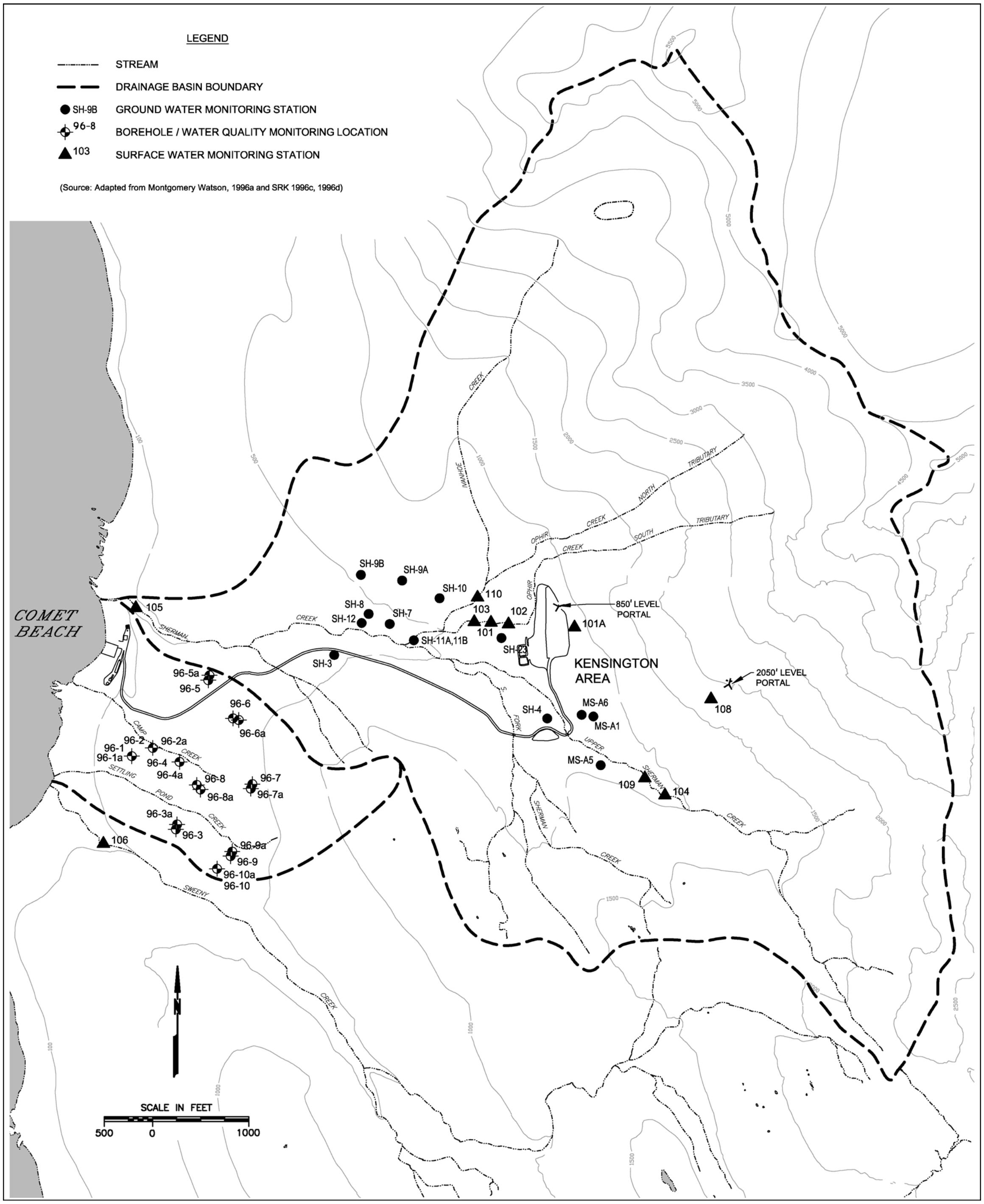


FIGURE 3-2. SHERMAN CREEK AND TERRACE AREA

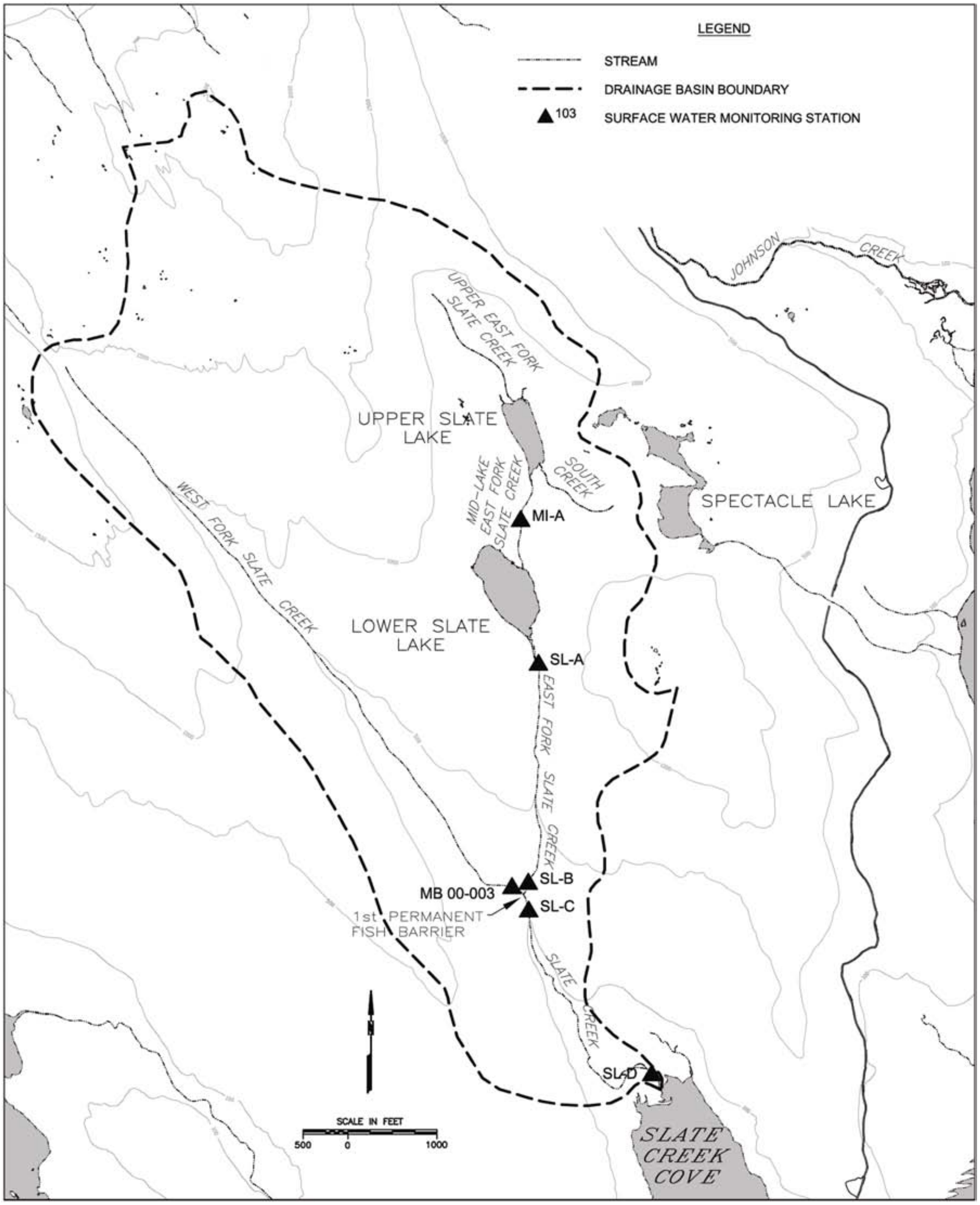


FIGURE 3-3. SLATE CREEK WATERSHED AND STREAMS WITHIN THE SLATE CREEK DRAINAGE

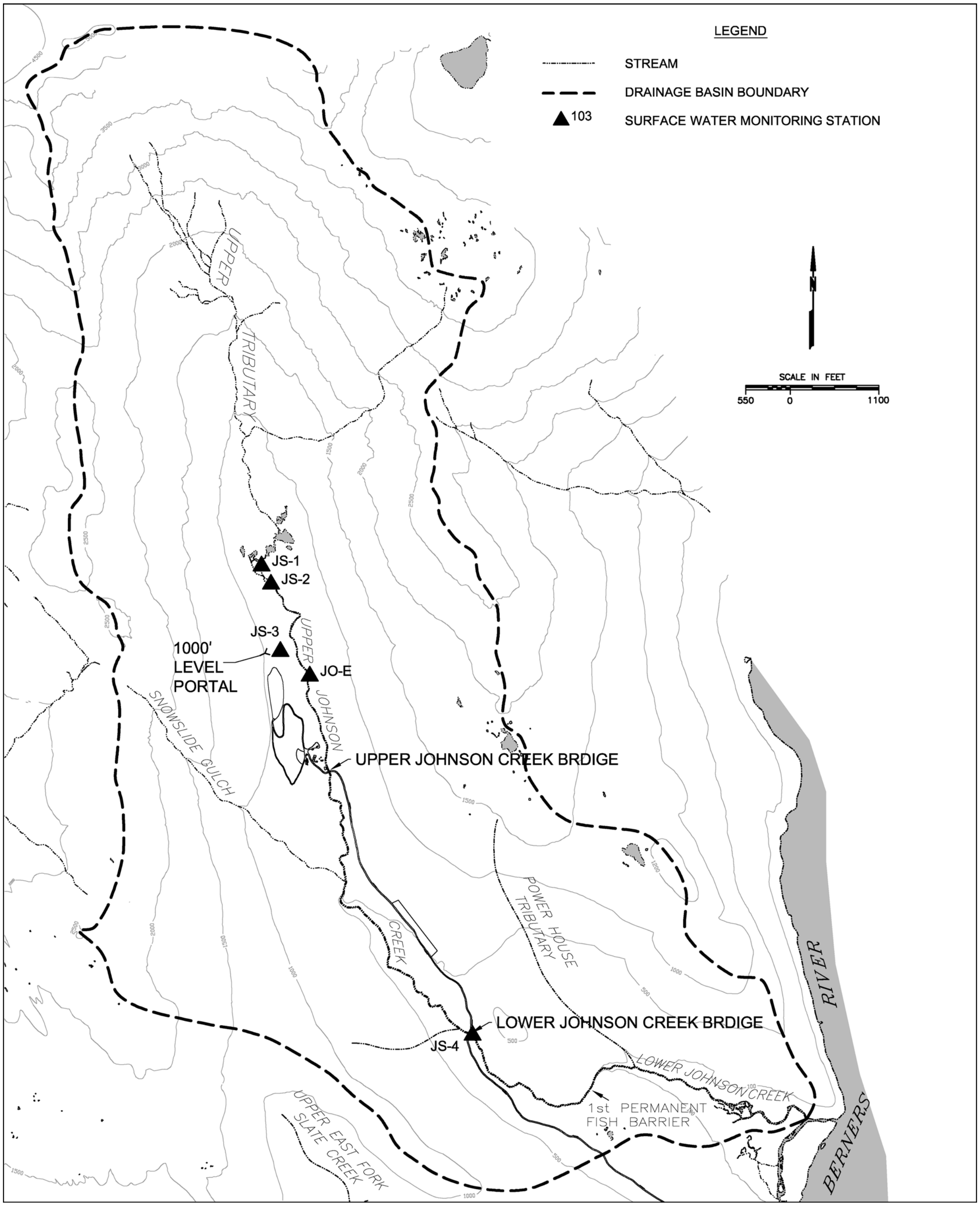


FIGURE 3-4. JOHNSON CREEK WATERSHED

No springs or seeps have been mapped in the project area. Because of the high precipitation throughout most of the year, much of the area is wet with seeps. Therefore, it would be difficult to identify individual seeps or small springs.

3.5.1 Sherman Creek and Sweeny Creek Watersheds

Sherman Creek (Figure 3-2) flows west from Lions Head Mountain to Lynn Canal at Comet Beach. This watershed has a drainage area of 2,681 acres, and its elevation ranges from sea level to approximately 5,500 feet. The four principal tributaries of Sherman Creek, from north to south, are Ivanhoe Creek, Ophir Creek, Upper Sherman Creek, and South Fork Sherman Creek. These subbasins are characterized by high channel densities or numerous, unnamed intermittent channels that join to form Lower Sherman Creek. The upper portions of these drainages typically are above timberline, with steep, actively eroding bedrock slopes affected by avalanches and rock slides. Channel gradients are lower, and vegetation covers most of the lower portions of the Sherman Creek watershed. The streambed in Sherman Creek and its tributaries are composed primarily of cobbles and boulders.

Mine water flows from the 850-foot level adit into the treatment system discussed in Section 2.3.7. Treated mine water is then combined with runoff and discharged via NPDES outfall 001 to South Fork Ophir Creek. From 1987 through 1995, the mine water flow ranged from 0.16 to 1.71 cubic feet per second (cfs), with a mean flow of 0.85 cfs (Forest Service, 1997a). More recent, separate mine water flow data are not available because only the flow of the combined discharge is measured. The mean flow rate from outfall 001 from 1997 through 2002 was 4.45 cfs.

Measurements of flow in Lower Sherman Creek near its mouth in 1987 through 1995 ranged from 2.3 to 105 cfs (SAIC, 1997). Based on a regression equation developed for the Forest Service, average annual flow for the mouth of Sherman Creek is calculated at 43 cfs, and the 20-year, 7-day low flow is 1.53 cfs (Forest Service, 1992). The following storm flows were calculated by the Forest Service (1992) for the mouth of Sherman Creek: 25-year, 24-hour storm = 1,025 cfs; 100-year, 24-hour storm = 1,656 cfs; and probable maximum precipitation (PMP) event = 2,491 cfs. A long-term record of flow measurements has not been established for Sherman Creek. Therefore, SAIC (1997) used a regional analysis procedure to estimate monthly and annual flow variations. Table 3-6 shows the estimated average monthly flows for Lower Sherman Creek derived from the regional analysis.

Table 3-6
Estimated Average Monthly Stream Flow for Sherman Creek at Mouth (in cfs)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Stream flow	9.1	8.4	9.4	15.8	44.0	45.1	30.9	31.6	34.9	36.7	21.4	10.2	NA
Percentage of annual	3.1	2.7	3.3	5.2	15.0	14.8	10.5	10.8	11.6	12.5	7.1	3.4	100.0

Notes: Sherman Creek flow distribution calculated as an average of seven regional stations and historical Sherman Creek data.
cfs = cubic feet per second. NA = not applicable.
Source: SAIC, 1997.

A small terrace area that consists of its own watershed is located between the main channel of Sherman Creek and the lower main channel of Sweeny Creek (Figure 3-2). Although the watershed area ranges in elevation from sea level to 1,400 feet, more than 50 percent occurs at elevations less than 250 feet. The basin has a catchment area of 300 acres (0.47 square mile), most of which drains internally through a series of small stream systems to Comet Beach. Runoff from the basin does not flow into Sweeny Creek or Sherman Creek.

A May 1996 field study conducted to characterize the basin identified 18 separate stream channels that combine to form six small stream systems in the area (Konopacky, 1996b). Four of these stream systems drain west into Lynn Canal, including Camp Creek, which is the proposed receiving water for the DTF discharge. The headwaters or drainage areas for these stream systems initiate in or slightly above, and to the east of, the DTF site. At the time the field study was conducted, flow from these four streams was not observed to outfall to Lynn Canal via surface flow; rather, observable flow terminated at Comet Beach. The final drainage to Lynn Canal was assumed to occur through the subsurface.

Headwaters and drainage areas for the two remaining stream systems begin above and to the northeast of the proposed DTF footprint. These streams join Sherman Creek slightly upstream of the fish passage barrier (1,200 feet upstream of Lynn Canal). Although these small stream systems and their associated drainage areas contribute runoff to Lower Sherman Creek, they do not drain the part of the watershed that would host the DTF. Flows measured in the small stream channels ranged from 0.002 to 0.01 cfs.

3.5.2 Slate Creek Watershed

Slate Creek (Figure 3-3) drains south-southeast to Slate Creek Cove on the west side of Berners Bay. This watershed has a total drainage area of 2,600 acres (4.06 square miles) and ranges in elevation from sea level to approximately 2,500 feet. Two tributaries compose Slate Creek: West Fork Slate Creek (1,179 acres) and East Fork Slate Creek (832 acres). The middle reach of East Fork Slate Creek drains through two small lakes: Upper Slate Lake (elevation 740 feet) and Lower Slate Lake (elevation 650 feet). The proposed TSF under Alternatives B, C, and D would be located in Lower Slate Lake. The east and west forks of Slate Creek merge approximately 4,000 feet downstream of the lower lake (Figure 3-3).

Upper Slate Lake covers a surface area of approximately 12 acres. The lake is about 1,200 feet long and has an average width of about 430 feet. Lower Slate Lake, with a surface area of approximately 20 acres, is nearly 1,600 feet long and has an average width of about 600 feet. The maximum depth of Upper Slate Lake is approximately 43 feet; the maximum depth of Lower Slate Lake is approximately 51 feet. The two lakes are on a relatively flat, south-facing terrace in the middle portion of the East Fork Slate Creek watershed.

Based on a regression equation developed for the Forest Service, average annual flow near the mouth of Slate Creek is about 34 cfs (Forest Service, 1992). Instantaneous flow measurements made in 2000 and 2001 by HDR Alaska, Inc., (2001, 2003) for Slate Creek near its mouth (SL00-D) and at the outlet of Lower Slate Lake (SL00-A) are presented in Table 3-7.

Konopacky Environmental (1995) also measured flow along Slate Creek in mid-July 1994 with the following results: Slate Creek near mouth = 2.47 cfs (July 16, 1994); East Fork Slate Creek above confluence with West Fork Slate Creek = 1.30 cfs (July 17, 1994); and East Fork Slate Creek above Lower Slate Lake = 1.26 cfs (July 17, 1994).

Table 3-7
Flow Measurements for Slate Creek and East Fork Slate Creek in 2000 and 2001

Station Location	6/29/00	7/12/00	8/23/00	9/13/00	10/11/00	11/29/00	12/13/00
Slate Creek near mouth (SL-D)	13.40	3.60	22.05	15.40	51.80	10.60	6.60
Slate Creek below confluence of East and West forks (SL-C)	NM	3.62	22.65	14.18	44.61	NM	NM
East Fork Slate Creek above confluence with West Fork (SL-B)	NM	1.48	9.17	4.59	22.04	NM	NM
East Fork Slate Creek at lower lake outlet (SL-A)	6.00	1.47	7.30	4.80	16.80	3.50	4.40
	1/24/01	**6/6/01**	**7/25/01**	**8/29/01**	**9/26/01**	**10/17/01**	**---**
Slate Creek near mouth (SL-D)	19.36	13.31	23.83	17.86	23.42	22.15	---
Slate Creek below confluence of East and West forks (SL-C)	17.19	10.23	15.96	14.21	17.74	14.24	---
East Fork Slate Creek above confluence with West Fork (SL-B)	8.79	4.50	3.85	4.25	7.24	7.52	---
East Fork Slate Creek at lower lake outlet (SL-A)	4.54	4.41	3.00	NM	7.31	6.36	---

Note: All flow measurements in cubic feet per second (cfs). NM = not measured.
Source: Earthworks, 2003b; HDR Alaska, Inc., 2001.

Low flow (20-year, 7-day recurrence interval) calculated for the mouth of Slate Creek using a regression equation developed for the Forest Service is 0.62 cfs (Forest Service, 1992). The following storm flows were calculated by the Forest Service (Forest Service, 1992) for the mouth of Slate Creek: 25-year, 24-hour storm = 173 cfs; 100-year, 24-hour storm = 355 cfs; and the PMP event = 1,584 cfs. Table 3-8 shows the estimated average monthly flows for East Fork Slate Creek and West Slate Creek derived from the same regional analysis previously discussed for Sherman Creek.

Approximately 0.5 mile of the proposed access road and tailings pipeline between the Jualin Mine Site and proposed tailings impoundment at Lower Slate Creek Lake would extend into a small drainage basin that contains Spectacle Lake. Water draining from the basin flows east to Berners Bay between Slate Creek and Johnson Creek.

Table 3-8
Estimated Average Monthly Stream Flow for Slate Creek (in cfs)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
East Fork Slate Creek at confluence	3.0	3.8	3.1	4.9	9.0	7.6	5.1	6.0	9.1	10.2	6.8	3.8
West Slate Creek at confluence	2.6	3.5	2.9	5.9	12.2	10.4	6.4	7.5	11.1	11.9	7.6	3.5

Note: Slate Creek flow distribution calculated as an average of seven regional stations. cfs = cubic feet per second.
Source: Earthworks, 2003b.

3.5.3 Johnson Creek Watershed

Johnson Creek (Figure 3-4) drains south-southeast from Lions Head Mountain to the ocean at Berners Bay. The total drainage area for this watershed is approximately 3,610 acres (5.64 square miles), ranging in elevation from sea level to 5,500 feet (Konopacky, 1995). One small tributary channel, known as Snowslide Gulch, joins Johnson Creek about 0.5 mile below the historic Jualin Mine site. Power House tributary flows into Johnson Creek from the north nearly 1 mile upstream from the creek's mouth.

From June 2000 through September 2001, several flow measurements were obtained in Johnson Creek near the Jualin Mine site (Table 3-9). The monitoring station (J000-E) is at an elevation of about 650 feet, approximately 2.5 miles upstream from the mouth at Berners Bay. The drainage area above this station is about 1,600 acres (2.5 square miles). Instantaneous flow measurements ranged from 33 to 42 cfs for June through September 2000, declining to approximately 8 to 14 cfs from November 2000 through January 2001 (HDR Alaska, Inc., 2001, 2003). In June, July, and September 2001, Johnson Creek flow was in the range of 31 to 97 cfs. Flow measurements by Konopacky Environmental (1996b) in mid-July 1995 were 92 cfs for lower Johnson Creek and 54 cfs for upper Johnson Creek.

Table 3-9
Flow Measurements for Johnson Creek in 2000 and 2001

Flow (in cfs) at Johnson Creek Next to Jualin Mine (J0-E)					
6/30/00	7/12/00	8/23/00	9/13/00	11/29/00	12/13/00
33.10	34.90	41.50	40.00	11.70	13.90
1/24/01	6/6/01	7/25/01	9/26/01		
7.61	49.15	96.95	31.78		

Source: HDR Alaska, Inc., 2001, 2003.

3.5.4 *Water Rights*

The operator has applied to the Alaska Department of Natural Resources (ADNR) for the water rights described in Table 3-10. All the water rights are for mining-related and domestic purposes in the following drainages: Sherman Creek, the terrace area between Sherman and Sweeny creeks, Johnson Creek, and Slate Creek.

Table 3-10
Water Rights Applications in Project Area

Water Source	State File No.	Applicant	Date Initiated	Water Use	Rate
Underground workings	13147	Coeur Alaska	12/24/90	Mining-related, domestic, backfilling, dust control	3.34 cfs
Ophir and Ivanhoe creeks	13148	Coeur Alaska	12/24/90	Diversions	13.37 cfs
Upper Sherman Creek	13149	Coeur Alaska	12/24/90	Mining-related, domestic, dust control	0.56 cfs
Unnamed streamlets and runoff between Sherman Creek and Sweeny Creek; includes ditch and sediment pond	20598	Coeur Alaska	10/17/96	Mining-related: diversion of water around proposed tailings site, including use of a sediment pond	1.20 cfs
Camp Creek	21120	Coeur Alaska	10/17/96	Mining-related, dust control	0.10 cfs
Johnson Creek	24432	Coeur Alaska	6/23/03	Mining-related, dust control, domestic	0.68 cfs
Slate Creek	24486	Coeur Alaska	10/24/03	Dam	11.8 cfs

Note: cfs = cubic feet per second
Source: ADNR, 2003.

3.6 SURFACE WATER QUALITY

Several surface water monitoring stations in the study area have been used to collect and analyze stream samples. Parameters analyzed include the following constituents of potential concern: pH, total dissolved solids (TDS), total suspended solids (TSS), nitrate (NO_3), ammonia (NH_4), sulfate, and numerous metals (aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc).

3.6.1 Johnson Creek and Slate Creek Watersheds

Water quality monitoring has been performed in the Johnson Creek and Slate Creek drainages at the locations shown in Figures 3-3 and 3-4. Monitoring was performed in the Johnson Creek drainage from 1995 through 1998 and in the Slate Creek drainage in 2000 and 2001 and in March through June 2004. These data are summarized in Table 3-11. The background water quality in Johnson and Slate creeks shows near-neutral pH and low TSS, with most TSS levels reported as less than 4 mg/L. Aluminum and, to a lesser degree, silver are sometimes found in Slate Creek at levels above the lowest applicable water quality criteria, 87 ug/L for aluminum and 0.37 ug/L for silver at 25 mg/L hardness. There are no known man-made sources of these metals in the Slate Creek drainage.

3.6.2 Sherman Creek Watershed

Background surface water quality data were collected from 1987 through 1995 from the Sherman Creek and Sweeney Creek drainages to support preparation of the 1992 FEIS and 1997 SEIS. These water quality data are available from six stream monitoring stations (Upper South Ophir Creek, station 102; Lower South Ophir Creek, station 103; North Ophir Creek below Ivanhoe Creek confluence, station 110; Upper Sherman Creek, station 109; Lower Sherman Creek, station 105; and Sweeny Creek, station 106). When the background water quality monitoring was performed in 1987 through 1995, the receiving stream for the mine water discharges was south Ophir Creek, with station 102 located above the discharge and station 103 located below the discharge.

Note that the data for 1987 through 1995 were collected before the NPDES permit was issued. The mine water flow was treated in settling ponds prior to 1997, but there were no limits on discharge quality. The water quality data collected from 1987 through 1995 are summarized in Table 3-12.

In general, the Sherman Creek watershed has calcium bicarbonate-type water, except at station 103, which was observed to have calcium sulfate-type water between 1987 and 1995 because it was influenced by mine water discharge from the 850-foot adit. Mean sulfate concentrations of 117 mg/L were observed at station 103. At the other Sherman Creek watershed stations, mean sulfate values were less than 20 mg/L (Forest Service, 1997a). Most water samples from the Sherman Creek watershed have low alkalinity and hardness. The water has a neutral pH, ranging from 6.5 to 8.5 standard units (s.u.). Stream samples from south Ophir Creek below the settling ponds (station 103) were similar in quality to the treated mine water quality. In contrast, Ophir Creek above the mine discharge (station 102) was better in quality, reflecting the portion of this stream that is not influenced by the mine discharges. Mean concentrations of nitrate (0.64 mg/L) and TDS (28 mg/L) at upper south Ophir Creek station 102 are lower than the levels (mean nitrate = 3.17 mg/L; mean TDS = 243 mg/L) at station 103 (Forest Service, 1997a). Concentrations of TSS at both south Ophir Creek stations are in the range of 0 to 33 mg/L.

Table 3-11
Summary of Water Quality Data for Slate and Johnson Creeks

Parameter	Lowest Applicable Water Quality Standard*	Upper Johnson Creek		Lower Johnson Creek		East Fork Slate Creek		Slate Creek	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
SC (µmhos/cm)	N/A	21	86	42	97	45	147	57	115
pH (std. units)	6.5–8.5	7.2	7.7	7.4	7.9	7.1	8.4	7.3	8.3
Temperature (ºC)	NA	4.5	6.2	4.4	6.8	-0.4	20	-0.5	20
TDS	500	< 20	58	< 20	96	21	86	23	99
TSS	NA	< 4	< 4	< 4	< 4	< 4	< 4	< 4	51
Turbidity (NTU)	See note	< 0.05	1.5	0.06	3.2	0.19	1.9	0.14	1.4
Acidity	NA	< 2	< 10	< 2	< 10	< 10	20	< 2	< 10
Alkalinity	NA	7.0	35	18	43.4	17	70	23	51
Hardness	NA	10	24	20	55	19	71	2	49
Carbonate	NA	< 0.1	0.139	0.036	0.273	< 0.1	0.55	< 0.1	0.34
Bicarbonate	NA	8.53	42.6	21.9	52.8	21	64	28	62
Sulfate	250	<2	5.8	2.2	7.8	<2	2.72	<2	4.98
Chloride	250	< 1.0	1.37	< 1.0	1.73	< 1.0	3.4	1.05	8.4
Calcium	NA	3.17	13.6	6.30	18.2	6.8	26	8.1	17
Magnesium	NA	< 0.5	0.5	< 0.5	1.18	< 1.0	3.5	< 1.0	2.0
Sodium	NA	< 1.0	1.32	< 1.0	1.99	< 3.0	8.1	< 3.0	3.74
Potassium	NA	< 0.5	< 1.0	< 0.5	< 1.0	< 1.0	1.2	< 1.0	0.4
SAR (ratio)	NA	< 0.0001	0.41	< 0.0001	0.56	< 0.001	0.61	0.13	0.28
Nitrate	10	< 0.1	0.8	< 0.1	0.5	0.05	0.126	< 0.05	0.119
Ammonia	0.00243	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.13	< 0.05	< 0.098
Aluminum	0.087	< 0.05	< 0.5	< 0.05	< 0.5	< 0.05	0.45	< 0.05	0.12
Arsenic	0.05	< 0.0005	< 0.002	< 0.0005	0.001	< 0.0005	0.00052	< 0.0005	0.00011
Barium	NA	< 0.004	< 0.5	< 0.5	< 0.5	< 0.01	0.038	< 0.01	0.01
Boron	NA	< 0.05	0.21	< 0.05	0.066	0.003	0.084	< 0.05	0.061
Cadmium	0.00052	< 0.0001	< 0.001	< 0.0002	0.00083	< 0.000015	< 0.001	< 0.000015	0.00027
Chromium	0.011	< 0.0002	< 0.05	< 0.0002	< 0.05	< 0.0002	0.0014	< 0.0002	0.0012
Copper	0.0029	< 0.002	< 0.02	< 0.002	< 0.02	< 0.002	0.00039	< 0.002	0.0022
Iron	1	< 0.05	0.15	< 0.05	0.25	< 0.05	0.37	< 0.05	0.23
Lead	0.00054	< 0.001	< 0.002	< 0.001	< 0.002	< 0.001	< 0.002	< 0.001	< 0.002
Manganese	0.05	< 0.01	< 0.02	< 0.01	< 0.02	< 0.01	0.165	< 0.01	0.0109
Molybdenum	NA	< 0.01	< 0.5	< 0.01	< 0.5	< 0.0005	0.00012	< 0.0005	0.00016
Mercury	0.00001	< 0.0002	< 0.0005	< 0.0002	< 0.0005	< 0.0002	< 0.0005	< 0.0002	< 0.0005
Nickel	0.016	< 0.01	< 0.02	< 0.01	< 0.02	< 0.01	0.0008	< 0.01	0.00094
Selenium	0.005	< 0.003	< 0.005	< 0.003	< 0.005	< 0.003	< 0.005	< 0.005	< 0.00072
Silver	0.00037	< 0.0001	< 0.05	< 0.0001	< 0.05	< 0.0001	.000983	< 0.0001	0.00476
Zinc	0.037	< 0.002	< 0.02	< 0.002	0.023	< 0.002	0.022	< 0.002	0.023

*Hardness = 25mg/L.

Notes:

1. All units in milligrams per liter unless otherwise noted. Metal concentrations are total.
2. SC = specific conductance in micromhos per centimeter (µmhos/cm); TDS = total dissolved solids; TSS = total suspended solids; NTU = nephelometric turbidity units; SAR = sodium adsorption ratio.
3. Samples were collected during 1995–1998 for Johnson Creek and 2000–2001 and March–June 2004 for Slate Creek.
4. The chromium standard is for chromium VI.

NA = Not applicable.

The applicable standard for turbidity is no more than a 5-NTU increase from background measured instream.

Sources: Coeur Alaska, 2004; Earthworks, 2002a.

Table 3-12
Summary of Sherman Creek Watershed Surface Water Data (August 1987–October 1995)

Station		Al (µg/L)	As (µg/L)	Cd (µg/L)	Cr (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Hg (µg/L)	Mn (µg/L)	Ni (µg/L)	Se (µg/L)	Ag (µg/L)	Zn (µg/L)	NO_3-N (µg/L)	NH_4-N (µg/L)	pH (s.u.)	TDS (mg/L)	TSS (mg/L)
Lowest applicable water quality standard (hardness = 25 mg/L)		87	50	0.52	11	2.9	1,000	0.54	0.01	50	16	5	0.37	37	10,000	2.43	6.5-8.5	1000	NA
Station 102	Mean	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	637	NA	--	23	NA
Upper South	Min	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10	<10	7.0	22	0
Ophir Creek	Max	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2,510	57	7.6	41	13
	Detects	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	6	4	2
	Non-detects	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Station 103	Mean	56	1.8	NA	NA	4.1	90	4.4	NA	23	NA	NA	0.17	12	3,169	718	--	243	3.6
Lower South	Min	100	0.59	<0.2	<30	2.1	50	1	<0.05	19	<10	<5	0.1	10	90	20	6.7	31	1
Ophir Creek	Max	600	50	<2	<50	50	730	317	<1	220	<20	<5	1.1	60	26,000	9,598	8.2	996	33
	Detects	12	11	1	0	15	40	17	0	31	2	0	14	30	84	59	93	90	50
	Non-detects	58	60	70	71	56	31	54	71	40	68	71	57	41	8	29	0	0	34
Station 105	Mean	51	0.47	NA	NA	3.1	72	1.1	NA	NA	NA	NA	0.09	7.7	774	54	--	71	4.2
Lower	Min	100	0.55	<0.2	<10	2.3	50	1	<0.05	<15	<10	<5	0.1	10	10	6	6.0	22	1
Sherman Creek	Max	1,000	0.81	<2	<50	30	2,070	36	<1	360	<20	<5	1.1	50	19,200	350	8.0	194	120
	Detects	11	6	0	1	13	32	12	0	2	2	0	10	19	81	50	92	88	47
	Non-detects	58	64	70	69	57	37	58	70	68	68	70	60	51	10	37	0	2	36
Station 106	Mean	96	NA	NA	NA	5.3	131	5.4	NA	NA	NA	NA	0.13	7.5	419	65	--	65	4.6
Sweeny	Min	100	<0.5	<0.5	<10	5	50	1	<0.05	<20	<10	<5	0.1	10	15	10	6.3	20	1
Creek	Max	1,100	5	<2	<50	25	2,070	256	<1	150	<20	<5	1.1	40	14,200	1,120	8.1	130	85
	Detects	22	5	2	0	14	43	15	0	5	5	0	12	17	71	45	82	79	47
	Non-detects	38	55	58	60	46	17	45	60	55	56	60	48	43	11	37	0	0	25
Station 109	Mean	35	1.2	NA	NA	4.3	61	0.76	NA	NA	NA	NA	0.11	7.0	459	60	--	54	3.4
Upper	Min	100	0.5	<0.5	<10	5	50	1	<0.05	<10	<10	<5	0.1	10	10	10	5.7	16	1
Sherman Creek	Max	300	2.8	<2	<50	30	700	3	<1	170	<20	<5	1.3	30	15,500	1,580	7.85	110	73
	Detects	7	13	1	0	11	29	13	0	3	4	0	10	16	77	86	78	78	52
	Non-detects	53	47	59	60	49	31	47	60	57	56	60	50	44	1	42	0	0	19
Station 110	Mean	NA	NA	NA	NA	4.3	45	3.9	NA	NA	NA	NA	0.1	10	214	55	--	31	1.7
North Ophir	Min	<100	<0.5	<0.2	<10	2	50	1	<0.05	<15	<10	<5	0.1	10	30	20	6.7	8	1
Creek	Max	<500	<5	<2	<50	41	480	186.5	<1	40	<20	<5	1.7	150	535	670	7.7	80	8
	Detects	4	1	1	0	13	14	10	0	2	1	0	9	14	45	24	54	48	24
	Non-detects	49	53	53	54	41	40	44	54	53	53	54	45	40	8	25	0	6	30

Note: The number of samples reported for each parameter and location is variable due to general changes in monitoring frequencies and analyzed constituent lists, individual data points that were discarded due to quality assurance/quality control (QA/QC) issues, and omission of analyses of single samples for specific constituents. The chromium standard is for chromium VI. There are no numeric water quality standards for TSS.

NA = Not applicable.
Source: SAIC, 1997.

Water quality parameters in samples collected near the mouth of Sherman Creek (station 105) were generally between the values measured in Upper and Lower South Ophir Creek described above (Forest Service, 1997a). Concentrations of metals were typically low, with iron and manganese usually measured above laboratory detection limits. Concentrations of TDS were in the range of 22 to 194 mg/L (mean = 71 mg/L). Nitrate at station 105 was in the range of 0.01 to 19.2 mg/L (mean = 0.774 mg/L). TSS concentrations in Lower Sherman Creek were still relatively low, with a range of 1 to 120 mg/L and a mean TSS of 4 mg/L.

When the 1997 FEIS was completed and the NPDES permit issued, the mine water discharge was moved to the current location in Upper Sherman Creek (where it would continue to occur under all alternatives). The NPDES permit required water quality monitoring above and below the outfall, at stations 105 and 109, respectively. Monitoring data for May 1998 to November 2003 for these stations are summarized in Table 3-13.

Table 3-13
Summary of Lower and Upper Sherman Creek Monitoring Data
May 1998–November 2003

Constituent	Station 105 Lower Sherman Creek, Total/Dissolved	Station 109 Upper Sherman Creek Total/Dissolved
Arsenic (µg/L)	ND (0.5) /ND (0.5)–0.7	ND (0.5)/ND (2)–11
Cadmium (µg/L)	ND (0.1)/ND (0.1)	ND (0.2)/ND (0.2)
Chromium (µg/L)	ND (0.2)–5.45/ND (0.2)–0.2	ND (0.2)–0.2[a]/ND (0.2)
Copper (µg/L)	ND (2)–3.93/ND (2)	ND (2)–4.73/ND (2)
Lead (µg/L)	ND (1)/ND (1)	ND (1)–1.3/ND (1)
Mercury (µg/L)	ND (0.2)/NA	ND (0.16)/NA
Nickel (µg/L)	ND (5)/ND (5)	ND (5)/ND (5)
Selenium (µg/L)	ND (2.5)/ND (2.5)	ND (2.5)/ND (2.5)–3.13
Silver (µg/L)	ND (0.1)–0.178 [a]/ND (0.1)	ND (0.1)–0.7[a]/ND (0.1)
Zinc (µg/L)	ND (2)–5.2/ND (2)–3.9	ND (2)–5.8/ND (2)–5.9
TSS (mg/L)	ND (4)–8.5[a]/NA	ND (4)–8/NA
TDS (mg/L)	ND (10)–200/NA	22–120/NA
Ammonia (mg/L)	ND (0.5)–0.275/NA	ND (0.1)–0.91/NA
Nitrate/Nitrite (mg/L)	ND (0.5)–1.19/NA	ND (0.5)–1.43/NA
Hardness (mg/L)	16–125/NA	16–150/NA
pH (s.u.)	7.36–7.97	7.59–7.91

[a] Only one detected value.
Note: ND = not detected; parenthetical values are minimum detection limit; NA = dissolved analysis not performed.

Surface water quality for the terrace area watershed that would contain the DTF associated with the Alternatives A and A1 has been characterized by four samples collected in June 1996 from two small streams in the small watershed. As summarized in SAIC (1997), the sparse data suggest that the baseline water quality of these streams is similar to that of Sherman Creek. Zinc and magnesium were the only metals measured above the laboratory detection limits.

3.7 GROUNDWATER HYDROLOGY

Information about groundwater hydrology for the Kensington Mine area is contained in the 1992 FEIS and 1997 SEIS for the Kensington Gold Project. The *Technical Resource Document for Water Resources, Kensington Mine Project* (SAIC, 1997) and reports by Montgomery Watson

(1996a, 1996b) contain more detailed groundwater information. Groundwater studies were initiated in 1988, and most information was collected through 1995. This section summarizes key groundwater information from the documents listed above, as well as more recent information obtained since 1997.

Groundwater flow in the project area generally follows topography, moving from the higher mountains down to the valley bottoms and eventually to the ocean. Recharge to the groundwater system is primarily from direct infiltration of precipitation and snowmelt. Most streams gain flow from the upper to lower reaches; therefore, the streams are not a major source of groundwater recharge. The rate of groundwater recharge at the project site is estimated at 15 to 20 percent of annual precipitation (SAIC, 1997).

3.7.1 Underground Mine Area

Groundwater flow encountered during underground exploration activities at the Kensington Mine (beneath the Sherman Creek and Johnson Creek watersheds) has been variable, ranging from about 100 to 400 gpm, or 0.22 to 0.9 cfs (SAIC, 1997). Approximately 1,800 gpm (4.0 cfs) is estimated for average initial groundwater flow into the production-scale underground mine workings (SAIC, 1997).

Most groundwater enters the underground workings along a fracture system that trends northwest-southeast. Variations in flow are due to changes in hydraulic head and permeability or hydraulic conductivity of the fracture zone in three dimensions, as well as monthly variations in precipitation and infiltration. Typically, groundwater flow is highest in mine workings for a short time after they are initially opened, after which water in storage is drained and flow rates decrease to a more constant rate based on recharge in the surrounding area. Based on water pressure measured in borings inside the Kensington Mine in 1996, the maximum water table in bedrock was estimated at an elevation of approximately 1,700 feet.

3.7.2 Sherman Creek Area and Terrace Area

A total of 14 groundwater monitoring wells or piezometers were installed in the Sherman Creek drainage as part of previous baseline studies. In addition, 19 wells or piezometers were installed in the proposed DTF area.

The Sherman Creek watershed typically is composed of peat and organic soil that overlies sandy glacial till and bedrock. Alluvial sand and gravel deposits are also present along drainage channels and some terraces. The DTF site associated with Alternative A is on a terrace where the unconsolidated soil and alluvial deposits are up to 30 feet thick. The underlying glacial till is up to 200 feet thick in places, overlying bedrock of phyllite and slate (Forest Service, 1997a).

Perched groundwater typically is present at the contact between alluvium and underlying glacial till, and regional groundwater is present in the bedrock. The depth to groundwater in these areas typically is less than 20 feet, including artesian conditions; however, some measurements show groundwater 30 to 55 feet below ground surface (Forest Service, 1997a). Hydraulic conductivity measured in the major hydrogeologic units of glacial till and bedrock is approximately 10^{-6} and 10^{-5} centimeters per second, respectively, but it varies considerably in bedrock near fracture/fault zones (SAIC, 1997). Natural groundwater gradients range from 0.06 to 0.20 foot per foot (SAIC, 1997). Most groundwater in the project area likely flows through preferential pathways in the glacial till (gravel/sand lenses) and bedrock (fractures/faults).

3.7.3 Lower Slate Lake

No specific groundwater information is available for the area surrounding Lower Slate Lake. Geologic mapping and a geophysical seismic refraction survey conducted in 2002 in the vicinity of the proposed impoundment embankment show that slate bedrock is at or near (< 1 foot) ground surface, with a surface material of moss and organics (muskeg) (Knight Piesold, 2002). The bedrock is heavily fractured on the surface (upper 12 to 20 inches), steeply dipping and striking north-south. Glacial deposits of till and glacio-fluvial sand/gravel likely compose some of the terraces forming Upper and Lower Slate lakes (Knight Piesold, 2002). The Slate lakes might provide some recharge for groundwater flow that travels down the watershed to the ocean, primarily through secondary openings in the bedrock; however, the surficial organic deposits and glacial till would likely have low permeability.

3.8 GROUNDWATER QUALITY

Information about groundwater quality for the Kensington Mine area is contained in the 1992 FEIS, the 1997 SEIS, and *Technical Resource Document for Water Resources* (SAIC, 1997) for the Kensington Gold Project, as well as other supporting documents. Groundwater studies were initiated in 1988, and most information was collected through 1995. Most of the 14 wells that have been sampled for water quality analyses are in the Sherman Creek watershed, and they were sampled as part of studies for the DTF (Alternatives A and A1). Quality of groundwater is also characterized by samples collected from the two Kensington Mine adits in the Sherman Creek watershed. This section summarizes key groundwater quality information from the two previous EIS documents, as well as more recent information obtained since 1997.

3.8.1 Underground Mine Area

During 1987 to 1995, mine water sampling and analysis was performed at two adit discharges (850- and 2,050-foot levels). In general, the mine water that discharges from the two adits in the Sherman Creek watershed has elevated levels of TDS, sulfate, nitrate, ammonia, and some metals. The mine water data for the 850-foot level are shown in Table 3-14. Samples with higher metal concentrations from the adits were generally taken during periods of exploratory drilling and adit work within the mine. Also, the higher nitrate and ammonia concentrations coincide with the period when explosives were used during exploration activities.

3.8.2 Sherman Creek and Terrace Area

Groundwater in the Sherman Creek watershed and surrounding drainages is characterized by low concentrations of most constituents. Appendix G summarizes groundwater sample analyses from 1988 through October 1995 for wells and piezometers in the Sherman Creek and terrace area watersheds.

Groundwater quality in the Sherman Creek and terrace area watersheds has a neutral pH and relatively low TDS (typically < 200 mg/L). Levels of TSS in groundwater samples have been highly variable, ranging from less than 10 to greater than 1,000 mg/L (Forest Service, 1997a). This wide range probably reflects the lack of adequate development of some wells. As a result of high TSS or turbidity, concentrations of total metals from these samples are often high. If these samples are filtered, however, concentrations of metals are relatively low. The dissolved metals typically detected in groundwater from this area are aluminum, iron, manganese, and zinc. Typical sulfate concentrations in groundwater are less than 20 mg/L; nitrate concentrations usually are less than 1.0 mg/L, with some nitrate values in the range of 1 to 5 mg/L.

Table 3-14
Summary of 1987–1995 Mine Drainage Data for Monitoring Station 101, 850-Foot Adit

Parameter	Units	Untreated Mine Drainage Monitoring Station 101
Ammonia	µg/L	10–22,600
Arsenic	µg/L	0.7–5.6
Cadmium	µg/L	ND
Chromium	µg/L	ND
Copper	µg/L	2.7–150
Lead	µg/L	1–20
Mercury	µg/L	ND
Nickel	µg/L	ND
Nitrate	mg/L	0.01–39
pH	s.u.	6.8–8.3
Selenium	µg/L	ND
Silver	µg/L	0.1–0.21
TDS	mg/L	70–1268
Zinc	µg/L	10–60
TSS	mg/L	1–140

Note: µg/L = micrograms per liter; mg/L = milligrams per liter; s.u. = standard units; TDS = total dissolved solids; TSS = total dissolved solids; ND = not detected.

3.8.3 Lower Slate Lake

No specific groundwater quality information is available for Lower Slate Lake. Based on proximity to this area, it is assumed that groundwater quality is similar to that described above for the Sherman Creek watershed. There is no historical mine-related disturbance in the Slate Creek watershed. Because the Slate lakes are near the headwaters of the drainage, it is likely that the lakes provide some recharge of good-quality water to groundwater in this area.

3.9 AQUATIC RESOURCES: FRESHWATER

The 1992 FEIS and 1997 SEIS prepared for Kensington Gold Project focused on potential impacts on the Sherman Creek drainage. This document includes descriptions of aquatic resources primarily in the Slate Creek and Johnson Creek drainages (Figures 3-3 and 3-4). Kline Environmental Research (2003a) provides a detailed summary of aquatic surveys conducted in the Slate Creek and Johnson Creek drainages, from which much of the following discussion was drawn.

3.9.1 Habitat Descriptions

To better understand the nomenclature of the major drainages (Sherman, Slate, and Johnson creeks) and how they would be associated with the current proposal, habitat components (including some hydrologic and geologic features as they relate to aquatic species) of these drainages are discussed below. Additional information on each drainage is also provided in Section 3.5, Surface Water Hydrology.

Sherman Creek Drainage

The Sherman Creek drainage consists of four upper tributaries, Ivanhoe and Ophir creeks to the northeast and Upper Sherman and South Fork Sherman creeks to the southeast (Figure 3-2). All tributaries converge into a single stream channel approximately 1 mile from its confluence with Lynn Canal at Comet Beach. The average annual flow in Sherman Creek at the mouth is 43 cfs. Upper Sherman Creek currently receives the discharge of treated mine water at the NPDES-permitted outfall from the settling ponds (outfall 001). A permanent barrier to upstream fish migration in the form of a falls occurs approximately 1,200 feet from the stream's confluence with Lynn Canal.

Six small stream systems, including Camp Creek, which would receive the DTF discharge, are in or near the terrace area basin (Konopacky, 1996b). Flows in all the identified channels are low and range from 0.002 cfs to 0.01 cfs.

Slate Creek Drainage

The Slate Creek drainage is composed of two tributaries, West Fork Slate Creek and East Fork Slate Creek. Slate Creek drains into Slate Creek Cove on Berners Bay with a mean annual flow of 34 cfs (Forest Service, 1992). A barrier to upstream anadromous fish movement in East Fork Slate Creek is located immediately upstream of the confluence between the two forks.

Upper Slate Lake and Lower Slate Lake are within the East Fork Slate Creek drainage, approximately 4 miles southeast of the historic Jualin mine site. Lower Slate Lake receives outflow from Upper Slate Lake via split channels. It discharges to East Fork Slate Creek from its southern end. The two lakes are further discussed below.

Lower Slate Lake

Lower Slate Lake is approximately 1 mile upstream of the confluence of the east and west forks of Slate Creek. The lake has a surface area of 20 acres, and it is approximately 1,600 feet long with an average width of 600 feet (Buell, 1989). It should be noted that Mid-Lake East Fork Slate Creek, a tributary to Lower Slate Lake, has a split channel prior to entering Lower Slate Lake. Some of the literature has considered this split two channels.

Much of Lower Slate Lake is surrounded by steeply sloping, wet coniferous forest with some deciduous understory. Bogs are present along the northern lake edge and near the lake outlet. The shoreline is 4,127 feet in length and not irregular. The bottom of the littoral zone varies between silt and clay with intermittent areas of gravel and beds of submerged and emergent vegetation. The littoral zone is relatively small (3.9 acres); the lake slopes quickly to a deep point of 51 feet near the center. Light penetration is poor in the lake due to coloring from dissolved organic compounds (Kline, 2003a).

Upper Slate Lake

Upper Slate Lake is 1,600 feet upstream of Lower Slate Lake. The split channels of Mid-Lake East Fork Slate Creek connect the two lakes. The lake has a surface area of approximately 12 acres and is approximately 1,200 feet long, with an average width of 430 feet and a maximum depth of 43 feet. Upper Slate Lake has five inlets, but only the two largest (Upper East Fork Slate Creek and South Creek) provide fish habitat during the summer months (Romey Environmental and Martin Environmental, 1998).

Upper Slate Lake has not been as thoroughly investigated as Lower Slate Lake. Data collected and observations made during field surveys suggest its habitat and fishery are similar to those of Lower Slate Lake (Kline, 2003a).

Johnson Creek Drainage

Johnson Creek (Figure 3-4) is approximately 5.1 miles long and consists of riffle, run, and pool habitat in the lower reaches with cascade habitat upstream. Flow measured between June and September 2001 near the historic Jualin Mine on Johnson Creek ranged from 7.61 to 96.95 cfs (HDR Alaska. Inc., 2001). A permanent barrier to upstream fish migration occurs approximately 1 mile upstream from the confluence of Johnson Creek and Berners Bay. For discussion purposes, this first segment is called Lower Johnson Creek, and the remainder of the drainage above this barrier is called Upper Johnson Creek. Powerhouse Tributary enters from the north of Lower Johnson Creek approximately 4,000 feet from the stream mouth at Berners Bay. As Figure 3-4 indicates, Snowslide Gulch Creek and a number of unnamed tributaries, none of which support fish populations, enter Upper Johnson Creek (Romey Environmental and Martin Environmental, 1998).

3.9.2 Freshwater Biota

Resident Fish: Sherman Creek Drainage

The 1992 FEIS and 1997 SEIS discussed resident and migratory fish species, macroinvertebrates, habitat, and metals concentrations in macroinvertebrates, sediment, and fish primarily in the Sweeny and Sherman drainages. Rearing fish populations in Sherman and Sweeny creeks were inventoried in July 1991. Over a distance of 13,800 feet, a total of 420 Dolly Varden char were estimated to be present, 392 above the fish barrier and 28 below the fish barrier. The density was estimated to be 0.19 fish per 100 square feet throughout Sherman Creek, including 0.20 per 100 square feet above the barrier and 0.10 per 100 square feet below the barrier. Rainbow and cutthroat trout were found only below the barrier at a density of 0.10 fish per 100 square feet. Dolly Varden char found in Sherman Creek, particularly those above the barrier, were relatively small; all were less than 8 inches in length.

No fish of any species were found during electrofishing surveys conducted in the four small stream channel systems in the terrace area drainage basin that drain to the subsurface (Konopacky, 1996b). In addition, no fish were found in the two unnamed stream channels that drain into Sherman Creek. The lack of fish in these channels may be due to the intermittent flows that occur during the summer and frozen winter months, the lack of food supply or a viable connection with Lynn Canal, or the presence of numerous fish passage barriers.

Resident Fish: Slate and Johnson Creek Drainages

Since the 1997 SEIS aquatic resource data have been gathered on the Slate and Johnson creek drainages. Most of the existing data focus on Lower Slate Lake. The following species have been captured in Slate Creek: Dolly Varden char, cutthroat trout, three-spine stickleback, pink salmon, chum salmon, juvenile coho salmon, and sculpin. Table 3-15 identifies the documented locations of resident populations (typically found above the permanent fish barriers that prevent upstream migration) and anadromous species within the project area. Although fish in the upper portions of the Slate Creek watershed (east and west forks) are considered residents, it should be noted that

Table 3-15
Freshwater and Anadramous Fish Species and Their Locations

Common Name	Scientific Name	Drainage Area[a]							
		Sherman Creek		Slate Creek		Slate Lakes		Johnson Creek	
		A	B	A	B	U	L	A	B
Dolly Varden char	*Salvelinus malma*	X	X	X	X	X	X	X	X
Pink salmon	*Oncorhynchus gorbuscha*		X		X				X
Chum salmon	*Oncorhynchus keta*		X		X				X
Cutthroat trout	*Oncorhynchus clarki*		X		X				X
Coho salmon	*Oncorhynchus kisutch*		X		X				X
Prickly sculpin	*Cottus asper*		X		X				X
Three-spine stickleback	*Gasterosteus aculeatus*			X	X	X	X	X	X

[a] All three drainages have fish barriers in their lower reaches. The A and B columns represent presence above (A) or below (B) the fish passage barrier. Two lakes are present in the Slate Creek drainage and are identified as Upper (U) and Lower (L).

Sources: Biostat, 1998; Buell, 1989; Kline, 2001, 2003a, 2003b; and Konopacky, 1992, 1995.

there is the potential for one-way migration. Fish below a permanent barrier would not be able to migrate upstream; however, fish within any portion of the system could move downstream through the barriers.

Dolly Varden char, cutthroat trout, prickly scuplin, chum salmon, pink salmon, and juvenile coho salmon have been captured in Lower Johnson Creek. Dolly Varden char have also been captured on Upper Johnson Creek above the barrier falls. No surveys for three-spine sticklebacks have been performed in Johnson Creek, but based on observations in Slate Creek, they are assumed to be present. The Dolly Varden char in Lower Johnson Creek are larger (up to 16 inches) than those in the upper stream (up to 13 inches) or those in Slate Creek, and they probably represent an anadromous population (Konopacky, 1996d). Sport fish are present throughout the project area, but there has been no documented use for sportfishing (see Section 3.13, Land Use and Recreation).

Dolly Varden char and three-spine stickleback have been captured in the stream above the fish passage barrier near the confluence of the east and west forks of Slate Creek. Several estimates of the population of Dolly Varden char in Lower Slate Lake have been made. Buell (1989) set gill nets and captured two fish. The conclusion was that the population was small, likely due to very oligotrophic (nutrient-poor) conditions in the lake. Another estimate of 439 fish (range of 162 to 716) was reported based on an acoustic survey conducted in 1994 (Konopacky 1995). This estimate, however, has been questioned due to the lack of success in catching fish in the deeper portion of the lake and the limited existence of a benthic macroinvertebrate food supply (Kline, 2001). Kline (2001) was unable to successfully capture Dolly Varden char in Lower Slate Lake using hoop nets, although 12 fish were captured using rod and reel techniques. Based on capture-tag-recapture survey, Kline (2003c) estimated the Dolly Varden char population at 996. By comparison, 1,378 Dolly Varden char were found in Upper Slate Lake in 2003. The density is more than 50 percent higher than that in Lower Slate Lake (Kline, 2003d). There is a limited population (estimated at 85 fish in 1994, 23 in 2001) of Dolly Varden char in East Fork Slate Creek below Lower Slate Lake (Kline, 2001; Konopacky, 1995). The population is thought to be small due to limited habitat. Dolly Varden char captured in the streams were four to nine times smaller on average, by weight, than those captured in the lakes (Kline, 2001).

As Kline (2003b) indicates, fish surveys conducted during June 2000, August and September 2001, and October 2003 have documented the occurrence of Dolly Varden char throughout the Slate Lake and Slate Creek system. Two-way fish passage occurs between Lower Slate Lake and approximately 1,500 feet of East Fork Slate Creek below the lake. A series of cascades precludes upstream movement from areas farther downstream. The capture locations of Dolly Varden char have demonstrated that fish move downstream from Mid-Lake East Fork Slate Creek (and likely Upper Slate Lake) through a series of cascades that likely are not ascended by most Dolly Varden char. The proportion of the approximately 1,000 Dolly Varden char in Lower Slate Lake that originated in Upper Slate Lake is not known. Given this information, it is likely that fish found in Mid-Lake East Fork Slate Creek, Lower Slate Lake, East Fork Slate Creek, and waters farther downstream have a genetic link to the Dolly Varden char in Upper Slate Lake.

Dolly Varden char are known to spawn in streams during the fall. There is no literature that documents their lake spawning. ADF&G is aware of lake spawning of Dolly Varden char in Alaska, but it is considered to be rare and has not been formally documented in the Slate lakes aside from being noted (Kline, 2003b). Kline (2003b) indicated, however, that Dolly Varden char redds have been documented in the littoral zone of Lower Slate Lake. Their spawning appears to be quite variable in timing between years and might occur as early as July. The consistently shallow locations of redds suggest that wave action, rather than stream currents, provides water movement in the redds. There is no evidence of Dolly Varden char spawning in the split channels of Mid-Lake East Fork Slate Creek or East Fork Slate Creek. Nevertheless, the lack of evidence of spawning is not sufficient to rule out the possibility that some stream spawning occurs (Kline, 2003b).

In addition to Dolly Varden char, three-spine stickleback (*Gasterosteous aculeatus*) have been captured in Lower Slate Lake (Kline, 2001). They have also been observed in Upper Slate Creek and throughout East Fork Slate Creek. Because no specific surveys have been conducted for three-spine stickleback, the numbers of fish have not been determined. Based on observation, their populations are greater than the Dolly Varden char populations in Lower Slate Lake, and they provide a food source for Dolly Varden in the lake (Kline, 2004).

Anadromous Fish

All three drainages have spawning runs of pink, coho, and chum salmon. Konopacky (1996b) indicated that surveys had been done for pink, coho, and chum salmon on Sherman Creek below the fish barrier with varying levels of intensity from 1990 to 1995. Based on count data from this 5-year study, Sherman Creek appears to have an “even year” pink salmon run with fish counts as high as 11,700 during even years. Chum salmon appear to be of limited proportions; counts ranged from 4 to 109 individuals during the study period. Coho were observed in only very limited numbers in 1990 during the aforementioned study. The Anadromous Waters Catalog of anadromous fish indicates that with few exceptions (e.g., Camp Creek), all the creeks in the project area support at least some anadromous fish (ADF&G, 2004a).

Slate Creek has approximately 0.7 mile of spawning habitat that extends from the intertidal zone upstream to the fish barrier near the confluence of the east and west forks of Slate Creek. Most of Johnson Creek is inaccessible to anadromous fish because of a series of cascades and falls approximately 1 mile upstream of the mouth (Figure 3-4). Lower Johnson Creek, however, supports anadromous runs of salmon.

Based on 6 years of surveys, salmon runs in Slate Creek were found to be a fraction of the runs in Johnson Creek (Table 3-16). Pink, coho, and chum salmon were observed in both streams; however, the last two species were not observed in appreciable numbers in Slate Creek (Kline, 2003b). In 1999 there was an extremely large run of pink salmon throughout Southeast Alaska, which was reflected in the numbers for Johnson and Slate creeks for that year.

Table 3-16
Total Number of Salmon Counted Per Year

Stream	Year	Pink	Coho	Chum
Slate Creek	1995	0	3	0
	1996	36	4	0
	1997	7	0	0
	1998	268	0	2
	1999	10,492	0	0
	2000	946	0	0
Johnson Creek	1995	812	31	672
	1996	245	270	0
	1997	10,947	275	2,630
	1998	4,001	270	1,470
	1999	60,000	653	14,879
	2000	13,013	333	2,732
Sherman Creek	1995	736	0	4

Macroinvertebrates

Both qualitative and quantitative studies on macroinvertebrates in the Sherman and Sweeny creek drainages have been conducted since the early 1990s. These studies have looked at the number and types of macroinvertebrates present in these drainages and have included tissue analysis on these organisms (see Section 3.9.3) to determine concentrations of trace elements (Aquatic Science, 1998, 2000b, 2001a; Konopacky, 1996a). Annelid worms dominated the samples, especially for Sherman Creek, but all four primary groups of insects (collectors, scrapers, shredders, and predators) were present in both streams. Ephemeropterans (mayflies) and chironomids (midges) represented collectors; ephemeropterans and trichopterans (caddisflies) represented scrapers; shredders consisted of plecopterans (stone flies); and predators included plecopterans (stone flies), trichopterans, and dipterans (various flies) (Konopacky, 1996a).

Konopacky (1995) collected 12 macroinvertebrate samples in the Slate Creek drainage, 6 above the fish barrier near the confluence of the east and west forks of Slate Creek and 6 below. As in the Sherman Creek drainage, all four primary functional groups of insects—collectors, scrapers, shredders, and predators—were present at sampling locations. The samples were dominated by the presence of mayflies (51 percent). This study also collected 12 macroinvertebrate samples in the Johnson Creek drainage, 6 above the fish barrier and 6 below. As in the Slate and Sherman Creek drainages, all four primary functional groups of insects were present at the sampling locations. These samples were also dominated by the presence of mayflies (71 percent).

Grab samples collected at a depth of 12 feet in Lower Slate Lake indicated limited benthic invertebrate populations. Results from three grab samples collected in June 2000 reported 123 individuals from four taxa (Chironomidae, Oligochaeta, Bivalvia, and Acari). A second round of sampling in August 2001 found 187 individuals in three grab samples. Taxa represented were the same as those in 2000 with the addition of Amphipoda, Nematoda, Diptera, Coleoptera, and Tricoptera. For both dates the vast majority of individuals collected were midges (Chironomidae). Sampling conducted at 45 feet, on the same dates, yielded essentially no invertebrates (Kline, 2001, 2003a). Gut analyses of Dolly Varden char from Lower Slate Lake indicated that larger char consumed sticklebacks and smaller char consumed chironomids and pill clams. No planktonic organisms were observed in the gut analyses, although plankton tows in Lower Slate Lake collected copepods, cladocerans, rotifers, and protozoans (Kline, 2001).

3.9.3 Trace Element Concentrations in Fish Tissues

The following subsections discuss trace element concentrations in the Sherman Creek and Slate Creek drainages. Research conducted since 1996 has varied in intensity, location, and the analyzed suite of parameters. Information has been collected on fish tissue, macroinvertebrates, and sediment.

In 2000 and 2001 Kline Environmental Research (2001) and Earthworks Technology (2002b), respectively, collected Dolly Varden char in both Upper and Lower Slate lakes for tissue analysis of trace elements. Results indicated that fish in Lower Slate Lake contained lower average tissue concentrations than fish in Upper Slate Lake for 15 of the 20 elements analyzed. These differences were significantly different for four metals (aluminum, arsenic, boron, and molybdenum). Table 3-17 summarizes the means of the elements evaluated in Upper and Lower Slate lakes by Kline in June 2000. USEPA-designated "screening values" are available for four of

Table 3-17
Mean Concentrations of Metals in Fish Tissue in Upper and Lower Slate Lake

Element	Lower Slate Lake[a]	Upper Slate Lake[a]
Al	22.8	34.2
As	0.507	1.402
Ba	1.34	5.17
B	8.41	11.87
Cd	0.1152	0.3009
Ca	11,267	12,933
Cr	0.834	1.155
Cu	4.39	5.06
Fe	149	620
Pb	0.1100	0.0612
Mg	1,260	1,137
Mn	7.95	323.33
Hg	0.667	0.694
Mo	0.0543	0.0962
Ni	0.520	0.720
K	17,800	15,967
Se	7.25	7.63
Ag	0.0274	0.0210
Na	5,673	7,137
Zn	192	159

[a] In milligrams per kilogram (mg/kg).
Source: Kline, 2001.

the evaluated elements: arsenic, mercury, selenium, and zinc. Fish tissue exceeded screening-level recommendations for arsenic (screening level 0.14 mg/L) and mercury (screening level 0.3 mg/kg). It should be noted that "screening levels" for fish tissue are considered guidelines in assessing potential risks to fish populations. It is not uncommon to observe ambient concentrations above those levels in healthy fish populations. Because no mining activities have occurred in the Slate Creek basin, elevated metal concentrations in fish tissue are assumed to be from natural sources.

Macroinvertebrates

Aquatic Science (2001a) provided analytical results for concentrations of trace elements in macroinvertebrate tissue from Sherman Creek. Nine trace elements (silver, cadmium, chromium, copper, nickel, lead, selenium, mercury, and arsenic) were analyzed using appropriate USEPA methodology. The results (Table 3-18) indicate some variability in metal concentrations above and below the mine outfall. The differences in metal concentrations between sites might be partly due to differences in the species composition of samples (Table 3-19), as well as the natural variability of metal concentrations in the environment among sites (Aquatic Science, 2001a).

Sediment

The *Ecological Risk Assessment of Aqueous Tailings Disposal at the Kensington Gold Mine* (Appendix C) compared Upper and Lower Slate Lake trace element sediment concentrations to risk-based criteria. Twenty-six analytes were submitted for laboratory analysis. Eight analytes (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) had corresponding USEPA sediment screening values. Both Lower and Upper Slate Lake sediments exceeded a range of sediment screening values for arsenic. Arsenic concentrations in Lower and Upper Slate lake sediments were reported to be 47.9 and 57 mg/kg, respectively. The range of sediment screening values for arsenic was reported to be 5.9 to 33 mg/kg (CCME, 2002; MacDonald et al., 2000; NOAA, 1999). As noted above, screening levels are considered guidelines for further evaluating potential risk from sediment to aquatic life and concentrations above these levels are not uncommon in natural sediment.

Table 3-18
Concentrations of Metals in Sherman Creek Invertebrates

	Below Mine Outfall (in mg/kg)			Above Mine Outfall (in mg/kg)	
Analyte	**Lower Sherman**	**Middle Sherman**	**Ophir Creek**	**Ivanhoe Creek**	**Upper Sherman**
Arsenic	0.4	6.3	3.9	1.6	7.4
Cadmium	2.21	0.91	0.46	1.32	1.30
Chromium	3.5	3.5	3.5	1.9	5.1
Copper	34.8	40.1	44.9	59.9	47.7
Lead	1.04	1.34	0.82	0.15	1.02
Mercury	0.06	0.05	0.08	0.04	0.04
Nickel	2.6	2.7	2.0	1.9	3.5
Selenium	1.4	0.8	1.7	0.9	6.6
Silver	0.15	0.11	0.10	0.15	0.11

Source: Aquatic Science, 2001a.

Table 3-19
Species Composition of Invertebrate Samples Analyzed for Metals Concentrations

Stream	Macroinvertebrate Order	Percent of Total Weight of Submitted Sample
Lower Sherman	Ephemeroptera	62
	Plecoptera	28.7
	Tricoptera	9.3
Middle Sherman	Ephemeroptera	91.7
	Plecoptera	8.3
Upper Sherman	Ephemeroptera	39.8
	Plecoptera	37.8
	Tricoptera	12.8
	Tipulidae	9.6
Ivanhoe Creek	Ephemeroptera	66
	Plecoptera	11
	Tricoptera	23
Ophir Creek	Ephemeroptera	35.5
	Plecoptera	41.8
	Tricoptera	22.7

Source: Aquatic Science, 2001a.

In 2001 sediment samples were also collected from East Fork Slate Creek below Lower Slate Lake. These samples were analyzed for the same trace elements as the Upper and Lower Slate lake samples, including the eight analytes with sediment screening values. The mean concentrations of arsenic, cadmium, mercury, nickel, and zinc each exceeded a range of sediment screening values.

No sediment chemistry data are available for other watersheds in the project area.

3.9.4 Essential Fish Habitat

Essential Fish Habitat (EFH) has been broadly defined to include waters and substrate necessary to fish for spawning, feeding, or growth to maturity (NOAA, 2003a). Habitat areas of particular concern were identified as living substrates in shallow and deep waters, and freshwater habitats used by anadromous fish (NOAA, 2003a). An assessment of EFH is presented in Appendix B.

Salmon EFH is the aquatic habitat, freshwater and marine, necessary to allow for the salmon production needed to support a long-term, sustainable salmon fishery and salmon contributions to healthy ecosystems. Freshwater EFH for the salmon in Alaska includes all streams, lakes, ponds, and wetlands currently or historically accessible to salmon. Sherman Creek, Slate Creek, and Johnson Creek all include EFH for salmon below the fish barriers.

3.10 AQUATIC RESOURCES: MARINE

The following descriptions of aquatic resources were derived from site-specific field studies, published reports, and scientific literature. This section also summarizes the analyses performed previously as described in the 1992 FEIS and 1997 SEIS.

3.10.1 Oceanography

Lynn Canal

The oceanography of Lynn Canal is discussed extensively in the 1992 FEIS. The circulation of Lynn Canal is principally estuarine; that is, it has a seaward surface flow with a corresponding landward deep flow that balances mass transport. The circulation is dominantly tide-driven, but wind also influences the overall circulation pattern. The estuarine flow is typically seasonal, with stronger flows during the summer (July and August) when freshwater input is at a yearly peak. Tidal flow exhibits a semi-diurnal pattern and is consistent throughout the year.

Berners Bay

Berners Bay is approximately 3 miles wide and 6 miles long, and it is oriented north-south (somewhat parallel to Lynn Canal). The entrance to the bay is about 4 miles wide. The bay is about 600 feet deep at the mouth and about 400 feet deep in its central portion, and it shoals steeply along the shoreline. Glacial sediments reduce the depth of the bay to inches at the head where the Antler, Gilkey, and Lace rivers join the bay. The surface area of the bay is about 17.6 square miles.

Berners Bay exhibits semidiurnal mixed tides, meaning that the water level in the bay fluctuates with two unequal highs and lows daily. The mean tidal range is 13.64 feet, and the diurnal range is 16.26 feet. Between April 1998 and June 1999, NOAA recorded extreme water elevations reflected in a high water elevation of 19.7 feet and a low of –4.3 feet, both relative to mean lower low water (MLLW).

No known current measurements are available. It is surmised that the currents in the bay might be tidally induced, with gyres in both Echo Cove and the north portion of the bay. The direction and magnitude of the tidal currents cannot be determined from geometry alone and would require confirmation measurements. Generally, such bays in Alaska have weak and variable currents.

Wave Action

Site exposure to wave energy is largely a function of the wave fetch window, the open-water area offshore from the site over which waves can be generated by winds. The larger the wave fetch window, the greater the wave exposure at a particular site. The British Columbia Estuary Mapping System (1999) considers sites with a maximum wave fetch of less than 6.2 miles to be protected, semiprotected up to 31 miles, and semiexposed to exposed when wave fetch is greater than 31 miles.

Wind measurements at Eldred Rock, a meteorological station approximately 6 miles north of Comet Beach, show that maximum wind speeds from the north are about 20 percent faster than maximum wind speeds from the south (Peratrovich, Nottingham & Drage, Inc., 1989). Wave heights in Lynn Canal can exceed 20 feet during heavy winds from the north and 14 feet during winds from the southeast. Table 3-20 presents hindcast wave conditions in Lynn Canal, at the entrance to Berners Bay, modeled by Pacific International Engineering (1997).

Table 3-20
Modeled Wave Conditions in Lynn Canal

Event	Eldred Rock Wind Speed (knots)	Lynn Canal at Entrance to Berners Bay Wind Direction deg. N (from North)	Wave Height (feet)	Wave Period (seconds)
10-year	55	340	14.4	7.5
	43	160	11.4	6.9
25-year	62	340	16.8	8.1
	45	160	12.0	7.0
50-year	69	340	19.2	8.6
	46	160	12.4	7.1
100-year	77	340	22.2	9.1
	48	160	13.0	7.3

Source: Pacific International Engineering, 1997.

Comet Beach is affected by the larger wave action associated with northerly storms; significant exposure occurs from a 20- to 30-mile fetch down Lynn Canal from the north-northwest (302º to 325º from North). Wave exposure is evidenced by the composition of the beach; large cobbles, boulders, and wave-deposited debris can be observed in the woods above the high tide line. Site engineering studies performed at Comet Beach indicated that significant armoring would be required for any fill or structures placed below the high water mark (Earthworks, 2003b). Comet Beach would be considered a semiprotected to semiexposed site, based on maximum potential fetch window and wind direction. Point Sherman provides some protection to Comet Beach from waves generated by southeasterly storms.

Slate Creek Cove is protected from Lynn Canal's wave climate by land to the north and west. The most significant exposure for Slate Creek Cove is from a 5-mile fetch across Berners Bay from the southeast; hence, Slate Creek Cove could be considered a protected site. The estimated wave height from a 25-year event in Slate Creek Cove is 5 feet, compared with 16.8 feet in Lynn Canal at the mouth of Berners Bay and 20 feet at Comet Beach (Earthworks, 2003b).

Cascade Point is protected by land on the south and east. The maximum waves modeled for Cascade Point would come from north winds in Lynn Canal. Although the extent of fetch to which Cascade Point is exposed is relatively limited, Cascade Point would be considered semiprotected. The estimated 25-year wave event for Cascade Point would be 9.1 feet (Earthworks, 2003b). No modeling has been completed for wave activity in Echo Cove; however, the limited exposure to Lynn Canal wind and waves would result in the entire cove's being "protected" in terms of the British Columbia Estuary Mapping System.

3.10.2 Substrate and Sediment

The characteristics of bottom sediments for Lynn Canal were described in both the 1992 FEIS and 1997 SEIS. The intertidal zone on the eastern shore consists of moderately sloped cobble beaches with rock outcrops. The beaches are exposed to storm-generated waves from the north, which likely prevents accumulation of finer-grained sediments. Cobble and rock substrates extend subtidally to a depth of approximately 30 feet. Below 30 feet, bottom sediments are finer and consist of varying proportions of silt, sand, and gravel. Sediments in the deepest, flat-bottomed portions of Lynn Canal consist of relatively fine-grained particles (Dames and Moore, 1988a).

Concentrations of total organic carbon (TOC) in bottom sediments range from 0.25 to 1.27 percent (Rescan, 1990). Sediments from offshore generally contain slightly higher concentrations than those from inshore. Sediment metal concentrations are generally consistent with expected background concentrations.

The intertidal substrate near Slate Creek in Berners Bay varies from hard bedrock to soft mud. The north and south ends of Slate Creek Cove are mostly bedrock, and the middle section is mostly gravel. The rocky substrate ends at about a 2-foot depth below MLLW, and the substrate is mostly sand to 25 feet. Below the sand the substrate becomes very fine silt, probably due to glacial deposit (Stekoll, no date b).

The area near Cascade Point is fairly steep and mostly rocky with little soft substrate down below the 30-foot level. South of the point, the bottom is less steep and becomes dominated by fine sand and mud (Stekoll, no date a).

3.10.3 Nearshore Marine Organisms

Lynn Canal and its adjoining bays, including Berners Bay, support an abundant and diverse biota. Both marine and anadromous species are present. The 1992 FEIS presents a description of the biological communities in Lynn Canal. There is considerable overlap in the biological communities between Lynn Canal and Berners Bay. The following section provides an overview, as well as new information collected since the 1992 FEIS and 1997 SEIS, for the biological communities that inhabit the vicinity of the project.

Intertidal

The invertebrates inhabiting intertidal zones in Lynn Canal are dominated by marine snails (*Littorina sitkana)*, acorn barnacles (*Balanus glandula)*, and blue mussels (*Mytilus edulis)*. The brown algae (*Fucus distichus)* occur in patches on cobbles in the lower intertidal zones. Rock outcrops in this area support higher densities and greater diversity of organisms than cobble areas.

Studies were conducted in 1999 to provide additional biological baseline data on the intertidal and subtidal zones near the proposed docking facilities at Slate Creek and Cascade Point in Berners Bay. In the intertidal area near Slate Creek, relatively few organisms were found, consisting mostly of algae and dominated by the brown perennial *Fucus gardneri*. Other common algae were the green ephemeral *Enteromorpha* and the filamentous brown ***Pilayella.*** There was more diversity found at the south end of the site where mussels and barnacles were common (approximately 15 percent cover) along with limpets and snails. Countable invertebrates averaged about 40 organisms per 3.28 square feet in the upper intertidal and 13 per 3.28 square feet in the lower intertidal, and fewer than 50 species were identified overall (Stekoll, no date b). Specific studies were not conducted at Echo Cove, which could provide intertidal habitat characteristics slightly different from those of Cascade Point or Slate Creek Cove. It is likely that these organisms would be similar in species composition and abundance to those found in other rocky shoreline habitat found locally.

Subtidal

The dominant invertebrate taxa in Lynn Canal include green sea urchin *(Strongylocentrotus drobachiensis)*, hermit crabs *(Pagurus* spp.), and sea stars (*Pycnopodia helianthoides, Leptasterias hexactis,* and *Solaster* spp.). Polychaete worms and, secondarily, mollusks dominate the bottom fauna at depths greater than 32 feet. A total of 126 infaunal species were present in three samples collected off Sherman Creek (Dames and Moore, 1988b).

Lynn Canal and Berners Bay support a variety of shellfish. Principal crab species include Tanner (*Chionoecetes bairdi)*; Dungeness (*Cancer magister*); and brown, blue, red, and golden king (*Paralithodes* spp.). Shrimp species include pink (*Pandalus borealis*), spot (*P. platyceros*), humpy (*P. goniurus*), coonstripe (*P. danae*), and sidestripe (*Pandalopsis dispar*). NMFS (1974) found Tanner crabs to be the most abundant crab species in Berners Bay in 1970. Of the shrimps, pink and sidestripe were the most common. Echo Cove in Berners Bay showed abundant shellfish populations in the 1960s. Tanner, Dungeness, and king crabs, as well as pink and humpy shrimp, were all observed (Myren, 1972).

In Slate Creek Cove, the density and diversity of organisms is relatively low when compared with other areas in Lynn Canal (Stekoll, no date b). Species observed near Slate Creek included benthic diatoms, crabs, shrimp, anemones, and the seastar *Evastserias*. The most common organisms found were crabs averaging less than one per 3.28 square feet (Stekoll, no date b). Carlson et al. (1982) reported small numbers of Tanner crabs and pink shrimp in Slate Creek Cove.

The subtidal community near Cascade Point is typical of Southeast Alaska. Benthic epibiota are common but not abundant. Stekoll (no date a) found more than 40 species of algae and animals in the area during June. The red alga *Lithothamnion* sp. occurs on almost all shallow subtidal areas. Other algae common in the shallow subtidal areas are green alga (*Ulva* sp.), *Constantinea*, and *Palmaria*. At depths greater than 7 feet, the large kelps are common; the most common is the *Laminaria.* The acid hair kelp *Desmarestia* sp. was observed mixed in with the large kelps (Stekoll, no date a). Sea urchins, chitons, tube worms, and snails were the most common invertebrates found on the rock substrate. On soft substrate polychaetes, fish, and clams were more common. Hermit crabs were found throughout the area (Stekoll, no date a). Specific studies have not been conducted at Echo Cove, but it is likely that species similar to those found at Cascade Point would be present in subtidal habitats.

3.10.4 Marine Mammals

Humpback whales (*Megaptera novaeangliae*), Steller sea lions (*Eumetopias jubatus*), and harbor seals (*Phoca vitulina*) have been observed feeding on eulachon (*Thaleichthys pacificus*) in Berners Bay (Marston et al., 2002). The humpback whale is listed as endangered, and the Steller sea lion is listed as a threatened species in the project area. Both are discussed in greater detail below and in the Biological Assessment/Biological Evaluation (BA/BE) in Appendix J.

Harbor seals can be found year-round in Berners Bay, but they are most prevalent during the April–May eulachon spawning period when several hundred concentrate at the head of the bay (USFWS, 2003). Their numbers may remain relatively high through summer. Counts conducted by ADF&G and NMFS in August 2002 documented mean counts of 70 and 349 harbor seals at haulouts near the mouth of the Antler River and Lace River, respectively.

Other marine mammals known to inhabit Berners Bay, at least occasionally, include killer whales, harbor porpoise, and Dall's porpoise (USFWS, 2003). Harbor porpoise probably occur year-round. The presence of transient killer whales may coincide with concentrations of pinnipeds associated with the April–May spawning of eulachon, although resident killer whales could occur within the bay at any time. Other marine mammals infrequently or potentially occurring in Lynn Canal include the Pacific white-sided dolphin, minke whale, gray whale, northern elephant seal, and sea otter (Mizroch et al., 1998).

Humpback Whale

Humpback whales are found in coastal areas or near oceanic islands and appear to occur primarily in nearshore waters, especially the highly productive fjords of Southeast Alaska and Prince William Sound (Calkins, 1986). Humpback whales have been protected since 1965 and are currently listed as endangered under the *Endangered Species Act* (ESA) (Angliss and Lodge, 2002). In the North Pacific, most remaining humpback whales reside in U.S. territorial waters (winter and summer grounds). They range from California to the Chukchi Sea, Hawaii, and the Mariana Islands (NMFS, 1991). During summer, humpback whales in the North Pacific migrate and feed over the continental shelf and along the coasts of the Pacific Rim, from Point Conception, California, north to the Gulf of Alaska, Prince William Sound, and Kodiak Island. Humpback whales spend the winter in three separate wintering grounds: the coastal waters along Baja California and the mainland of Mexico, the main islands of Hawaii, and the islands south of Japan (NMFS, 1992).

Humpback whales were commercially hunted extensively from the late 1800s through the first part of the 20th century. Worldwide, their population is approximately 10,000. This is 8 percent of the historical population size, although this species is now recovering. The greatest threats to humpback whales today are entanglements in fishing gear, ship strikes, and coastal habitat pollution. The pre-1905 population of humpback whales in the North Pacific was approximately 15,000. By 1966 whaling had reduced this population to approximately 1,200 individuals. It is estimated that more than 3,600 humpback whales exist in the Central North Pacific (NMFS, 2001).

Most humpback whales occur in temperate and tropical waters in winter. Humpback whales in the North Pacific are seasonal migrants that feed on zooplankton and small fishes in the cooler northern coastal waters during the summer. Humpback whales have separate populations that migrate between their respective summer/fall feeding areas to winter/spring calving and mating areas. The humpback whales that feed in Southeast Alaska during the summer migrate to Hawaii in the winter and are referred to as the Central North Pacific stock.

Humpback whales are regularly sighted in the Inside Passage and coastal waters of the Southeast Alaska panhandle from Yakutat Bay south to Queen Charlotte Sound, and they have been documented foraging in Berners Bay (Forest Service, 1997a; Marston et al., 2002). Up to three humpback whales were documented during boat surveys in 2000 (USFWS, 2003), and a maximum of five humpback whales have been observed feeding in Berners Bay during the spring eulachon run (Womble, 2003, personal communication).

Humpbacks remain in the Gulf of Alaska through the summer and fall and begin their migration south in November, although they have been observed in Lynn Canal all months of the year. Peak numbers of whales are usually found in nearshore waters during late August and September, but substantial numbers may remain until early winter. The Forest Service (1997a) estimates that 300 to

500 humpback whales inhabit Southeast Alaska during the summer and fall. Baker et al. (1986) estimated 374 individuals for the southeastern Alaska region.

The local distribution of humpbacks in Southeast Alaska is correlated with the density and seasonal availability of prey species, particularly herring; euphausiids (small crustaceans); and, within Berners Bay, eulachon. Other prey includes Pacific sand lance (*Ammodytes hexapterus*), capelin (*Mallotus villosus*), Atka mackerel (*Pleurogrammus monopteryguis*), walleye pollock (*Theragra chalcogramma*), and haddock (*Melanogrammus aeglefinus*) (Bryant et al. 1981; Krieger and Wing, 1984). Adults consume up to 3,000 pounds per day, although they likely feed only during the 6 to 9 months of the year that they are on their feeding grounds. They fast and live off their fat layer for the winter period while on their breeding grounds.

Steller Sea Lion

The Steller sea lion is widely distributed over the continental shelf and throughout the coastal waters of the Gulf of Alaska (Calkins, 1986). The world population of Steller sea lions is distributed around the North Pacific from northern Japan through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea off the coast of Alaska, and south to the Channel Islands, California (NMML, 2003).

The Steller sea lion was originally listed as a threatened species under the ESA in 1990. Protected status was deemed necessary because of a large decline in Steller sea lion numbers throughout their range and particularly in Alaska. Populations are estimated to have declined between the 1950s and 1990 by 78 percent (NMFS, 1992). In certain parts of Alaska, declines of greater than 80 percent have occurred since 1985. Population modeling has suggested decreased juvenile survival is likely the reason behind the decline. Critical habitat for Steller sea lions was designated in 1993 (NMFS, 1993). In 1997 NMFS classified the Steller sea lion as two distinct population segments and reevaluated its status. Steller sea lions occurring west of 144° W longitude were reclassified as endangered. The stock differentiation is based primarily on differences in mitochondrial DNA, but also on population trends in the two regions. The eastern Pacific population, listed as threatened, includes the Berners Bay population, and the population levels for this group are increasing. However, Raum-Suryan et al. (2002) documented limited movement by western stock individuals to the eastern stock region from branding studies conducted between 1975 and 1995. During this 21-year study a total of 8,596 Steller sea lion pups were branded; there was little interchange between stocks between 1979 and 1987 with 23 resightings (0.4 percent of 5,746 resightings) of the western stock at three different locations within the eastern stock region, including areas near Juneau. No adult Steller sea lions were observed breeding in the opposite stock, although adults of breeding age did move between stocks (Raum-Suryan et al., 2002). Resightings of branded Steller sea lions showed wide dispersal from natal rookeries, particularly of juvenile animals, occasionally traveling over 1,500 km to other rookeries and haulouts and crossing stock boundaries; yet individuals returned to breed at either their natal rookery or a non-natal rookery within their respective stock (Raum-Suryan et al., 2002). Therefore, the potential presence of some members of the western stock population foraging in Berners Bay cannot be completely ruled out.

Steller sea lions are opportunistic predators, feeding primarily on a wide variety of fishes and cephalopods. Prey varies geographically and seasonally. Some of the more important prey species in Alaska are walleye pollock, Atka mackerel, Pacific herring (*Clupea harengus*), capelin, Pacific sand lance, Pacific cod (*Gadus macrocephalus*), salmon (*Oncorhynchus* spp.), and, locally, eulachon. Eulachon is an important prey species in early spring (NMFS, 1992; Marston et al., 2002). Steller sea lions have also been known to prey on harbor seal, fur seal, ringed seal, and possibly sea otter pups, but these animals would represent only a supplemental component in the diet. At Berners Bay, harbor seal abundance did not increase until after Steller sea lion abundance had decreased (Marston et al., 2002).

The abundance of marine mammals in Berners Bay increases during the early spring, timed with the eulachon run. Each spring eulachon spawn in Berners Bay in the lower reaches of the Antler, Berners, and Lace rivers (Marston et al., 2002). These runs are considered an "ecological cornerstone" for regional coastal ecosystems. Since 1996 several studies on eulachon and Steller sea lion interactions have been conducted in Berners Bay. A recent study first documented sea lions in Berners Bay on April 8, 2002, and a peak count of 949 occurred on April 18 (Sigler et al., 2003). Sea lions were detected in the Antler River from April 22 to May 1, 2002. Peak marine mammal counts of 419 in 1995 and 250 in 1996 occurred in Berners Bay the first week in May (Marston et al., 2002). In 1995 and 1996, no distinction was made between Steller sea lions and harbor seals. The Steller sea lion abundance trend appears to follow the eulachon abundance trend in Berners Bay. Both sea lion and eulachon abundance are typically low in early April, peak in mid to late April, and then decrease to near-zero by early May (Sigler et al., 2003). There is a major sea lion haulout at Benjamin Island 14 miles south of Berners Bay, and it is occupied seasonally, primarily from September to April. Sea lion abundance decreases at Benjamin Island as the numbers increase in Berners Bay.

In addition to Benjamin Island, there are two other documented Steller sea lion haulouts in Lynn Canal, at Gran Point and Met Point. During the eulachon run in April and May, Berners Bay is likely to be an important foraging area for sea lions from all three haulout sites (Womble, 2004, personal communication). Although there is no specific documentation in the existing literature, it is obvious that the eulachon run in Berners Bay is important to Steller sea lions and other marine wildlife during certain times of the year.

Cooperative feeding behavior by sea lions has been documented in Berners Bay. Gende et al. (2001) reported several observations of 75 to 300 Steller sea lions foraging cooperatively on schools of eulachon in late April or early May 1996 through 1999. Sigler et al. (2003) also noted cooperative foraging along the western shore of Berners Bay in April 2002. When not foraging, sea lions have been observed forming large "rafts" of 10 to 80 sleeping or resting individuals in the middle of the bay (Gende et al., 2001). Steller sea lions have also been observed hauling out just south of Slate Creek Cove during late April (Womble, 2004, personal communication).

The nearest rookery to the project area is Graves Rock, on the outer coast, approximately 75 air miles from the project area. This is a new rookery, previously documented as a sea lion haulout only. Most of the sea lions observed during peak counts in Berners Bay were either adult or juvenile sea lions (Sigler et al., 2003); however, most sea lions observed at the Benjamin Island haulout at the same time were 10- to 11-month-old pups, and some were still likely dependent upon their mothers' milk for nutrition (Womble, 2003, personal communication). The number of pups produced in the eastern stock has nearly doubled since 1978, with an annual rate of increase of 5.9 percent during 1979 to 1998; the annual rate of increase declined between 1989 and 1997 to 1.7 percent (Calkins et al., 1999). Sease and Gudmundson (2002) estimated 1.8 percent annual increase in non-pup sea lions between 1991 and 2002. In the Southeast Alaska portion of the eastern stock, where non-pup counts on trend sites have increased 29.3 percent since 1990 (Sease et al., 2001), Calkins et al. (1999) found that there are probably more sea lions at present than at any time in recorded history.

Harbor Seal

The distribution of harbor seals ranges from the shores of Baja California to the Aleutian Islands and northward. They occur throughout Lynn Canal year-round, occurring most frequently in estuaries and protected waters. They are considered nonmigratory and move as necessary depending on weather, food availability, and season (NMFS, 1998). The Alaska Scientific Review Group has identified three distinct biological stocks of harbor seals in Alaska. The population in Lynn Canal is part of the Southeast Alaska stock, which includes individuals from the Alaska/British Columbia border to Cape Suckling (144° W). The Southeast Alaska population is considered to be stable, and counts conducted through the mid-1990s suggest an upward trend in population numbers in many locations (NMFS, 1998). Recent studies, however, conclude that current evidence supports a minimum of 12 stocks of harbor seals in Alaska (see below).

Although harbor seals are considered abundant throughout their range, they have declined dramatically in some areas over the past few decades while in other areas their numbers have increased or remained stable over a similar time period (Pitcher, 1990; Frost et al., 1999; Matthews and Pendleton, 2000). When Alaska Marine Mammal Stock Assessment Reports for harbor seals were developed by NMFS in 1995, they stated that there was considerable uncertainty about Alaskan harbor seal stock structure and that genetic studies were under way.

The three separate trend routes within Southeast Alaska stock exhibit different trends. Numbers in the Ketchikan area increased significantly at 7.4 percent per year between 1983 and 1998, while counts in the Sitka area were stable across a similar time period (NMFS, 1998). By contrast, seal numbers in Glacier Bay have been declining at a rate of 4.9 to 10.9 percent per year since 1992 (Matthews and Pendleton, 2000). Results of a recent study by O’Corry-Crowe et al. (2003) concluded that there are at least 12 distinct stocks of harbor seals in Alaska, based on genetics and dispersal distance measures. These findings indicate that current stocks are too large and continued declines in certain locations increase the risk of local depletion (O’Corry-Crowe et al., 2003). However, the 12 demographically independent clusters, 8 of which were identified in Southeast Alaska, do not represent a complete picture of population subdivision and dispersal in Alaskan harbor seals because substantial gaps remain in sampling coverage. Efforts are under way to increase sampling coverage. In the area of Berners Bay, additional sampling will be required to determine whether linkages occur between identified clusters surrounding the project area or whether harbor seals within the Lynn Canal region are a distinct population. As sample coverage increases, O’Corry-Crowe et al. (2003) expect the configuration of some of the existing strata to change somewhat as new strata are added and the connectivity matrix is modified.

The 1992 FEIS reports that harbor seals use the area between the Lace and Antler rivers for pupping and pup rearing because concentrations have been observed in the spring. In addition, the rocky point just east of Slate Creek Cove has been used as a haulout for harbor seals. The USFWS also documented concentrations of harbor seals in this area during spring surveys conducted between 2000 and 2002 (USFWS, 2003). It is likely that the seals also feed on eulachon during their run up the Antler and Lace rivers. Other prey includes shrimp, octopus, salmon, capelin, pollock, and sculpins.

3.10.5 Fish

Salmon are the most important fish species in Lynn Canal from an economic standpoint. Salmonids include sockeye (*Oncorhynchus nerka*), pink (*O. gorbuscha*), chum (*O. keta*), coho (*O. kisutch*), and chinook (*O. tshawytscha*), as well as Dolly Varden char (*Salvelinus malma*), steelhead trout *(O. mykiss)*, and cutthroat trout (*O. clarki*). Adult salmon returning to Lynn Canal occur primarily along the eastern shore. Spawning migrations vary somewhat by species, but the primary movement occurs between June and November (Archipelago Marine Research, 1991). During spring to early summer, the newly emerged salmon fry congregate in nearshore waters (within 50 feet of the shoreline) and feed in the beach and rocky habitats for periods up to several weeks. At the age of 1 to 2 months, they move into deeper waters and eventually migrate to the open ocean through the summer and fall.

Berners Bay contains seven streams with anadromous fish runs (Table 3-21, Figure 3-5). All salmon species with the exception of chinook are found in Berners Bay streams. In some years, pink salmon are the most abundant, but consistently, on average, coho are the more numerous. For example, in 1999 more than 40,000 pink salmon were counted in the Antler-Gilkey rivers alone, but on a consistent basis the coho run to the Berners River is the most numerous, averaging more than 30,000 total fish (10,000 fish escapement) since 1982 (ADF&G, 2003a).

Table 3-21
Major Anadromous and Resident Salmonids and Smelt Species in Berners Bay Streams

Stream	Species Present
Antler-Gilkey	Coho, chum, pink, eulachon
Lace	Coho, eulachon
Berners	Coho, sockeye, chum, cutthroat, Dolly Varden char, eulachon
Johnson	Coho, chum, pink, cutthroat, Dolly Varden char
Slate	Coho, chum, pink, cutthroat, Dolly Varden char
Sawmill	Chum, pink, Dolly Varden char
Cowee-Davies	Coho, chum, pink, steelhead, cutthroat, Dolly Varden char

Excluding anadromous fish, 73 marine species of fish have been found north of 58° N latitude (Lenz et al., 2001). The more prevalent fish species in Lynn Canal are Pacific cod and Pacific herring, although the Lynn Canal Pacific herring population is depressed compared to numbers from the late 1970s and early 1980s. Other fish species common to the area are eulachon, capelin, walleye pollock, arrowtooth flounder (*Atheresthes stomias*), yellowfin sole (*Pleuronectes aspera*), Pacific halibut (*Hippoglossus stenolepis*), rock sole (*P. bilineata*), starry flounder (*Platichthys stellatus*), sablefish (*Anoplopoma fimbria*), rockfish (*Sebastes* spp.), skates (*Raja* spp.), and sculpins (*Cottus* spp.).

Threatened and Endangered Salmonids

Six populations of chinook salmon, one population of sockeye salmon, and four populations of steelhead trout are listed under the ESA. These listed populations of salmon and steelhead do not spawn in Alaska but are known to seasonally inhabit waters on the outside coast to the west of the Tongass National Forest. They are not known to inhabit coastal marine waters of the Tongass National Forest but may feed on fish that are dependent on these waters at some stages of their lives.

Eulachon

A species of significance found in Berners Bay is the eulachon, an important food fish for indigenous peoples as well as an important prey species for Steller sea lions and other marine mammals. Eulachon are anadromous smelt that usually spawn from March to May in Southeast Alaska. Information on juvenile life stages is scarce, and only about 30 streams from northern California to the Bering Sea support spawning populations of eulachon (Hart and McHugh, 1944). Most of these streams are confined to mainland glacier-fed systems.

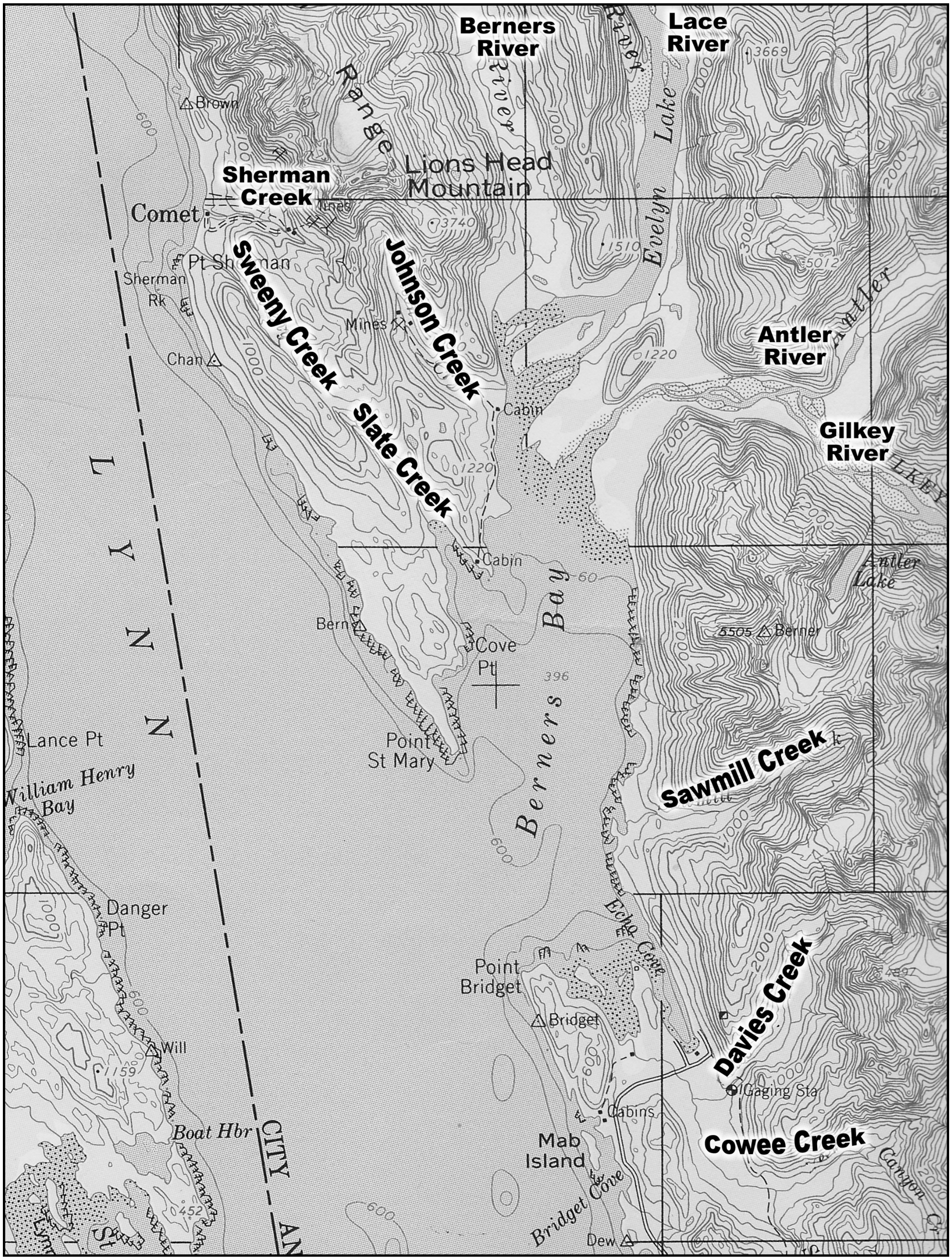


FIGURE 3-5. ANADROMOUS FISH STREAMS IN THE STUDY AREA

Adult eulachon were found in the western and northern parts of Berners Bay from Point Saint Mary to the mouth of the Berners River during spring of both 2001 and 2002. Eulachon density was greatest for the area near the mouth of the Berners River and was greatest at depths of 120 to 450 feet for Berners Bay overall (Sigler et al., in press). Again in spring 2004 returning adults were found in the same areas, with highest densities in the main bay at 300 to 360 feet deep and in Slate Creek Cove at 90 to 210 feet deep (Sigler, 2004, personal communication). One eulachon spawning location in the lower 1 mile of the Antler River has been identified by radio tagging (Spangler, 2002), although eulachon also are noted to spawn in the Berners River.

Pre-spawning aggregations of eulachon are found in Berners Bay during April and May. These fish congregate in the bay for a variable period of time before moving into fresh water to spawn (Spangler, 2003, personal communication). The timing of the eulachon pulse appears somewhat predictable.

Returning adults generally school in deep water near the bottom of the bay when the tides are running, but they have been observed at the surface during slack tides. Eulachon were most abundant in Berners Bay during April 18–20 in 2001 and April 17–23 in 2002 (Sigler et al., 2003). Adults were again very abundant in the bay for only about 10 to 14 days in April 2004 (Sigler, 2004, personal communication). Eulachon were most abundant between May 5 and 10 in 1996 and 1997 (Marston et al., 2002) and the last week of April in 1998 (Gende et al., 2001). They were detected in the Antler River in 2002 from April 19 to May 21 (Spangler, 2002). The location of the eulachon aggregation is also predictable because large schools of eulachon return in a relatively short spawning period (10 to 12 days) (Marston et al., 2002).

Spawning preferences for eulachon have been identified as coarse sand, or sand and pea gravel substrate, moderate stream flows, and colder temperatures (Smith and Saalfeld, 1955). Turbidity does not seem to affect the spawning fish, but temperature changes likely affect the time for spawning and for migration (Smith and Saalfeld, 1955). Spawning can occur at a range of depths, but eggs have been found most often at depths of 20 to 25 feet (Smith and Saalfeld, 1955). The eggs are adhesive and stick to the substrate. Eulachon eggs in the Cowlitz River, Washington, were found to hatch after 30 to 40 days at 40 to 45 °F (Smith and Saalfeld, 1955). However, cooler temperatures in Alaska would likely extend the time for eulachon eggs to hatch in Berners Bay. Larval eulachon drift has been observed over the period of June through July in the Antler River.

Juvenile eulachon are initially ineffective swimmers and float with the current out to marine waters (McKenzie, 1964). Juveniles likely feed in estuaries or protected waters such as Berners Bay before swimming into the open ocean (Smith and Saalfeld, 1955). In Canadian waters, eulachon larvae disperse and mix with other plankton in coastal areas during an 18- to 20-week period (April to August), about 4 weeks after adult spawning, with both dispersion and retention occurring in major inlets (Hay and McCarter, 2000). Eulachon juveniles were captured in Berners Bay during January 2004 by midwater tow net at a depth of about 210 feet (Sigler, 2004, personal communication), suggesting some early life stage rearing in the bay. Juveniles have been observed to stay close to the bottom (Smith and Saalfeld, 1955). Little is known about the life history of eulachon at sea, but they are believed to feed on euphausiids and other small organisms (Hart and McHugh, 1944).

Pacific Herring

Pacific herring are found from southern California to the eastern Beaufort Sea. The region of greatest abundance is along the coasts of British Columbia and Southeastern and Central Alaska.

Herring are one of the more abundant fishes along the coast of Alaska, although this abundance tends to be seasonal and varies tremendously from year to year. Prior to 1983 the Lynn Canal Pacific herring stocks supported several commercial fisheries, including a sac roe fishery, a bait pound fishery, and a winter food and bait fishery. The Lynn Canal herring stock traditionally spawned from Auke Bay to Point Sherman. The stock declined in 1982 and has since remained at low levels. The reason for the decline is not clear, although potential causes are overfishing, habitat degradation or disturbance, geographic shifting of spawning aggregations, population growth of major predators such as sea lions, or a combination of these factors. If the decline was attributable solely to overfishing, the stock would likely be showing signs of recovery during the 20-year period since the close of commercial harvests, as has occurred in other areas in Southeast Alaska.

Pacific herring spawn from December to July depending on latitude. In Southeast Alaska, most spawning activity takes place between mid-March and mid-April. The documented spawn for the Lynn Canal herring stock from 1953 to 1981 ranged from 6 to 18 nautical miles, averaging approximately 12 miles. Auke Bay was among the key areas where spawning occurred. In recent years, however, ADF&G records demonstrate that spawning activity for the stock has centered between Point Bridget and the Berners Bay flats (Moulton, 1999). Since 1982 the documented spawn has ranged from 0.5 to 7 nautical miles, averaging 3.5 nautical miles. Spawning locations vary from year to year.

The established biomass threshold level for the Lynn Canal stock is 5,000 tons of spawning biomass, meaning that before a herring fishery can be considered for the Lynn Canal stock, a forecast spawning biomass must meet or exceed 5,000 tons. Based on shoreline miles of spawn, it is estimated that the stock biomass has varied between 100 and 2,500 tons over the past 20 years. A spawning survey conducted in spring 2004 estimated approximately 500 tons of spawning biomass in the Berners Bay area (Monagle, 2004, personal communication).

During February and March herring concentrate near the bottom (at 200 to 300 feet) off traditional spawning beaches in Lynn Canal. They remain there until late April, when sea-surface temperatures increase to 41° to 42.8 °F, and they move into tidal shallows and commence spawning. Herring spawning typically takes place over nearshore habitat from mean higher high water to –40 feet, but typically +3 to –7 feet deep. The herring deposit eggs on a variety of substrates, including kelp and eelgrass (Emmett et al., 1991). The eggs are sticky and adhere to whatever they contact. They hatch in about 10 days, and feeding begins 2 weeks or less after hatching. During this time waves and currents may disperse the young herring. Many are carried out to sea and perish. Those remaining congregate in suitable shallow bays, inlets, and channels. They move into deeper water in the fall and virtually disappear for the next couple of years (Morrow, 1980). Spawning in Lynn Canal typically takes place over a 2- to 3-week period between late April and early May. After spawning the herring return to areas in Lynn Canal, Stephens Passage, and the western shore of Douglas Island (Carlson, 1980). After hatching in the spring, juvenile herring spend time in the shallows before moving offshore, typically in the fall (Emmett et al., 1991).

3.10.6 Marine Essential Fish Habitat

The *Magnuson–Stevens Fishery Conservation and Management Act* mandates that agencies initiate consultation with NMFS for any activities that could affect EFH. EFH has been broadly defined to include waters and substrate necessary to fish for spawning, feeding, or growth to maturity (NOAA, 2003a). EFH for North Pacific groundfish includes all habitat within a general distribution for a species' life stages. Habitat areas of particular concern are identified as living substrates in shallow and deep waters, and freshwater habitats used by anadromous fish (NOAA, 2003a). Salmon EFH is the aquatic habitat, freshwater and marine, necessary to allow for the salmon production needed to support a long-term, sustainable salmon fishery and salmon contributions to healthy ecosystems. Marine EFH for salmon includes all estuarine and marine areas used by salmon of Alaskan origin, extending from the tidally submerged habitat out to the open ocean (ADF&G, NMFS, NPFMC, 1998). The shallow marine waters in Berners Bay, Slate Creek Cove, Echo Cove, and off Comet Beach are considered EFH for salmon. Appendix B presents an assessment of EFH within the project area.

3.10.7 Commercial Fisheries

Lynn Canal supports major commercial fisheries, and the salmon fishery is the largest. There are other commercial fisheries in the area for halibut, sablefish, crabs, and shrimp. These fisheries are covered in detail in the 1992 FEIS. A herring sac roe fishery was present in Berners Bay until it was closed in 1983. It remains closed due to low stock numbers.

Commercial fisheries for groundfish occur in Lynn Canal, where catches are principally composed of halibut and sablefish. The halibut fishery is the largest in terms of both boats and tonnage captured. Before 1994 the fishery consisted of 1 to 3 open days per year. In 1995 the fishery changed to an individual quota system (Individual Fishermen Quota), and it is now open between March 15 and November 15. The commercial catch of halibut in Area 2C (Southeast Alaska) between 1995 and 2001 ranged between 7,761,000 and 10,192,000 pounds. Halibut landings at Juneau and Haines (ports nearest Lynn Canal) in 2002 consisted of 358 boats taking 1,069,567 pounds and 99 boats taking 377,612 pounds, respectively. The sablefish fishery is now also an Individual Fishermen Quota fishery with the same season as halibut. Sablefish landings for 2002 were 82 boats with 964,562 pounds in Juneau and 9 boats with 18,106 pounds in Haines (NOAA, 2003b).

Dungeness crab is the largest shellfish fishery in Southeast Alaska in terms of both pounds and value. There are two commercial Dungeness crab fishing seasons, a summer season from June 15 through August 15 and a fall/winter season from October 1 through November 30 or February 28. Most of the shellfish fisheries are fully developed and limited to entry (Hebert and Bishop, 2002). There is a small commercial fishery for crab and shrimp in Lynn Canal and Berners Bay. Most of the commercial fishing in or near Berners Bay is for Dungeness crab in the summer or spot shrimp in the fall. These are small fisheries with fewer than 10 boats in the crab fishery and fewer than three boats in the shrimp fishery.

The 1992 FEIS and 1997 SEIS provide harvest data for salmon in Lynn Canal by species for 1985 to 1995. For this Final SEIS, the data have been updated to include more recent information on salmon harvests since 1995 (Table 3-22). Chum salmon provide the largest commercial catch numbers. The Lynn Canal fishery is primarily a drift gillnet fishery. Much of this salmon fishery occurs near the project and is centered in the area of Point Sherman.

Table 3-22
Commercial Salmon Harvests of Individual Fish in Upper Lynn Canal (1995–2002)

Year	Chinook	Sockeye	Coho	Pink	Chum
1995	831	88,572	79,949	5,799	743,519
1996	642	149,961	52,658	2,358	621,166
1997	834	118,348	15,572	32,962	629,330
1998	679	134,937	26,118	32,351	354,754
1999	553	163,530	35,330	62,737	613,044
2000	297	109,380	35,636	21,008	919,350
2001	1,672	147,811	34,215	67,718	694,941
2002	582	82,009	74,881	88,044	910,777
Average	786	124,318	44,295	39,112	685,860

Source: ADF&G, 2003, personal communication.

There is a commercial salmon fishery in Berners Bay that centers on coho salmon returning to the Berners River. It is both a troll and a drift gillnet fishery. The total coho catch from the Berners River has averaged over 21,000 fish since 1990 (Table 3-23).

Table 3-23
Estimated Harvest by Gear Type for Individual Berners River Coho Salmon

Year	Troll	Seine	Gillnet	Sport	Catch	Escapement	Total Run
1990	14,751	149	7,339	525	22,764	11,050	33,814
1991	6,417	579	16,519	117	23,632	11,530	35,162
1992	15,337	344	14,677	192	30,550	15,300	45,850
1993	19,353	192	14,239	140	33,924	15,670	49,594
1994	27,319	1,686	27,907	891	57,808	15,920	73,728
1995	8,847	22	14,869	117	23,855	4,945	28,800
1996	10,524	380	6,434	412	17,750	6,050	23,800
1997	2,454	282	2,477	179	5,392	10,050	15,442
1998	10,427	435	5,716	380	16,958	6,802	23,760
1999	12,877	208	9,317	261	22,663	9,920	32,583
2000	5,362	145	5,296	196	11,005	10,650	21,655
2001	8,840	195	3,499	123	12,657	19,290	31,947
2002	8,677	278	12,189	477	21,621	27,700	49,321
Average	11,477	264	9,254	226	21,221	9,831	31,403

Source: ADF&G, 2003, personal communication.

3.11 WILDLIFE

The 1992 FEIS discussed the potential occurrence and abundance of wildlife species in the project study area (Forest Service, 1992). Since 1992 several changes have occurred relative to the adequacy and extent of data used for the 1992 FEIS analysis, including the revision of the *Tongass National Forest Land and Resource Management Plan* (Forest Plan) (Forest Service, 1997b). Information related to these changes is included in the following discussion. For some species that were discussed in the 1992 FEIS analysis, additional information (e.g., from subsequent inventories) is now available for the project area and is therefore included in this section.

As indicated in the marine mammals section (3.10.4), one threatened and one endangered marine species occur in the vicinity of the project—the endangered humpback whale and the threatened Steller sea lion. The U.S. Fish and Wildlife Service (USFWS) recently delisted American peregrine falcon, and monitoring of its recovery continued through August 2004. In addition to these species, Forest Management Indicator Species (MIS), Forest Service-listed sensitive species, and other USFWS species of concern are known to occur or have potential habitat in the project vicinity. Table 3-24 lists MIS, Forest Service sensitive species, and USFWS species of concern considered in the analysis. Scientific names of these species are included in Table 3-24 and are not repeated in the text. For additional information, see the 1992 FEIS.

ABR, Inc., (2000b) conducted a review of data on selected wildlife species in the Jualin Mine Project area. The review summarized resource studies conducted in the area since the late 1980s, including more recent ADF&G studies, Game Management Area inventory and survey reports, the revised Forest Plan, and the Juneau Access Improvements Draft Environmental Impact Statement (USDOT and ADOT&PF, 1997). ABR also conducted field surveys in the area for bald eagles and northern goshawks.

3.11.1 Management Indicator Species

Regulations on wildlife resources are outlined in 36 CFR 219.19 and 219.27. They state that MIS will be identified by each national forest to maintain adequately distributed habitat for these species and to evaluate the impacts of management activities.

MIS were identified in the planning process, and they are used to monitor effects of management activities on populations of wildlife and fish, including those that are socially or economically important (e.g., big game). The revised Forest Plan identifies 13 terrestrial MIS (Table 3-24).

Although some MIS are associated with several habitat types, all are associated with the spruce and hemlock forests of Southeast Alaska, which represent, according to the Forest Plan, 98 percent of the productive old-growth forests of the Tongass (Forest Service, 1997b). The study area includes over 8,500 acres of spruce and hemlock forest, as shown in Table 3-25. The table shows the amount of available habitat in each habitat cover type for the 13 MIS.

Black and Brown Bear (MIS)

Black and brown bears occur throughout most of Alaska, and neither species is considered a species of concern by federal or state agencies (ABR, 2000b). Population estimates in Game Management Unit 1C, which encompasses the study area, are lacking for black bears, although the brown bear population has been estimated at between 251 and 418 bears. Both bear populations are considered stable (ABR, 2000b). Black bears are considered the more common bear species, although a few documented sightings of brown bears (or tracks) have occurred in the area in the past 10 years (two bears feeding on salmon in Slate Creek in 1994, two bears in the Antler River, bear tracks above the Kensington Mine portal in 1990) (ABR, 2000b).

A black bear monitoring study conducted in 1996 in the study area found that home range sizes averaged about 16,000 acres (Robus and Carney, 1996, cited in ABR, 2000b). Males in that study used a wider range of elevations than females and had much larger home ranges. During radio relocations, black bears were found most often in hemlock-spruce forests, though most available habitats (except snow and ice fields) were used. The Forest Service habitat capability model

Table 3-24
Wildlife Species in Southeast Alaska Considered Species of Concern (USFWS), Management Indicator Species (Forest Service), Sensitive Species (Forest Service), or Threatened and Endangered Species

Species Common and Scientific Names	Species of Concern/ Candidate Species	Management Indicator Species	Sensitive Species	Threatened and Endangered Species
MAMMALS				
Red squirrel (*Tamiasciurus hudsonicus*)		X		
Alexander Archipelago wolf (*Canis lupus ligoni*)	X	X		
Black bear (*Ursus americanus)*		X		
Brown bear (*Ursus arctos*)		X		
Sitka black-tailed (mule) deer (*Odocoileus hemionus sitkensis*)		X		
Mountain goat (*Oreamnus americana*)		X		
Marten (*Martes americana)*		X		
River otter (*Lutra canadensis*)		X		
Steller sea lion *(Eumetopias jubatus)*				T
Humpback whale *(Megaptera novaeangliae)*				E
BIRDS				
Trumpeter swan (*Cygnus buccinator*)			X	
Vancouver Canada goose (*Branta canadensis fulva*)	X	X		
Bald eagle (*Haliaeetus leucocephalus*)		X		
Northern (Queen Charlotte) goshawk (*Accipiter gentilis laingi*)	X		X	
Peale's peregrine falcon (*Falco peregrinus anatum*)			X	
Kittlitz's murrelet (*Brachyramphus brevirostris*) [a]	X			
Marbled murrelet (*Brachyramphus marmoratus*)	X			
Osprey (*Pandion haliaetus*)			X	
Red-breasted sapsucker (*Sphyrapicus rubber)*		X		
Hairy woodpecker (*Picoides villosus*)	X	X		
Brown creeper (*Certhia americana*)		X		
REPTILES				
Leatherback sea turtle (*Dermochelys coriacea)*				E
FISH				E
Chinook salmon— Upper Columbia River–spring-run (*Onchorhynchus tshawytscha*)				E
Chinook salmon—Puget Sound (*Onchorhynchus tshawytscha*)				T
Chinook salmon—Lower Columbia River (*Onchorhynchus tshawytscha*)				T
Chinook salmon—Upper Willamette River (*Onchorhynchus tshawytscha*)				T

Table 3-24
Wildlife Species in Southeast Alaska Considered Species of Concern (USFWS), Management Indicator Species (Forest Service), Sensitive Species (Forest Service), or Threatened and Endangered Species (continued)

Species Common and Scientific Names	Species of Concern/ Candidate Species	Management Indicator Species	Sensitive Species	Threatened and Endangered Species
Chinook salmon—Snake River–spring/summer (*Onchorhynchus tshawytscha*)				T
Chinook salmon—Snake River–fall run (*Onchorhynchus tshawytscha*)				T
Sockeye salmon—Snake River (Onchorhynchus nerka)				E
Steelhead Trout—Upper Columbia River (*Onchorhynchus mykiss*)				E
Steelhead Trout—Middle Columbia River (*Onchorhynchus mykiss*)				T
Steelhead Trout—Lower Columbia River (*Onchorhynchus mykiss*)				T
Steelhead Trout-—Snake River Basin (*Onchorhynchus mykiss*)				T

[a] Proposed for listing under the Endangered Species Act.

Table 3-25
Habitat Cover Types and Productive Old Growth Delineated Within the Kensington Gold Study Area

Habitat Cover Types	Study Area
Low-Volume Old Growth (8-20 mbf)	1,356
Medium-Volume Old Growth (20-30 mbf)	5,196
High-Volume Old Growth (30-50+ mbf)	1,914
Total Productive Old Growth (POG)	8,466
Nonproductive/Low Site Index Forest (0–8 mbf)	5,338
Nonforest Brush	163
Alpine	376
Fresh Water	39
Rock Outcrop	387
Slide Zone	1,146
Muskeg	1,858
Total	17,773

Percentage	Study Area
Low-Volume Old Growth	7.6%
Medium-Volume Old Growth	29.2%
High-Volume Old Growth	10.8%
Nonproductive Forest	30.0%
Non-Forested	22.4%
Total	100%

Notes: Acreages from GIS may vary slightly with tables due to rounding.
Mbf = 1,000 board feet.

developed for the Kensington Mine Project area showed the vicinity of the Jualin Mine as being in low-quality habitat and surrounded by low to moderately suitable habitats (Forest Service, 1992). Additional habitat capability analyses in the area identified the Berners Bay area as especially high-quality habitat for black bears from spring through fall (ABR, 2000b).

Mortality factors associated with these species include primarily predation (by humans and other bears), disease, and accidents. In the study area, hunting is likely the primary mortality factor for black bears. Black bear harvest in the vicinity of the project averaged five bears annually from 1984 to 1991, while brown bear harvest in the same area was approximately one bear annually (ABR, 2000b). In Southeast Alaska, brown bears appear to be more sensitive to human disturbance than black bears and can be displaced or otherwise affected by human development, such as road building (displacement), forest clearing (habitat loss), and watershed degradation (declining food supply) (ABR, 2000b).

Sitka Black-tailed Deer (MIS)

Sitka black-tailed deer, a subspecies of black-tailed deer, occur throughout most of Southeast Alaska. Populations are documented for the Juneau area generally north to approximately Berners Bay, in coastal habitats south of Anchorage, and on Kodiak Island. Documented sightings have occurred in the project area (ABR, 2000b; Forest Service, 1992). Sitka black-tailed deer occupy low-elevation old-growth forests during the winter, and the quality and quantity of this winter habitat is considered the most limiting factor for the species in Southeast Alaska (Forest Service, 1997b).

Good-quality winter range for deer includes the following characteristics: (1) mature Sitka spruce and western hemlock forest with at least 30 thousand board-feet (mbf) per acre; (2) below 800 feet in elevation; and (3) south, east, or west aspect (Hanley et al., 1989; Kessler, 1982). Approximately 26 percent of the medium- and high-productivity old-growth forest within the study area occurs below 800 feet in elevation (Table 3-26). Optimum winter deer habitat during deep-snow conditions consists of an understory of abundant bunchberry (*Cornus canadensis*), five-leaf bramble (*Rubus pedatus*), and *Vaccinium* species (Hanley et al., 1989; Kessler, 1982).

Table 3-26
Distribution of Productive Old-Growth (POG) Forest within the Kensington Gold Project Area by Elevation (in acres)

	Elevation Range				
Productive Old-Growth Forest	**0 to 800 Feet**	**801 to 1,500 Feet**	**<1,500 Feet**	**Total Acres**	**Percent by POG**
High Productivity	1,114	766	32	1,912	23%
Medium Productivity	2,764	1,907	524	5,195	61%
Low Productivity	1,141	151	61	1,354	16%
Total Productive Old Growth	5,019	2,824	618	8,462	100%
Coarse Canopy Structure[1]	74	95	0	169	---
Percent by Elevation	59%	33%	7%	100%	

[1] Volume classes 6 and 7 are used to identify coarse canopy or high structure old growth attributes; however, no volume class 7 is mapped within the study area.

Alexander Archipelago Wolf (Species of Concern and MIS)

The Alexander Archipelago wolf had been proposed for listing under the ESA, but the USFWS determined that listing was not warranted because the population was not in danger of extinction in the foreseeable future (62 FR 46709). The primary prey species for the wolf in the vicinity of the project area include moose, mountain goat, salmon, and beaver (Fogels, 2004). According to the Forest Service (1992), a small group of wolves might occupy the study area, based on sightings, tracks, and trapper observations (ABR, 2000b).

Bald Eagle (MIS)

Bald eagles are local residents in and around the study area. In the vicinity of the project, nests have been found around Berners Bay from north of Echo Cove to Point St. Mary and along the edge of Lynn Canal north to Point Sherman (ABR, 2000b). The USFWS conducted surveys within the Berners Bay area in 2003. In addition, Mike Jacobson of USFWS conducted a bald eagle survey by ground in June 2004 and documented that one of the known nest sites adjacent to the proposed Slate Cove dock facility was active. Bald eagles in the area typically nest in large trees in spruce-hemlock forest, and over 90 percent of the nests are within 500 feet of a saltwater beach. A protective management zone 330 feet in diameter surrounds all identified nest trees. Disturbance factors for bald eagles include human activity in the vicinity of the nest during incubating and early nestling development.

Mountain Goat (MIS)

Mountain goats are found on suitable habitats (primarily rocky terrain above the tree line) on the mainland throughout Southeast Alaska. In the study area, a small population occurs to the north on Lions Head Mountain, where they spend the majority of the summer months. During winter, they move into lower-elevation, forested areas as snow depth increases. The availability and distribution of high-quality winter habitat (closed-canopy forest with understory forage) is a limiting factor for mountain goats in Southeast Alaska (Forest Service, 1997b). Mountain goats have been recorded during winter on the slopes above Independence Lake, on the ridge east of Sweeny and Slate creeks, and northwest of the Jualin Mine near the Kensington Mine (ABR, 2000b). Mortality and disturbance factors for mountain goats include hunting, predation, and human activity-induced displacement. Annual hunter harvest of goats from the Lions Head population has averaged about two animals per year (ABR, 2000b).

Red Squirrel (MIS)

Red squirrels inhabit mature coniferous habitats (Figure 3-6), which are distributed throughout the project area. Optimum habitat is believed to contain patches of mature/old-growth forest greater than 30 acres (Forest Service, 1997b). The red squirrel is a primary prey species of goshawks and marten. Habitat modification associated with forest management is considered the primary disturbance factor for this species because relatively contiguous forest cover is needed for dispersal among populations.

Marten (MIS)

The distribution of marten in Alaska generally coincides with that of mature/old-growth forests, primarily moist coniferous or mixed species stands (Forest Service, 1992, 1997b). The distribution of old growth in the study area is shown in Figure 3-6. Marten habitat is considered

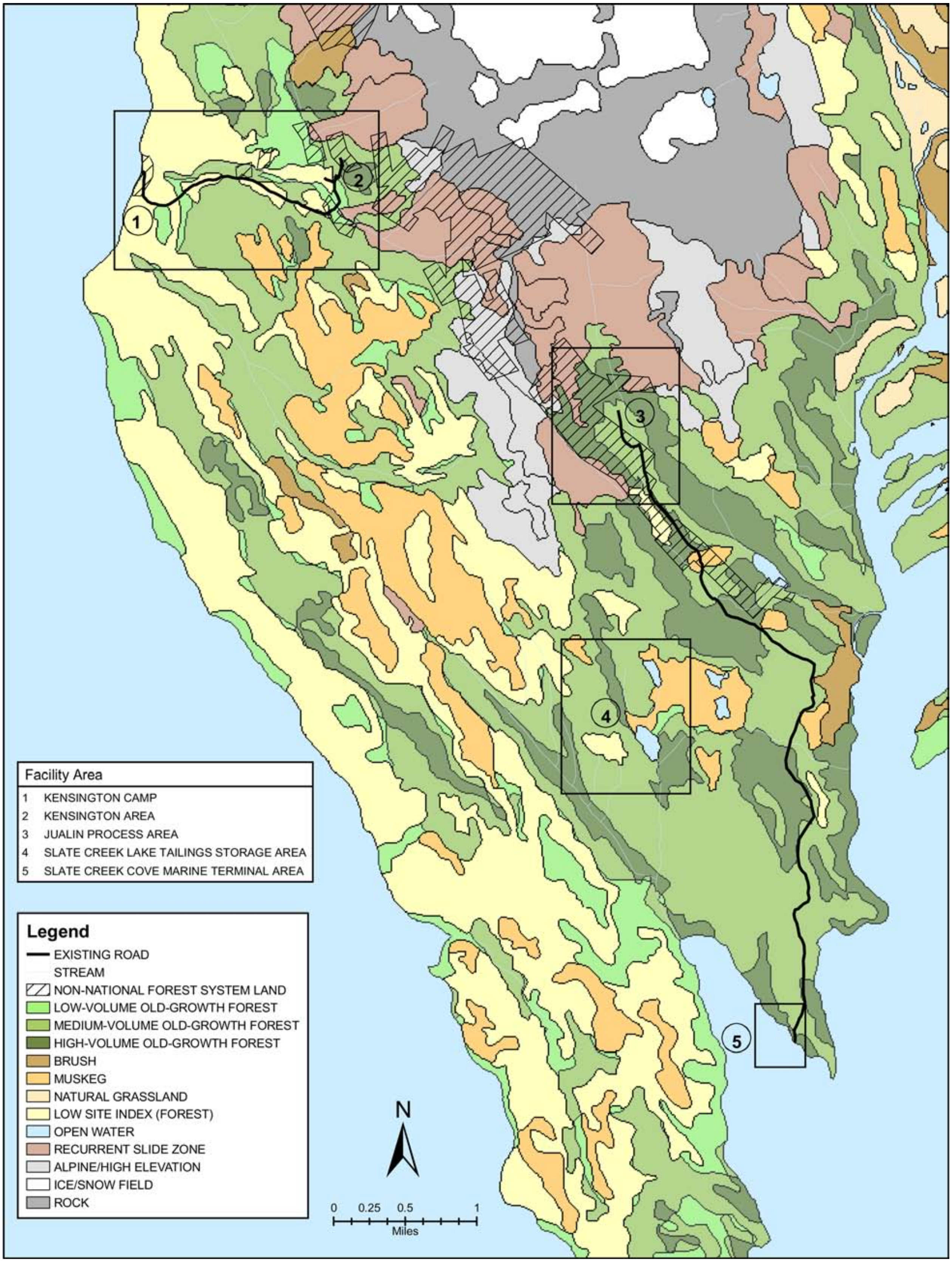


FIGURE 3-6. OLD-GROWTH HABITAT WITHIN THE KENSINGTON STUDY AREA

to be high-volume old-growth forest below 1,500 feet in elevation. Currently, there are approximately 169 acres of high-probability marten habitat in the study area, or approximately 1 percent of the total study area. Marten are expected to occur throughout the lower elevations of the study area and were documented by Forest Service personnel in 2002.

Marten feed on a wide variety of prey, including squirrels, voles, birds, and fish (Forest Service, 1992). Primary disturbance factors for marten include habitat modification (stand conversion), which could influence the distribution and availability of prey species or limit the marten's ability to disperse by making forest cover less continuous. Marten are considered easy to trap, and local populations can be overharvested (Forest Service, 1997b). Development that provides easy or additional access for local trappers can influence the trappers' harvest of the species.

Vancouver Canada Goose (Species of Concern and MIS)

The Vancouver Canada goose is one of the most conspicuous species of breeding waterfowl in and near the project area, particularly in Berners Bay (Forest Service, 1992). It is a nonmigratory bird, and in Southeast Alaska it nests almost exclusively in forested habitats. In the project area, Vancouver Canada geese might nest in beach-fringe habitats within 100 yards of the shoreline (ABR, 2000b). Feeding and molting geese also use the Slate lakes during parts of the year (ABR, 2000b), and evidence of molting geese was observed at Upper Slate lake during summer 2004.

Hairy Woodpecker (Species of Concern and MIS)

The hairy woodpecker is an uncommon, permanent resident throughout Southeast Alaska, where it inhabits mature and old-growth forests containing snags, or partially dead trees used for foraging and nesting (Forest Service, 1997b). The species probably inhabits old-growth habitats in the project area. Its winter habitat may be the primary limiting factor (Forest Service, 1997b). Snag quantity has a direct relationship to the potential use of an area by hairy woodpeckers. Old-growth forests provide the best long-term snag habitat, and high-volume old-growth stands receive more use than low-volume stands. Optimum habitat use is believed to occur when patches of preferred habitat are greater than 500 acres (Forest Service, 1997b).

Brown Creeper (MIS)

Brown creepers are considered uncommon, permanent residents throughout Southeast Alaska. They are associated with large-diameter trees found in high-volume old-growth forests. Winter habitat has been suggested as the principal limiting factor for cavity-nesting birds, including the brown creeper (Forest Service, 1997b). Optimum habitat use is believed to occur when patches of preferred habitat are greater than 15 acres. (Forest Service, 1997b).

Red-breasted Sapsucker (MIS)

The red-breasted sapsucker inhabits all of Southeast Alaska during spring, summer, and fall. It typically winters in the coastal portions of its breeding range. Like the hairy woodpecker, this species requires forests containing snags and dying trees for foraging and nesting. The quantity of snags has a direct relationship to the number of red-breasted sapsuckers in an area. Old-growth forests provide the best snag habitat over the long term, with the low-volume old-growth forest classes receiving more use than the high-volume classes (Forest Service, 1997b). Optimum habitat use is believed to occur when patches of preferred habitat are greater than 250 acres (Forest Service, 1997b). The species has been documented in the project area (ABR, 2000b).

River Otter (MIS)

River otters are found throughout the Tongass National Forest where suitable coastal and freshwater aquatic habitat occurs. Upland vegetation adjacent to water is important in providing cover for the species. Old-growth forests have the highest habitat value because they provide canopy cover, large-diameter trees and snags, and den and burrow sites (Forest Service, 1997b). River otters are associated with coastal and freshwater aquatic environments and the immediately adjacent to (within 100 to 500 feet) upland habitats (Forest Service, 1997a). Beach characteristics affect the availability of food, and nearby upland vegetation is also important in providing cover for otters. The study area provides suitable habitat for river otters, and they are likely to occur in the Sherman, Johnson, and Slate creek drainages (ABR, 2000b). ADNR staff observed a river otter in Upper Slate Lake in October 2003 (ADNR, 2003).

3.11.2 Threatened, Endangered, and Sensitive Wildlife Species

Threatened and endangered species are managed under authority of the ESA (36 U.S.C. 1531–1544) and the National Forest Management Act (16 U.S.C. 1600–1614). The ESA requires federal agencies, such as the Forest Service, to make certain that all activities they “authorize, fund, or carry out” will not likely jeopardize the continued existence of any threatened or endangered species. The Forest Service designates and manages sensitive species such that its actions do not result in a trend toward federal listing of sensitive species. Species of concern designated by the USFWS generally correspond to species formerly considered under the Candidate Species Conservation Program. Special status wildlife species that might occur in the vicinity of the project area or be influenced by project construction or implementation are discussed below and listed in Table 3-24.

Humpback Whale (Endangered)

Discussed in Section 3.10.4.

Steller Sea Lion (Threatened)

Discussed in Section 3.10.4.

Peale’s Peregrine Falcon (Sensitive)

Peale’s peregrine falcon is a Forest Service-listed sensitive species. Peale’s peregrine falcons are known to migrate through Southeast Alaska in spring and fall but are more commonly known to Interior Alaska (Forest Service, 1992). Forest Service standards and guidelines call for the protection and maintenance of habitats for migrating peregrine falcons. The rock outcrops overlooking water or marshy areas preferred for nesting are not present in the study area. Rock outcrops in the study area are more common in areas above the tree line, which do not provide suitable nesting habitat (Forest Service, 1992).

Northern Goshawk (Species of Concern and Sensitive)

The Queen Charlotte northern goshawk is a species of concern and a Forest Service-listed sensitive species. Concern exists over the viability of the goshawk population in Southeast Alaska because of reductions in the amount of this species’ preferred habitat—mature and old-growth forests—as a result of timber harvesting (Forest Service, 1997a). In 1994 the USFWS received a petition to list the northern goshawk under the ESA. The USFWS decided not to list the goshawk at that time, and again in 1997. Conservation measures for this species such as the standards and guidelines in the Forest Plan could eliminate the need for additional protection and possible listing.

Productive old-growth forest is an important component of goshawk habitat use patterns. Radio-marked goshawks consistently select this forest habitat type, relative to availability; 68 percent of all relocations occur in productive old-growth forest. Most other habitat types (such as alpine, subalpine, peatland [muskeg], and clear-cuts) are used infrequently or avoided by goshawks. Timber harvesting in the Tongass (and on private lands in Southeast Alaska) results in the conversion of old-growth forest (a selected habitat type) to young-growth forest (an avoided habitat type) and thus suggests decline in goshawk habitat capability.

Forest Plan standards and guidelines require maintenance of at least 100 acres of productive old-growth generally centered around the nest tree (Forest Service, 1997b). Goshawk habitat in Southeast Alaska is generally considered to be mature (old-growth) forest stands (Figure 3-6). Primary prey species include forest birds and small mammals such as grouse and red squirrel (ABR, 2000b). Mortality and disturbance factors for this species include accidents, starvation, and disturbance during the nesting season by human activities in or near the nesting territory.

Because most recent research on goshawks in Southeast Alaska has focused on the large islands to the south, only a few nests have been found north of Juneau. Potential habitat for goshawks (i.e., old-growth forest) can be found throughout the Johnson and Slate Creek drainages, and an active goshawk nest was documented on National Forest System lands in 2000 approximately 2 miles from the Jualin Mine site (ABR, 2000). In addition to this nest site, other known goshawk nesting areas have previously been documented in the vicinity of the project area on state-owned land near Echo Cove, and in the Lace River drainage (Titus et al. 1994, Forest Service project records). A more recent goshawk survey was conducted in June 2004. No goshawks responded to taped broadcast calls in the vicinity of the nest tree previously documented in 2000. The nest tree location was approached after broadcast calls from the road were conducted with no response and field personnel found that the nest tree was likely downed by wind. Additional calls were conducted nearby with no response. Based on the 2004 survey effort, no active nest is present and the nesting area is not occupied.

Trumpeter Swan (Sensitive)

Trumpeter swans breed in Alaska and winter along the Pacific Coast from the Alaska Peninsula to the mouth of the Columbia River. They nest in the Interior and Gulf Coast regions of Alaska and winter primarily in coastal Southeast Alaska, British Columbia, and south to the Columbia River in Washington State (Bellrose, 1976). The largest nesting population of swans on the Tongass National Forest occurs on the Yakutat Forelands (Conant et al., 2001).

Swans pass through southern Southeast Alaska in the spring and fall during migration to and from their breeding grounds. Swans that overwinter here usually move to large lakes and estuaries once the weather turns cold. They arrive in the area in mid-October as they are migrating south, and their numbers increase as migration continues. Their preferred winter habitat is open-water lakes and large freshwater streams, especially near intertidal flats (Conant et al., 2001). Wintering swans have been located in three areas on Admiralty Island: Mitchell Bay, Hood Bay, and Gambier Bay.

Swans typically leave for their breeding area by mid-April. The USFWS has been monitoring nesting and wintering swans since 1965. The summer population of swans in Southeast Alaska continues to increase. Nesting swans have been documented along the Berners, Antler, and Lace rivers, which feed into Berners Bay. However, no known nesting by trumpeter swans occurs in the Jualin/Kensington area.

Osprey (Sensitive)

Ospreys are specialized raptors that are not commonly observed in Southeast Alaska. Sixteen osprey nesting areas have been documented on the Tongass National Forest, 15 in the Stikine River area and 1 in the Ketchikan area. Osprey nests in Southeast Alaska usually occur in broken-top spruce trees or western hemlock snags. The mean diameter breast height of nest trees in the Stikine River area was 38.6 inches (ranging from 15.7 to 54 inches), and the mean height was 105 feet (ranging from 49 to 177 feet). Nests were located within the beach fringe and averaged 0.7 miles (ranging from 0.25 to 1.4 miles) from the closest salt water. The osprey's diet consists mainly of fish; therefore, ospreys are usually found near lakes, streams, beaver ponds, coastal beaches, or large estuaries (Forest Service, 1997a).

Although ospreys frequently adapt to human activities, disturbances that keep adults from their nests during incubation in May or June can increase the mortality rate of eggs or nestlings. The osprey is adversely affected by stream or waterway alterations that reduce fish populations or visibility in areas traditionally used as feeding areas (VanDaele, 1994). Potential nesting habitat for this species is maintained under the Forest Plan estuary and beach fringe standards and guidelines, which require maintaining a 1,000-foot-wide beach fringe of mostly unmodified forest to provide important habitats for wildlife (Forest Service, 1997b).

Although osprey nesting and foraging habitat is available near the study area, especially along the major rivers draining into Berners Bay, no ospreys have been recorded in the study area.

Kittlitz's Murrelet (Species of Concern/Candidate Species)

On May 9, 2001, the Secretary of the Interior was petitioned to list the Kittlitz's murrelet as endangered with concurrent designation of critical habitat under the ESA. Petitioners cited dramatic reductions in population size over the past decade and declining habitat quality as reasons for the requested listing. The species was officially designated a candidate species (warranted, but precluded) on May 4, 2004.

Kittlitz's murrelet is closely associated with glacial habitats, particularly tidewater glaciers, along the Alaska mainland coast. Breeding sites are usually chosen in the vicinity of glaciers and cirques in high-elevation alpine areas, with little or no vegetative cover. When present, vegetation is primarily composed of lichens and mosses. The species nests a short distance below the peak or ridge on coastal cliffs, barren ground, rock ledges, and talus above timberline in coastal mountains, generally near glaciers 0.2 to 47 miles inland. The remote and solitary nesting habits lead to extreme difficulty in finding nests. Non-breeding or off-duty breeders spend the summer in inshore areas, especially along glaciated coasts.

The only American population occurs in Alaskan waters from Point Lay south to northern Southeast Alaska. The largest breeding populations are believed to be in Glacier Bay National Park and Preserve, Prince William Sound, Kenai Fjords, and Malaspina Forelands. In Southeast Alaska, the Kittlitz's murrelet breeds in Port Houghton, Endicott Arm, and Tracy Arm.

According to the petition, the southern boundary of the breeding range is LeConte Bay on the Tongass National Forest.

The Kittlitz's murrelet is one of the rarest seabirds in North America. Latest worldwide population estimates range from 9,000 to 25,000 birds. The best information available from the USFWS indicates that Prince William Sound populations have declined by 84 percent since 1984, Kenai Fjords area by 83 percent since 1976, Malaspina Forelands by 38 percent and perhaps as much as 75 percent between 1992 and 2002, and Glacier Bay by 60 percent between 1990 and 1999. The USFWS believes that glacial retreat and oceanic regime shifts are the major factors causing decline of the species (69 FR 86: 24875–24904). Other related factors include increased adult and juvenile mortality and low recruitment. Human-caused mortality includes gillnet fisheries and oil spills like that from the *Exxon Valdez* or smaller tourism and fishing boats. Increased disturbance from helicopter tours and cruise ships in the three main breeding grounds might also be a factor.

Marbled Murrelet (Species of Concern)

Marbled murrelets generally select old-growth stands and large-diameter trees as nest sites (DeGange, 1996; Kuletz et al., 1995; Ralph and Miller, 1995). A small percentage (less than 10 percent) of birds may nest on the ground (DeGange 1996). Large limbs of old-growth trees are the preferred area for nest placement. Kuletz et al. (1995) stated that the best predictor of marbled murrelet activity and occupation was the location relative to heads of bays, tree size, and epiphyte cover on trees.

A coarse filter analysis of geographic information system (GIS) data layers was conducted to quantify the amount of suitable marbled murrelet habitat present in the project area. Suitable marbled murrelet habitat was defined as medium- and high-volume forest regardless of elevation; however, higher-volume, lower-elevation stands are more likely to be used than higher-elevation stands based on previous studies and known occupied stands in Washington and Oregon. Approximately 1,939 acres of medium-volume and 169 acres of high-volume old growth forest occur within the project area.

Threatened and Endangered Salmonids

Discussed in Section 3.10.5.

Leatherback Sea Turtle (Endangered)

Leatherback sea turtles (*Dermochelys coriacea*) are uncommon in Alaska marine waters. They are usually seen when warmer marine currents shift to the north; leatherback sea turtles follow along with the current. Leatherback sea turtles have been known to occur in marine waters off the Tongass National Forest although there are no records of their occurrence in Berners Bay or Lynn Canal north of Juneau.

3.11.3 Waterbirds

A variety of waterfowl, seabirds, and wading birds occur in the Berners Bay area depending on the season. Seven species of loons, grebes, and cormorants; 19 species of waterfowl; 10 species of wading birds and shorebirds; 6 species of gulls and terns; and 4 species of seabirds (mainly marbled murrelets) have been observed during 3 years of extensive boat surveys in Berners Bay (USFWS, 2003). King (1991) noted that species present in Berners Bay, primarily during spring migration, included loons, horned and red-necked grebes, tundra swan, northern pintail, American wigeon, goldeneye, scaup species, green-winged teal, black-bellied plover, black turnstone, western sandpiper, least sandpiper, short-billed dowitcher, and Bonaparte's gull, among others.

The majority of marine bird use in Berners Bay occurs during April and May, coinciding with the presence of spawning eulachon, as well as outmigrating salmon smolts and concentrations of herring and sandlance (Forest Service, 1992; USFWS, 2003). During this period thousands of scoters (surf and white-winged) and gulls (Bonaparte's, mew, and glaucous-winged) concentrate at the head of Berners Bay and at Cowee Creek, Sawmill Creek, and Echo Cove, with the greatest concentrations of waterbirds noted in the vicinity of the Berners Bay River delta and between Point Bridget and Echo Cove (King, 1991; USFWS, 2003). Relatively large concentrations of waterfowl (e.g., ducks) have also been documented at Sawmill Point and on both sides of Slate Creek Cove during April and May. During helicopter surveys conducted in the spring 1991, King (1991) observed waterbird numbers peaking on May 5, with over 80,000 birds recorded within Berners Bay, and noted that these numbers indicated a tenfold increase from a survey conducted on April 25. Most of the birds recorded during this time were gulls (mew and Bonaparte's) with over 60,000 counted, followed by scoters (primarily the surf scoter) with over 10,000 recorded. The April–May period also coincides with peak numbers of shorebirds (black turnstones, surfbirds, rock sandpipers, and dunlin). Thousands of shorebirds stop over at the mudflats at the head of Berners Bay during spring and fall migration. In comparison, in the area along the eastern coastline of Lynn Canal from Point St. Mary to approximately 3 miles north of Point Sherman (adjacent to Comet Beach), total numbers of waterbirds and waterbird species were substantially less than those found in Berners Bay (King, 1991). In this section of Lynn Canal, bird numbers peaked in mid-May during 1991 surveys, with approximately 6,000 birds counted; the predominant species present along the eastern coastline of Lynn Canal were harlequin ducks, surf scoters, and gulls.

Little use by marine birds is found within Berners Bay during the summer and early fall (USFWS, 2003). By mid-May there are significant declines in the number of birds observed within the Lynn Canal/Berners Bay area, primarily because of the end of the fish runs. King (1991) reported that two-thirds of the gulls and over half of the scoters had moved through by May 15, although the number of murrelets and mergansers continued to increase. By early June, almost all species had declined as adults moved on to nesting areas beyond the project area.

By November large numbers of marine birds, almost entirely waterfowl (especially Barrow's goldeneyes, buffleheads, and surf scoters), return to Berners Bay and remain through the winter. They are concentrated at the head of Berners Bay and in the protective waters of Echo Cove (King, 1991; USFWS, 2003). During two aerial surveys conducted in December 1990 and January 1991 (King, 1991), the most abundant species recorded within Berners Bay were mallard, surf scoter, goldeneye, bufflehead, and mew and glaucus-winged gulls. Grebes, loons, harlequin ducks, long-tailed duck, and mergansers were also recorded but in relatively smaller numbers. The most abundant species recorded along the eastern coastline of Lynn Canal during the same survey period were harlequin ducks and mew and glaucus-winged gulls.

Birds potentially nesting in or near the tidal flat areas within Berners Bay include semipalmated plover, and black oystercatcher (Forest Service, 1992). Potential freshwater breeders include Vancouver Canada goose, mallard, harlequin duck, and common and red-breasted merganser, with greater yellow legs, spotted sandpiper, and common snipe nesting in association with freshwater habitats (e.g., muskeg, lakes, and streams) (Forest Service, 1992).

Factors that could affect these large bird concentrations include disturbances and activities that could disrupt their food supply or preclude the birds from concentrating in traditional areas. Disturbance, such as boat traffic, can force birds from optimal foraging areas, simultaneously increasing energy expenditure (flight) and reducing energy intake (less food supply), thereby reducing bird fitness and potential reproductive success (Madsen, 1994; Ward et al., 1994). Aircraft overflights can similarly disturb waterbirds (Ward et al., 1999).

3.11.4 Migratory Birds

Executive Order 13186 provides for the conservation of migratory birds and their habitats. It requires federal agencies to evaluate the effects of their actions on migratory birds, with emphasis on species of concern. Agencies are required to support the intent of the *Migratory Bird Treaty Act* by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources.

Neotropical migratory birds are far-ranging species that require a diversity of habitats for foraging, breeding, and wintering. Patterns of population decline for these species are generally detected at a larger observational scale than those traditionally used to manage lands (e.g., a National Forest). Therefore, the effects of management on bird populations cannot be solely addressed at the project level. An individual project area is generally too small to effectively detect population-level changes or to significantly affect migratory bird populations.

Birds protected under the act include all common songbirds, waterfowl, shorebirds, hawks, owls, eagles, ravens, crows, native doves and pigeons, swifts, martins, swallows, and others, including their body parts (e.g., feathers, plumes), nests, and eggs. A complete list of protected species can be found at 50 CFR 10.13. The act addresses "takes" only and does not specifically address habitat destruction or alteration. *Take* is defined in the CFR as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or any attempt to carry out these activities." Many migratory bird species are likely to nest in the vicinity of the project area in forested, riparian, and coastal habitats, including several of those discussed above. A list of migratory birds found on the Tongass National Forest and their preferred habitat types is provided in Appendix H.

3.11.5 Forest Fragmentation and Habitat Corridors

Forest Fragmentation

Forest fragmentation is used to describe a process in which a forest block becomes subdivided into smaller, more isolated units. Fragmentation has the potential to isolate small populations, contribute to decreased population distribution, and contribute to the increased likelihood of local extinction. Patches of old-growth forest can be characterized as having two zones: (1) a boundary zone between the forest and the adjacent habitat (referred to as "edge" forest habitat) and (2) an interior zone that is not significantly influenced by adjacent habitat (referred to as "interior" forest habitat).

Interior habitat retains moisture, temperature, and vegetation conditions that are unique to old-growth forest conditions. Old-growth-dependent species typically thrive in interior forest habitat conditions and tend to be sensitive to the influence of the encroachment of edge habitat (i.e., "edge effects"). The "edge effect" can typically extend 100 meters or more into the forest, depending primarily on definable differences in micro-climate (Concannon, 1995). When fragmentation occurs in a forested environment, there is an increase in the amount of edge habitat and a decrease in the interior forest habitat, making patches less suitable for interior forest, old-growth-dependent species.

The Tongass National Forest is characterized by fragmentation on many scales, and this fragmentation is the result of different processes. On a small scale, single-tree gaps within a 400-year-old Sitka spruce stand provide habitat for forest interior birds such as the hairy woodpecker. On a broader scale, large patches of wind disturbance of 10 acres or more create nesting habitat for songbirds such as the orange-crowned warbler. From a regional perspective, the Tongass National Forest is highly fragmented due to numerous islands and dramatic topographic relief. At a landscape level across the study area, the natural distribution of productive old-growth forest is quite patchy and is linear in many areas, with fragmentation created by muskeg, forested wetlands, and alpine areas.

A total of 1,914 acres within the study area contain high-volume old-growth forest (11 percent). Medium-volume old-growth forest accounts for 5,196 acres (29 percent), and there are 1,356 acres of low-volume old-growth forest (8 percent). Nonproductive forest and non-forested areas constitute 52 percent of the study area, which indicates a high level of natural fragmentation (Table 3-25).

A patch size analysis was conducted to assess the degree of fragmentation of productive old-growth forest at the study area level. A total of 18 low-, medium-, and high-volume productive old-growth forested patches exist. Patch sizes range from 6 acres to 5,216 acres, with 13 patches (72 percent) ranging between 1 acre and 50 acres. There are two patches between 50 acres and 250 acres, one patch between 250 acres and 1,000 acres, and two patches larger than 1,000 acres (1,624 acres and 5,216 acres) (Table 3-27).

Table 3-27
Patch Size Analysis for All Productive Old Growth (Low-, Medium-, and High-Volume Old Growth Combined) Within the Kensington Gold Study Area

	Number of Patches, by Patch Size							
Productive Old Growth	**1 to 15 Acres**	**15.1 to 50 Acres**	**50.1 to 100 Acres**	**100.1 to 250 Acres**	**250.1 to 1,000 Acres**	**>1,000 Acres**	**Total Number Patches**	**Total Patch Acres**
Low, Medium, and High	1	12	1	1	1	2	18	8,466

Habitat Corridors and Connectivity

Timber harvest operations, including road-building, add to the level of fragmentation or edge that occurs naturally. The effect of timber harvest varies with the placement of units and their proximity to large existing forest blocks. Simulation studies have indicated that when 50 percent of a watershed is harvested with a staggered setting design, little if any interior forest remains. Whether a particular patch pattern and degree of fragmentation is beneficial or deleterious depends largely on the characteristics of the species using the landscape (Morrison et al., 1992). Low-elevation passes, beach and estuary fringe, and stream corridors provide natural connections between forested blocks and are important areas for migrating and dispersing wildlife. Corridors can be protected by restricting harvest within them or by managing the matrix of habitat between the reserves (Suring et al., 1992). Maintaining forested corridors between old-growth habitat (OGH) is a key component to maintaining viable wildlife populations on the Tongass National

Forest because most of the habitat matrix between the reserves is scheduled for harvest (Forest Service, 1997b).

Maintaining effective wildlife corridors between the small OGHs within the study area, as well as adjacent non-development land use designations (LUDs), is essential for wide-ranging species. From a landscape perspective, OGHs provide some connectivity or linkages to other reserves or other protected LUDs outside the study area. (See Appendix F, Old-Growth Habitat.) Within the study area, corridors that link alpine areas to the beach fringe are important. Connectivity does not necessarily mean that old-growth areas have to be physically joined in space because many associated animal species can move across areas that are not in old-growth ecosystem conditions. Landscape features affecting connectivity of OGH ecosystems are distances between old-growth areas and forest conditions in the areas between the old-growth areas (Forest Service, 1997b).

3.12 SOIL, VEGETATION, AND WETLANDS

3.12.1 Soils

The following discussion is based on the information presented in the 1992 FEIS, a report by IME (1991a), and soil mapping data collected by the Forest Service. Soils form slowly, influenced by parent material, climate, vegetation, topography, and time. In Southeast Alaska glaciation and climate are the largest influences in soil development. Recent glaciation has reduced the period of time during which soil formation processes have had to work, resulting in the presence of "young" soils throughout the area. Glacial movement scraped some surfaces down to bedrock, and receding glaciers left behind pockets of glacial till material. Both conditions occur within the study area. The cool, wet climate enhances the growth of vegetation, which serves as a source of organic material. Because of the temperature and moisture levels, organic materials decompose slowly, resulting in many areas where organic materials greatly exceed the mineral content of the soil. Muskegs are a typical example where the soil resource primarily consists of organic material.

The size distribution of particles within a soil determines its texture, which can range from larger sand particles to very fine particles of clay. ABR (2000c) noted that upland soils in the vicinity of the Jualin Mine were moderately well-drained thin silt or sandy soils spread over bedrock or glacial till. Soils in the vicinity of the Kensington Mine were also described as thin and silty, overlaying silty or clayey glacial tills (IME, 1991a). Wetland soils tended to be thick, consisting of organic material or silty loams (IME, 1991a).

Soil productivity and erodibility are important properties that need to be considered in assessing potential impacts on the soil resource. *Productivity* refers to a combination of texture, nutrient levels, and drainage, reflected in the vigor of vegetation supported by a particular soil. Therefore, the most productive soils are those that support the largest volume of timber. Within the study area, the most productive soils are those that have better drainage and produce high volumes of Sitka spruce. *Erodibility* refers to the tendency of a soil to be worn away by water, wind, or ice. The erodibility of a soil is important in terms of assessing how the soil reacts to disturbances. Generally the soils in the area have a relatively low susceptibility to erosion, particularly the poorly drained soils common to muskegs, emergent wetlands, and evergreen forest/scrub wetlands (IME, 1991a). The extent of vegetation cover and high organic content also combine to reduce erosion potential. The soils tend to be shallow and show a low susceptibility to induced sediment production. They range from well-drained to poorly drained, depending somewhat on topographic conditions.

The Forest Service performed soil surveys in the study area using methods established by the U.S. Department of Agriculture's Soil Conservation Service (now the Natural Resources Conservation Service) (Forest Service, 1990). The mapping effort identified 47 soil mapping units within the area, representing 30 soil types. The Forest Service provided the results of the soil survey in the form of a digital map (Forest Service, 2002c). Soils on the Kensington side of the study area were investigated as part of the extensive geotechnical work conducted in support of the 1992 FEIS (IME, 1991a). There is a mixture of soil types within the study area: slightly less than 70 percent of the soils are considered mineral soils, and the remainder are classified as organic soil types. Table 3-28 summarizes some of the key characteristics of the dominant soil types in the study area.

Table 3-28
Characteristics of Major Soil Types Within the Study Area

Soil Type	Mineral or Organic	Drainage Class	Permeability Class	Depth	Plant Associations
Cryosaprists and Histic Cryaquents	Organic	Very poorly drained	Moderately rapid	Shallow to deep	Tufted Club Rush/Bog Kalima; Mixed Conifer/Blueberry/Deer Cabbage
Cryohemists Typic Cryaquod Association	Organic	Very poorly drained	Moderately slow to moderately rapid	Very deep	Tufted Club Rush/Bog Kalima; Mixed Conifer/Blueberry/Skunk Cabbage; Mixed Conifer/Blueberry/Deer Cabbage
Humic Cryorthods	Mineral with well-developed organic layer	Moderately well to well drained	Rapid	Moderately deep to very deep	Western Hemlock/Blueberry-Shield Fern; Western Hemlock/Blueberry-Devil's Club (Most productive hemlock stands on Tongass)
Lithic Cryosaprist and Lithic Cryaquod Soils	Organic	Very poorly drained	Moderately slow to moderately rapid	Shallow	Mountain Hemlock/Blueberry Mertens Cassiope; Alpine Shrubland/Emergent Muskeg
Entic Cryumbrept McGilvery and Rock Outcrop Soils	Mineral	Moderately well drained	Moderately rapid	Shallow	Alder/Salmonberry; Alder/Lady Fern; Western Hemlock/Blueberry-Devil's Club
Cryaquents Sandy/Skeletal Association	Mineral	Poorly to somewhat poorly drained	Moderately rapid	Very deep	Alkali Grass-Sand Spurry; Bluejoint/Mixed Forb (Occur at saltwater boundary)
Cryorthods Cryofluvents Complex	Mineral	Somewhat poorly to well drained	Moderately rapid	Very deep	Sitka Spruce/Blueberry-Devil's Club; Sitka Spruce/Blueberry; Sitka Spruce/Alder
Typic Cryaquods Humic Cryorthods Association	Mineral	Poorly to somewhat poorly drained	Moderately rapid	Moderately deep to very deep	Western Hemlock/Blueberry; Western Hemlock/Blueberry-Devil's Club

Source: IME, 1991.

3.12.2 Vegetation

Coastal rain forest forms the predominant vegetation type in the study area and throughout Southeast Alaska. The forest within the study area consists primarily of western hemlock (*Tsuga heterophylla*) and mountain hemlock (*T. mertensiana*) as sole dominants or intermixed with Sitka spruce (*Picea sitchensis*) to form the overstory. A mixture of shrubs and herbaceous species form the understory. The species present in the understory reflect a number of factors, including the slope, aspect, soil type, soil moisture, and degree of canopy cover.

Western hemlock, mountain hemlock, and Sitka spruce communities in the study area range from low-volume, open-canopy woodlands to closed-canopy, medium-volume forests. Western hemlock occurs at lower elevations, and mountain hemlock occurs at higher elevations. Sitka spruce grows interspersed with both, occurring more frequently along the edges of avalanche chutes, drainages, and beaches. Within the study area, Sitka spruce occurs along with hemlock on the slopes east of Slate Creek Cove, along Sherman Creek, and near the Jualin and Kensington mine sites. Shrub layer plant species include Alaska blueberry (*Vaccinium alaskaense*), devil's club (*Oplopanax horridum*), rusty menziesia (*Menziesia ferruginea*), and salmonberry (*Rubus spectabilis*). Herbaceous species include five-leaf bramble (*R. pedatus*), bunchberry (*Cornus canadensis*), deerberry (*Maianthemum dilatatum*), fern-leaf goldenthread (*Coptis asplenifolia*), deer fern (*Blechnum spicant*), and spinulose shield fern (*Dryopteris austriaca*).

Many of the coniferous forests in Southeast Alaska have been described as being near climax and late-successional. This is true within the study area as well, although logging associated with the past mining activities has affected the successional stage of portions of vegetation in the Sherman, Johnson, and Slate creek drainages.

Figure 3-6, presented in the previous section, illustrated the distribution of productive old-growth forests and land cover types within the study area and corresponds to the habitat cover types presented previously in Table 3-25. The figure is derived from aerial photography, topographic information, and underlying soil types. The following sections describe each of the cover types.

Productive Old Growth

Old-growth forests are ecosystems distinguished by old, large trees and related structural attributes (Forest Service, 1997b). Old growth encompasses the later stages of stand development, which typically differ from earlier stages in a variety of ways, including larger tree sizes and more variation in size and spacing, large dead standing or fallen trees, broken or deformed tops and bole and root decay, multiple canopy layers, and canopy gaps and understory patchiness (Forest Service, 1997b). Old-growth forests are important sources of valuable forest products, and they also have aesthetic and cultural values. Old-growth forests provide critical nesting, foraging, rearing, denning, and cover habitat for old-growth forest-dependent wildlife species such as Sitka black-tailed deer, American marten, black and brown bears, goshawks, and cavity or snag-dependent species like flying squirrels, woodpeckers, and owls. Large dead or defective trees provide nesting sites for owls and bald eagles, as well as foraging sites for woodpeckers, sapsuckers, brown creepers, and other species.

There are differences between timber volume and forest structure, although confusion between the two exists. Some associate big trees with high timber volume without accounting for the sparse stocking that generally characterizes stands of big trees. Stands of medium-sized trees often have as much or more timber volume than stands of large trees owing to differences in the number of trees. Caouette et al. (2000) provides further discussion of these differences.

Although timber volume information is critical for many management objectives, such as calculating forest-wide harvest rates or the allowable sale quantity and planning timber sales, timber volume alone provides a limited description of a forest. To manage a forest for quality wildlife habitat, timber values, alternative harvest prescriptions, biodiversity, and recreational opportunities, Caouette et al. (2000) suggested the development of a system of forest measures that capture differences in forest structure as well as volume. The measures used for the analysis of old growth habitat include information from volume classes as well as the volume strata described below. The volume strata categories of high, medium, and low are synthesized from a combination of mapped characteristics including soil, volume class, and slope.

High-Volume, Old-Growth Forest

High-volume, old-growth forests have average timber volumes of 35 mbf/acre and higher (Forest Service, 1997b). The average height of codominant trees is greater than 100 feet. Canopy closure is 65 to 95 percent, with western hemlock or Sitka spruce dominating most sites. Stands are typically uneven-aged, with small gaps in the overhead canopy. Understory production is moderate, but snow interception is high, making forage (for deer) more readily available during winter. Winter thermal cover for wildlife is good. Approximately 1,914 acres of high-volume, old-growth forest have been mapped within the study area. High-volume old-growth constitutes 10.8 percent of the study area.

Medium-Volume, Old-Growth Forest

These forests have average timber volumes of 25 mbf/acre (Forest Service, 1997b). The average height of codominant trees is 70 to 100 feet, and canopy closure is 40 to 75 percent. Western hemlock and Sitka spruce are still the dominant species. The stands are uneven-aged, with numerous gaps in the overhead canopy. The more open canopy results in a more abundant understory, but it is subject to burial by snow in the winter. Winter thermal cover for wildlife is moderate. The study area has approximately 5,196 acres of medium-volume, old-growth forest, approximately 29.2 percent of the study land area.

Low-Volume, Old-Growth Forest

These forests have average timber volumes of 16 mbf/acre with western hemlock as the dominant species (Forest Service, 1997b). Tree height is typically less than 60 feet, and canopy closure is 20 to 50 percent, providing poor thermal cover for wildlife. The study area has approximately 1,356 acres of low-volume, old-growth forest, approximately 7.6 percent of the study land area.

Other

Nonproductive Forest

Nonproductive forests, including low-site-index forests, support less than 8 mbf/acre and constitute nearly 30 percent of the study area. Productivity in these areas is typically low because of either a high water table or shallow soils.

Muskeg

Muskeg habitats support a range of herbaceous and shrub species, including sedges (*Carex* spp.), bluejoint reedgrass (*Calamagrostis canadensis*), skunk cabbage (*Lysichitum americanum*), Sitka alder (*Alnus sinuata*), bog kalima (*Kalima polifolia*), crowberry (*Empetrum nigrum*), highbush cranberry (*Viburnum edule*), and labrador tea (*Ledum groenlandicum*). Muskegs may also support open forests that consist of stunted shore pine (*Pinus contorta*) and occasionally western hemlock and Sitka spruce along with the previously mentioned shrub and herbaceous species. Alaska yellow cedar (*Chamaecyparis nootkatensis*) has also been observed in muskegs around the Slate lakes (ABR, 2000c). Productivity is low in these areas because of the high water table, although small pools of open water scattered throughout contribute to the habitat value of these areas.

Brush

Areas considered brush are most frequently dominated by Sitka alder, which forms dense stands in avalanche chutes, along drainages, and in other areas that have been disturbed. To a lesser extent, willow (*Salix* spp.), salmonberry, and devil's club can also be present in drainages, particularly along channels with developed banks.

Rock Outcrop and Alpine

Rock outcrops and the alpine zone occur primarily on the steep slopes above the areas proposed for mining-related development. Rock slopes are often stripped of vegetation and soils by avalanches. Alpine areas are vegetated with low-growing herbaceous species stunted by the harsh growing conditions. These areas provide limited value as habitat except for mountain goats and other species adapted for the conditions.

Plant Associations

IME (1991b) described vegetation within the project area on the basis of plant associations. Plant associations are based on soil type and reflect the dominant two or three species (or groups of species) occurring within a soil type. IME reported that 24 plant associations occur within the study area. The most commonly occurring association is Western Hemlock/Blueberry, either as dominants alone or in conjunction with devil's club, skunk cabbage, or spinulose shield fern. Table 3-28 presents the plant associations associated with the major soil types within the project area. Although the plant associations are not specifically identified on a map, they provide a level of detail that supplements the land cover and productivity data provided above.

Sensitive Plant Species

The Forest Service maintains a list of sensitive plants in the Alaska Region. The list dated May 31, 2002, identifies 12 species known or suspected to occur in the Juneau Ranger District. These species are *Aphragmus eschscholtzianus* (Eschscholtz's little nightmare), *Arnica lessingii* subspecies *norbergii* (Norberg arnica), *Botrychium tunux* (moon wort fern), *Botrychium yaaxudakeit* (moon wort fern), *Carex lenticularis* var. *dolia* (goose-grass sedge), *Hymenophyllum wrightii* (Wright filmy fern), *Isoetes truncata* (truncate quillwort), *Ligisticum calderi* (Calder lovage), *Papaver alboroseum* (pale poppy), *Poa laxiflora* (loose-flowered bluegrass), *Puccinellia kamtschatica* (Kamchatka alkali grass), and *Romanzoffia unalaschcensis* (Unalaska mist-maid).

A survey of Lower Slate Lake conducted in October 2002 specifically for *Isoetes truncata* failed to locate the species (Icy Strait Environmental Services, 2002). A sensitive species survey conducted in July 2003 focused on the other 11 species known or expected to occur in the Juneau Ranger District. None of the species on the list were identified during the survey (ENSR, 2003).

3.12.3 Wetlands

The USFWS produces the National Wetlands Inventory, which contains information about the characteristics, extent, and status of wetlands in the United States. The National Wetlands Inventory uses the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979) as the basis for mapping and characterizing wetlands and can be applied to wetlands throughout the country. Using National Wetland Inventory nomenclature, four systems of wetlands occur within the project area—estuarine (estuary and shoreline), riverine (stream), lacustrine (lake), and palustrine (ABR, 2000c; Cowardin et al., 1979). The palustrine wetland system consists of nontidal areas dominated by trees, shrubs, and emergent vegetation. Palustrine wetlands within the study area include emergent, scrub-shrub, and forested types. Over 70 percent of the wetlands in the study area are forested, and nearly half of those occur as wetlands intermixed with uplands. Figure 3-7 illustrates the distribution of wetlands in the study area, and Table 3-29 summarizes the acreages of each of these wetland types in the study area.

Estuarine wetlands include the tidal marsh and sandy intertidal shoreline at the north end of Slate Creek Cove. Rocky intertidal shorelines constitute most of the remaining shoreline on the east and west shores of Slate Creek Cove. The area surrounding Comet Beach is also considered a rocky intertidal shoreline. The waters of Slate Creek Cove are identified as subtidal estuary and are discussed in Section 3.10 (Aquatic Resources: Marine).

Lacustrine (open-water) wetlands apply to Lower Slate Lake and Spectacle Lake. Upper Slate Lake is considered a palustrine aquatic bed because of its size. Palustrine aquatic bed wetlands are ponds or areas within ponds and lakes dominated by plants growing on or below the surface of the water. The small pond between Spectacle Lake and Upper Slate Lake is also a palustrine aquatic bed. Riverine wetlands (streams) within the project area include Sherman Creek, Ophir Creek, Slate Creek, and Johnson Creek. Combined, these wetlands constitute approximately 97.6 acres within the study area. The habitat provided by these systems is discussed in Section 3.9 (Aquatic Resources: Freshwater).

Palustrine emergent wetlands are dominated by herbaceous (non-woody) vegetation. Within the study area, this wetland type is concentrated in the vicinity of Spectacle Lake and supports tufted clubrush (*Trichophorum caespitosum),* sedges *(Carex)*, and bluejoint reedgrass as the dominant species. Palustrine emergent wetlands are also located at the northern ends of Upper and Lower Slate lakes. Approximately 130 acres of palustrine emergent vegetation occurs within the study area, including some of the disturbance near the existing Kensington facilities and Jualin camp.

Palustrine scrub-shrub wetlands are dominated by woody vegetation less than 20 feet tall (Cowardin et al., 1979). Almost 140 acres of scrub-shrub wetland types occur in the vicinity of Spectacle Lake, Upper and Lower Slate lakes, the terrace area, and west of Ivanhoe Creek. These wetlands are dominated by Alaska blueberry, crowberry, rusty menziesia, and deer cabbage (*Fauria crista-galli)* within the project area.

Palustrine forested wetlands are the single most common wetlands within the study area (1,134 acres). These wetlands are dominated by mountain hemlock, western hemlock, fern-leaf goldenthread, and Alaska blueberry. Forested wetlands occur throughout the area and include evergreen forests and complexes consisting of upland forests with 25 percent wetland inclusions as discussed above. The forest complexes contain upland soils and hydric soils under saturated conditions (ABR, 2000c). Hydrophytic species occur throughout the complexes although the hydrologic conditions required for jurisdictional wetland delineation, like the soils component, are limited in distribution in this wetland type (ABR, 2000c).

Wetland Function

The *Southeast Alaska Freshwater Wetland Assessment Method* (USACE, 2000) provides a method to characterize wetland functions without instrumentation or long-term monitoring data. The method allows comparison of the wetlands in the study area. The following discussion summarizes the functions assessed under this analysis and how those functions are provided by wetlands in the project area. Table 3-30 presents functional ratings based on the *Southeast Alaska Freshwater Wetland Assessment Method* for wetland types in portions of the study area that would be disturbed.

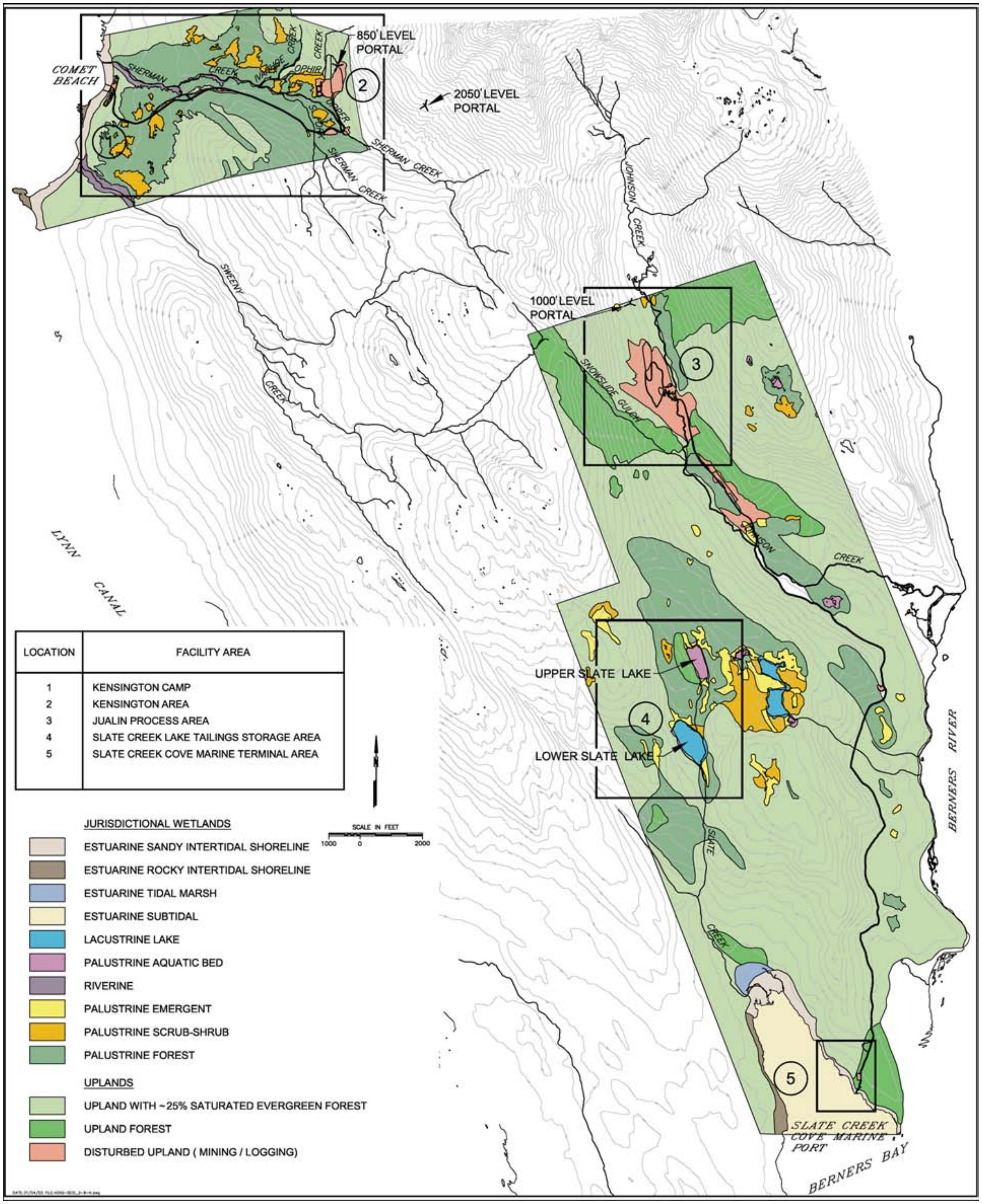


FIGURE 3-7. WETLANDS WITHIN THE KENSINGTON STUDY AREA

Table 3-29
Wetland Types and Acreages Within the Study Area

Wetland Type	Acres Within Study Area	Percentage of Wetland Type Within Study Area
Estuarine subtidal	230.3	7.9%
Estuarine rocky intertidal shoreline	24.1	0.8%
Estuarine sandy intertidal shoreline	92.7	3.2%
Estuarine tidal marsh	14.4	0.5%
Lacustrine	40.3	1.4%
Riverine	35.7	1.2%
Palustrine aquatic bed	21.6	0.7%
Palustrine emergent	94.6	3.2%
Palustrine scrub-shrub	164.2	5.6%
Palustrine forested	1,134.0	38.7%
Forested upland/wetland complex*	925.3	31.5%
Disturbed wetlands/uplands	155.8	5.3%
Total	2,933	100%

*Values represent the wetland portion (25%) of the upland/wetland complex (3,701 acres total).

Table 3-30
Functional Ratings for Selected Wetlands Types Within the Study Area

	Spectacle Lake	Slate Lakes		Lower Slate Lake Outlet	Johnson Creek	Terrace Area	Sherman Creek	
Function	Scrub-shrub and Emergent	Forested	Littoral	Forested	Disturbed Wetlands (emergent)	Forested and scrub-shrub	Forested	Scrub-shrub
Floodflow alteration	High	Moderate	Moderate	Moderate	Moderate	Moderate	Low	Moderate
Groundwater interchange	Low	Low	Low	Low	Low	Low	None	Low
Sediment/toxicant retention	Moderate	None	Moderate	None	Moderate	Moderate	Low	High
Sediment/shoreline stabilization	Low	Low	Moderate/ Low	Moderate	Moderate	Low	Low	Moderate
Nutrient cycling	Moderate	Moderate	High/ Moderate	Moderate	Moderate	Low	Moderate	Moderate
Carbon/detrital export	Moderate	High/ Moderate	High/ Moderate	High	Moderate	Moderate	Moderate	Moderate
Wildlife habitat	High	High	High	High	Moderate	High	High	Moderate
Fish habitat	Moderate	Moderate/ Low	Moderate	High	Moderate	None	Low	Low

Floodflow alteration is the ability of a wetland to temporarily store water and thereby reduce the magnitude of flood events. The source of these floods is typically overbank flows or overland flow from uplands. In Southeast Alaska, the forested, scrub-shrub, and emergent wetlands that occur along stream courses lower in the watershed, particularly those with deep organic soils, would have the greatest opportunity to affect flood flows. Most of the watercourses in the project area, however, occur within steep-sided bedrock channels and have limited opportunity to perform this function. Wetlands around Spectacle Lake have the soils and topography to support floodflow alteration, although the discharge from Spectacle Lake appears to be limited. Wetlands within the terrace area are relatively large and also have the topography and soils to provide floodflow alteration, but they are not adjacent to a stream course, limiting the extent to which they actually provide this function.

Groundwater interchange addresses groundwater recharge and discharge functions. Groundwater discharge supports stream flow, creates springs, and causes upwelling in lakes. Groundwater also regularly discharges at the base of slopes. Groundwater recharge typically occurs in bog and shrub wetlands higher in the watershed rather than at the sites of groundwater discharge. As discussed in Section 3.7 (Groundwater Hydrology), the bedrock underlying most of the project area is not porous and limits the extent of the groundwater recharge and discharge that occur. On a localized basis, shallow groundwater would tend to accumulate in the relatively flat areas, such as the emergent and scrub-shrub wetlands in the vicinity of Spectacle Lake and the scrub-shrub wetlands that occur in the terrace area. This shallow groundwater would then discharge on the downgradient portions of these wetlands in the form of sheet flow or small, intermittent streams.

Sediment/toxicant retention reflects a wetland's capacity to act as a sink for sediment and toxins. These functions typically apply in watersheds where upstream development provides sources of these materials. Scrub-shrub wetlands below the existing waste rock pile at Kensington and disturbed wetlands in the vicinity of the Jualin Mine would have the greatest opportunity to provide these functions. Wetlands in the vicinity of Spectacle Lake and in the terrace area also have the structure (relatively flat topography, deep organic soils, dense vegetation) to provide these functions but less opportunity due to the lack of disturbance in these areas.

Sediment/shoreline stabilization applies to the ability of wetlands to prevent erosion, including shoreline erosion. Dense vegetation along the shorelines can reduce the effect of streamside flooding or high tidal stages. Forested, scrub-shrub, and to some extent emergent wetlands along watercourses have the greatest opportunity to stabilize shorelines and trap sediments. Within the study area the wetlands occurring along Sherman, Slate, and Johnson creeks provide these functions. Wetlands surrounding Slate and Spectacle lakes would also have an opportunity to stabilize the shoreline, although changes in lake levels are likely less dynamic than changes in creek flow over similar time periods.

Nutrient cycling provides a pathway for nitrogen, phosphorus, and organic material to break down and become available again to the system. This function provides benefits in watersheds where nitrogen and phosphorus levels may reduce water quality and affect other uses. Potential nutrient sources in the project area are limited because of the limited amount of existing disturbance and the nature of the disturbance present. Wetlands in the vicinity of exploration-related disturbance would be most able to enhance nutrient cycling, assuming a source of nutrients is present. The most efficient wetlands for this function would be emergent types occurring on organic soils, where nutrients might be bound for periods of time, allowing microbial action to change nitrogen and phosphorus into forms that plants can take up.

Carbon/detrital export allows carbon and organic material to move from plants (producers) to other sources in the aquatic food web, although wetlands can also support terrestrial species. One example of export could occur through an insect eating plants falling into a creek, and then in turn being eaten by a fish. Tree branches also fall from wetlands (or uplands) into streams and provide habitat and food sources for aquatic species. The wetlands with the greatest capacity for carbon export are those that occur adjacent to stream courses or water bodies—the wetlands along

Sherman, Slate, and Johnson creeks, as well as those that surround Slate and Spectacle lakes. The scrub-shrub and forested wetlands in the terrace area provide this function to a lesser extent through the intermittent streams that drain the area.

Wildlife habitat includes supporting food webs, providing cover, and enhancing connectivity between upland areas. Depending on size and structure, wetlands may support a wide variety of species, including birds, deer, bear, and furbearers. Most of the wetlands in the study area provide a relatively high level of this function. The highest levels are provided by wetlands diverse in form and surrounded by old-growth forests, such as those around Slate and Spectacle lakes. Wetlands in the vicinity of existing disturbances—the waste rock storage and settling ponds at Kensington and the camp near the Jualin Mine—provide this wildlife function to a lesser degree because of occasional human activity.

Fish habitat applies to those wetlands that provide direct or indirect support to fish and fisheries. This function typically applies to streams, rivers, and open water, including saltwater wetlands. Forested wetlands in the vicinity of Upper and Lower Slate lakes, the scrub-shrub and emergent wetlands around Spectacle Lake, and forested wetlands along Sherman and Johnson creeks support fish habitat. The aquatic bed and lacustrine wetland areas in Upper and Lower Slate lakes, respectively, support populations of three-spined stickleback and Dolly Varden char, as well as benthic communities.

3.13 LAND USE AND RECREATION

3.13.1 Land Use and Recreation Resource Management

The Forest Plan provides prescriptions, standards, and guidelines for managing land use and recreation resources in the study area (Forest Service, 1997b). As discussed previously, the Forest Plan establishes land use designations (LUDs) for each part of the forest, and each LUD has specific prescriptions for managing recreation and other resources. The LUD for the area containing the Kensington and Jualin mines is Modified Landscape (ML) with a Minerals overlay. The ML prescription is intended to provide a sustained yield of timber and a mix of resource activities while minimizing the visibility of developments in the foreground and providing a spectrum of recreation opportunities consistent with resource activities. The ML prescription acknowledges the previous gold mining activities in the area, whereas the Minerals overlay provides management prescriptions for current or proposed mining activities, with the intent that the LUD will revert back to ML once mining is completed.

The only project facilities outside the ML designation are the Slate Creek Cove marine terminal and approximately 2.5 miles of the main access road to the historic Jualin Mine. This area is designated Old-Growth Habitat (OGH). The Old Growth Habitat LUD was established as part of a forest-wide strategy to maintain viable wildlife populations. The conservation strategy includes a system of large, medium, and small OGH and a set of standards and guidelines designed to preserve the integrity of the old-growth ecosystem. There are three small OGH within the project area. The Forest Plan allows for adjustment of the reserves' boundaries based on site-specific information. The additional information developed during the Kensington SEIS process is being used to adjust the boundaries of these small OGH LUDs to better conform to the standards and guidelines established by the Forest Plan. If the Forest Service accepts the proposed boundary modification, the marine terminal and access road will be entirely within the ML LUD (see Appendix F).

The Forest Plan designates corridors for existing and proposed road or utility systems. The Forest Plan map shows a Transportation and Utility System (TUS) Corridor crossing the study area to reflect the potential Juneau Access Road. Figure 3-8 shows the study area LUDs and transportation/ utility system corridor.

The project is located within a roadless area identified in the 2003 Forest Plan Supplement as the Skagway-Juneau Icefields Roadless Area (301). Roadless area 301 extends from Juneau to Haines, encompasses 1,201,474 acres and includes three biogeographic provinces; icefields, Lynn Canal, and Northern Coast Range. The roadless area description recognizes the existence of both the Kensington and Jualin historic mining properties including existing access roads to both properties.

The framework for recreation planning in the National Forest is the Recreational Opportunity Spectrum (ROS), an inventory system that categorizes the range of recreational opportunities of each area as falling into one or more of six classes, ranging from Urban to Primitive. The ROS describes the settings for activities occurring in the area, the type of recreation experience, and the managerial intent. Most of the study area is characterized as Semi-Primitive Non-Motorized (Figure 3-9). A strip of land approximately 0.25 mile wide along the western and southeastern shorelines of Berners Bay and along Lynn Canal is designated Semi-Primitive Motorized because of the use of motorized boats. The Semi-Primitive Motorized designation also extends approximately 1.2 miles up Sherman Creek, toward the Kensington Mine. The area immediately north of the Jualin and Kensington adits, extending up toward Lions Head Mountain, is designated Primitive; no project facilities are planned within the Primitive ROS area. Table 3-31 outlines the standards and guidelines to be used in managing the Semi-Primitive Non-Motorized, Semi-Primitive Motorized, and Roaded Modified ROS designations.

The ROS system is incorporated into the Forest Service Recreation and Tourism Standards and Guidelines. The system is used to plan for and manage the activities and level of development on the Tongass National Forest. The LUDs assigned to each area specify which ROS settings need to be maintained or attained and prescribe future management activities. Most of the study area lies within the Modified Landscape LUD, in which approved activities, such as mining, should maintain the Semi-Primitive Non-Motorized ROS where feasible. However, these activities are allowed to alter the existing ROS of Semi-Primitive Non-Motorized if necessary. The guidelines direct the Forest Service to "manage for the existing recreation settings and opportunities until approved activities and practices change the ROS setting(s). In locations where approved activities change the recreation setting(s), manage the new setting(s) with the appropriate ROS guidelines (generally Roaded Modified)" (Forest Service, 1997b). These guidelines incorporate the ROS but also provide additional forest-wide management direction requiring that the effects of projects on the diversity and quality of recreation settings and activity opportunities within, and adjacent to, the project area be assessed.

Within the area currently designated as Old Growth Habitat LUD, the prescription encourages maintenance of the inventoried ROS, "recognizing that more developed settings may be present due to authorized activities, existing use patterns, and activities in adjacent Land Use Designations" (Forest Service, 1997b). The portion of the study area with the Old Growth Habitat LUD has an inventoried ROS of Semi-Primitive Motorized at the Slate Creek Cove marine terminal and the first mile of access road. The next 1.5 miles of access road, also within the Old Growth Habitat LUD, is designated Semi-Primitive Non-Motorized. If the OGH boundaries are modified as proposed in Appendix F, this area will revert to the ML LUD, and thus the ROS could be altered if necessary to a Roaded Modified setting.

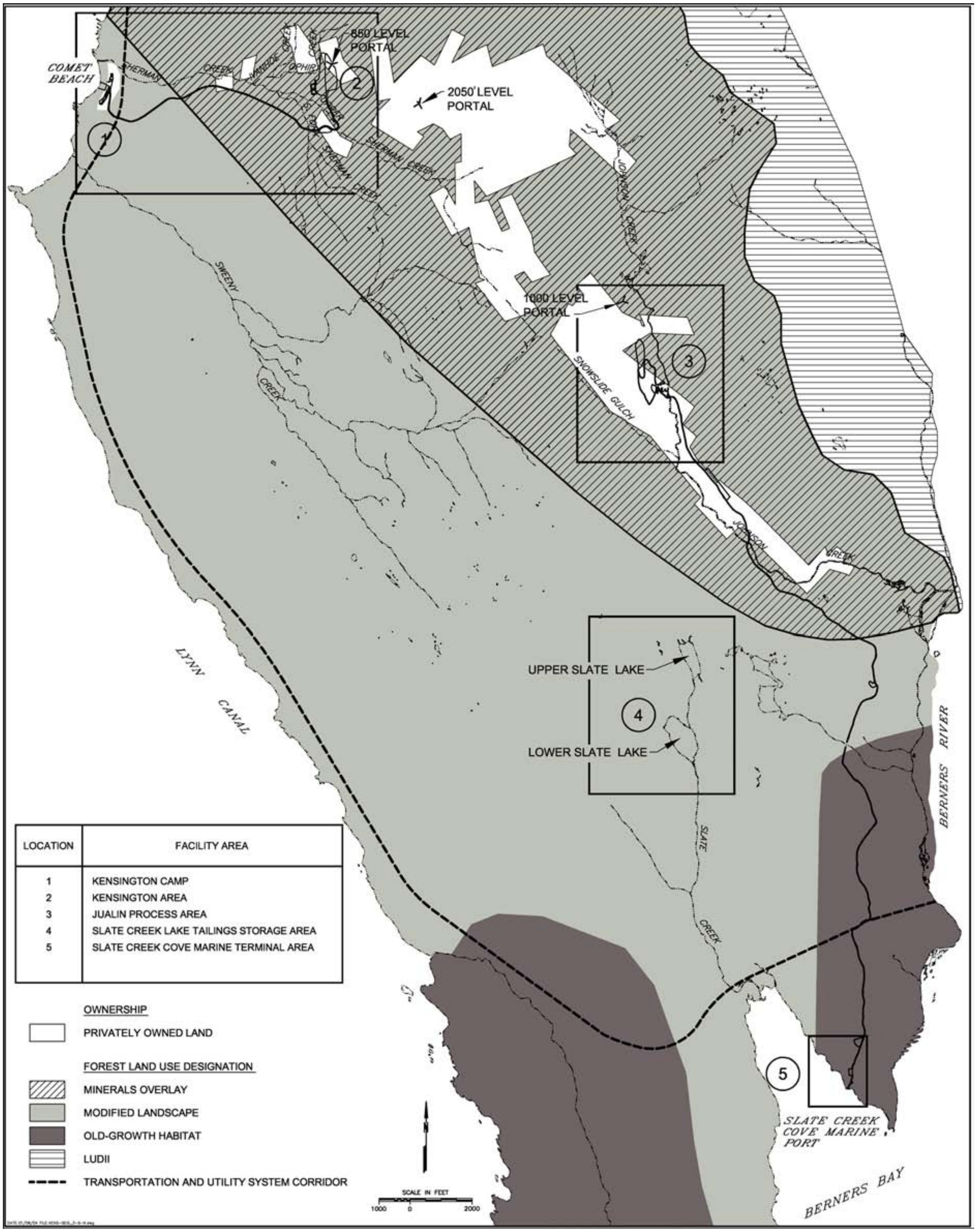


FIGURE 3-8. LAND USE SITE OVERVIEW

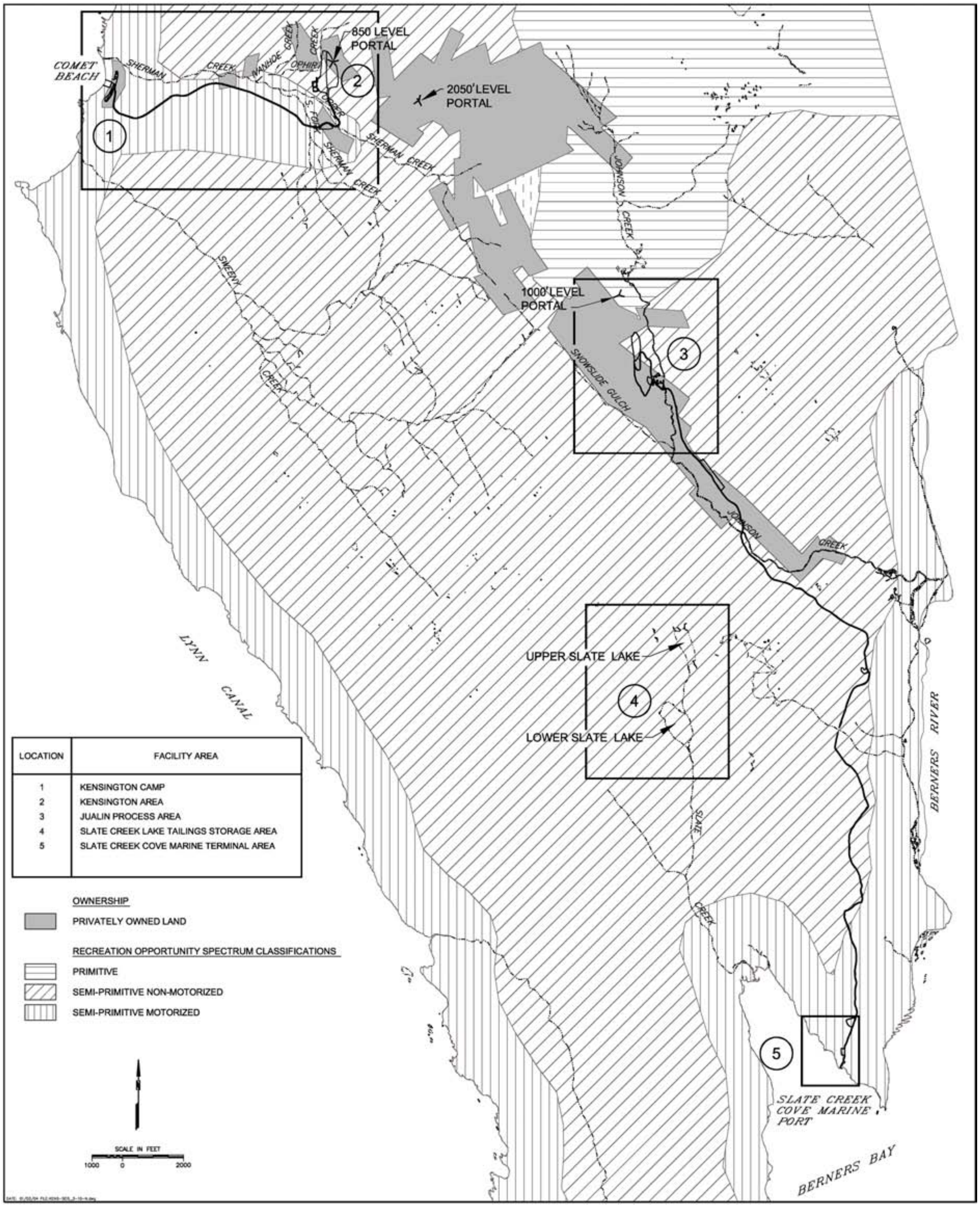


FIGURE 3-9. RECREATIONAL OPPORTUNITY SPECTRUM FOR THE STUDY AREA

Table 3-31
Recreational Opportunity Spectrum Standards and Guidelines

	Semi-Primitive Non-Motorized	Semi-Primitive Motorized	Roaded Modified
Visual Quality Objective (VQO) and Existing Visual Condition (EVC)	Not to exceed Retention VQO. Preservation EVC is fully compatible and encouraged.	Not to exceed Partial Retention VQO. EVCs from Preservation through Retention are fully compatible and encouraged.	Not to exceed Maximum Modification VQO. Apply visual management techniques to soften effects of alterations in the foreground of sensitive travel routes and recreation sites.
Access	Cross-country travel and travel on non-motorized trails. Motorized vehicles allowed for traditional activities, subsistence, emergencies, and other management activities.	Travel on motorized and non-motorized trails. Use by high-clearance vehicles and motorized boats.	All forms of access and travel modes may occur, predominantly high-clearance vehicles.
Remoteness	Nearby sights or sounds of human activity are rare, but distant sights or sounds may occur.	Nearby sights or sounds of human activity are rare, but distant sights or sounds may occur.	Remoteness from urban conditions and high concentrations of other people; low concentrations of human sights and sounds in a backcountry roaded setting preferred.
Visitor Management	On-site controls are rare; visitor information facilities may be used but are not elaborate.	On-site controls are few and consist primarily of informational signs and site-specific road closures. Visitor information facilities may be used but are not elaborate.	On-site controls are few and are appropriate for the predominating backcountry roaded setting. Visitor information facilities may be used but are not elaborate.
On-Site Recreation Development	Facilities and structures generally do not exceed Development Scale II and are maintained to accommodate the types and levels of use anticipated for the site.	Facilities and structures generally do not exceed Development Scale II and are maintained to accommodate the types and levels of use anticipated for the site.	Facilities and structures generally do not exceed Development Scale II and are maintained to accommodate the types and levels of use anticipated for the site.
Social Encounters	User meets fewer than 10 parties per day on trails and waterways, and no other parties are within sight or sound of dispersed campsites during 80% of the primary use season.	User meets fewer than 10 parties per day on trails, roads, and shorelines, and no other parties are visible from campsites during 80% of the primary use season.	User meets fewer than 20 parties per day on trails and in dispersed areas during 80% of the primary use season. Numerous other parties may be encountered on roads. Few, if any, other parties are visible at dispersed campsites.
Visitor Impacts	Visitor-caused impacts on resources are rare and usually not long-lasting. Site hardening is limited to boardwalk trails, boat tramways, moorings and docks, bear-proof food cache facilities, and rustic public recreation cabins.	Visitor-caused impacts may be noticeable but not degrading to basic resource. Site hardening is very infrequent, but when it occurs it is in harmony with and appropriate for the natural-appearing backcountry setting.	Visitor-caused impacts may be noticeable but not degrading to basic resource. Site hardening may dominate at campsites and parking areas, but it is in harmony with and appropriate for the backcountry roaded setting.

Source: Forest Service, 1997b.

3.13.2 Existing Land Use

The area in the immediate vicinity of the proposed project has historically been used for gold mining and milling activities (see Section 3.17, Cultural Resources), which included logging of some areas. Exploration operations at the Jualin and Kensington mines began in 1987 and are permitted to continue through the present. There are small camps at Johnson Creek and Comet Beach to house workers. Helicopters have provided the required support for the exploration operations.

Recreational activities also occur on the immediate project sites (historic Kensington and Jualin mines), but on a very limited basis because of private ownership and lack of access. Hunting and trapping are the predominant activities near these historic mine sites.

Recreation is more popular outside the immediate project sites. Water-based recreation along Lynn Canal consists primarily of cruise ship and ferry passengers that pass by the site. In contrast, Berners Bay, Echo Cove, and Slate Creek Cove are popular among boaters who use the area for motorboating and kayaking.

Land-based recreation outside the immediate project site is limited primarily to the shores of Berners Bay and includes camping and beachcombing. The southeastern shores of the bay, between Echo Cove and Point Bridget, have the most land-based activities due to road access and developed facilities. Although Berners Bay is used mostly by local residents, some commercial guide services take visitors to Berners Bay for both water- and land-based recreation, as well as some limited “flightseeing” activities. Section 3.13.3 provides a more detailed discussion of recreational activities.

Although there is considerable use of the Berners Bay area for sportfishing, hunting, clamdigging, crabbing, trapping, and berry harvesting, these activities are not considered subsistence uses because the area lies within the City and Borough of Juneau (CBJ). Residents of CBJ are classified as nonrural and thus are not considered subsistence users. There is no evidence that people qualifying as subsistence users come to the area from rural communities (Forest Service, 1998).

Commercial fishing occurs in the study area, primarily within Lynn Canal. Most of the commercial salmon fishing activity in Upper Lynn Canal is centered around Point Sherman. Commercial fishing boats are allowed in Berners Bay only for several weeks during the summer for chum and sockeye salmon and sometimes in the fall during larger coho runs. Drift gillnetting is the only type of commercial fishing that occurs in the bay and Lynn Canal (Shaul, 2003, personal communication).

Some commercial fishing for crab occurs in and near the mouth of Berners Bay. The commercial harvest season extends over 2 months in the summer and 2 months in the fall for Dungeness crab, several weeks in November for king crab, and 1 week in February for Tanner crab. During the past five seasons, an average of 5.6 Dungeness crab boats and 2.6 Tanner crab boats operated in the bay each season. Commercial king crab harvesting consisted of one boat operating during the 1999–2000 season and five boats in the 2001–2002 season. There is also a very limited commercial shrimp harvest in the bay, with one boat operating during each of the past two seasons (Bishop, 2003, personal communication).

3.13.3 Existing Recreation

Most of the recreational activity within the study area occurs within and around Berners Bay. The bay provides an important recreational resource to the residents of Juneau, as well as to visitors. The bay is unique in that it is one of the few places readily accessible from Juneau that provides what many in the public perceive as a wilderness experience.

The 1992 FEIS provides a discussion of the resident and nonresident recreational activities that occur in the study area. The following discussion summarizes new data on recreational use of the study area that have become available since 1992, with an emphasis on changes in use since 1992.

Recreation Facilities

Developed recreational facilities in the study area are minimal, consistent with the semi-primitive classification of the area. Recreational facilities built before the 1992 FEIS consist of the Echo Cove boat ramp, constructed in 1989 by the ADF&G; a small, informal campground at Echo Cove owned by the CBJ; and the privately owned Echo Ranch Bible Camp, west of Echo Cove. There are also three special-use cabins near the mouth of the Berners and Antler rivers. These are privately owned cabins that pay a rental fee to the Forest Service for use of the property (Thomas, 2003, personal communication). There are several float cabins on the eastern side of the bay; they are private facilities that require registration by the U.S. Coast Guard (Yurko, 2003, personal communication).

Since completion of the 1992 FEIS, the state of Alaska has constructed two public-use cabins at Point Bridget State Park. The Cowee Meadows cabin is in the park's interior, and the Blue Mussel cabin is on the shoreline. The Forest Service also constructed the Berners Bay cabin, which opened to the public in 1994, on the eastern shore of the bay. In addition, since 1992 the Forest Service has permitted construction of a private tent platform near the mouth of the Berners River (Thomas, 2003, personal communication).

Recreational Activities and Use

The 1992 FEIS lists the types of recreational activities occurring in the study area, based on a survey of recreation organizations conducted for the FEIS. The activities include fishing, hunting, trapping, wildlife viewing, camping, sightseeing, flightseeing, whale watching, beachcombing, kayaking, canoeing, nordic skiing, boating (motorboats, Jet Skis), hiking, snowshoeing, snowmobiling, and off-road vehicle use. Most of these activities occur on or near Berners Bay. In addition, the Lynn Canal portion of the study area is visited by passengers on ferries and cruise ships.

Because the area in the immediate vicinity of the Jualin and Kensington mine portals is accessible only by boat or air, recreational activities in this area are limited mostly to hunting and trapping. Some boaters hike up the existing access road from Slate Creek Cove, but few hike the entire 5 miles to the site and back. A few people bring dirt bikes, off-road vehicles, or snowmobiles using their boats to access the site via the road.

Recreational use in the study area has increased since publication of the 1992 FEIS because of increases in both population and tourism. According to local boat outfitters, the increase in recreational use of Berners Bay and Lynn Canal since 1992 has most likely resulted from rising tourism and the development of the public use cabins (Fisher, 2003, personal communication;

Kirkpatrick, 2003, personal communication). Because most visitors to Berners Bay are local residents, Juneau's 15 percent increase in population between 1990 and 2000 has also likely put more pressure on Berners Bay (USDOC Census, 2003).

Use of Lynn Canal tends to be more tourism-based than use of Berners Bay. Visitor arrival statistics published by the Alaska Department of Community and Economic Development show that the total number of visitors to Alaska arriving for vacation or pleasure increased 51 percent between 1993 and 2001, with travel by cruise ships becoming increasingly popular (Northern Economics, 2002). A total of 739,757 cruise ship passengers passed through Juneau in 2002, an increase of 59 percent since 1996 (McConkie, 2003, personal communication). In contrast, arrivals to the state via the Alaska Marine Highway ferry system have decreased since 1993. Most of the 2001 ferry arrivals were traveling for pleasure (Northern Economics, 2002).

The 2000 *Southeast Alaska Commercial Recreation Survey* (ADCBD, 2001) also indicates an increase in tourism over the past decade: 73 percent of the commercial operators reported an increase in business since 1995. The majority of the outfitters responding to the survey had opened their businesses within the past 10 years (ADCBD, 2001). These recent increases in visitors to the region would affect all tourist-oriented activities that occur in the study area, such as nature tours and wildlife viewing, while the increase in cruise ship popularity would affect the number of people passing by the Lynn Canal side of the study area on cruise ships.

Since completion of the 1992 FEIS, several new sources of data on the use of Berners Bay have become available. The USFWS conducted a survey of wildlife and human uses of the bay over a 2-year period from May 1, 2000, to April 29, 2002. The surveyors traveled the periphery of the bay by boat, noting human uses within 650 feet on either side of the boat. The uses were divided into the following categories: motorized boats, non-motorized boats, people, crab pots, and tents. The data do not indicate total use of the bay because the surveys were all done on weekdays and noted only the human activities occurring within the 1,300-foot transect. The study does, however, indicate the timing and distribution of the uses, showing that human use of the bay was concentrated on the eastern shore, mainly within Echo Cove. Use was relatively constant through the summer and fall months and minimal in the winter. The highest use (out of 22 days surveyed) was observed on July 12, 2001, when several boats were distributed along the eastern shoreline, from Echo Cove to the delta area, and crab pots were observed around the entire periphery (USFWS, 2003).

Use of Berners Bay increases significantly on weekends. Use of the bay for boating is estimated at approximately 30 to 35 boats on a typical weekend day and 60 to 65 boats on a high-use weekend day. This is based, in part, on the estimated use of the parking facilities at Echo Cove, which can accommodate approximately 60 to 70 vehicles with trailers and 45 cars. According to estimates made by the Juneau harbormaster's office, the parking lot is approximately half full on typical weekend days. On high-use weekends and holidays, the lot tends to be between 75 percent and 100 percent full. An estimated one-half of the vehicles are launching boats; the others are there for land-based activities, such as fishing, camping, off-road vehicle use, or picnicking, or for the Echo Ranch Bible Camp. In addition, a small percentage of the boat traffic on the bay (estimated at less than 10 percent) originates from other harbors, such as Auke Bay, 25 miles south of Berners Bay, or Haines (Clauder, 2003, personal communication).

Most boats on Berners Bay are motorboats (mostly small skiffs). Few charter boats use the area except during the spring eulachon run, when tour boats come from Juneau to see marine mammals and birds. The motorboats tend to be distributed around the periphery of the bay, with a heavier concentration on the eastern side. A number of boaters go to Slate Creek Cove and camp overnight on the beaches. An estimated 12 to 20 persons from Juneau use airboats to access the rivers north of the bay or the privately owned special-use cabins (Clauder, 2003, personal communication; Yurko, 2003, personal communication).

Berners Bay is also a popular destination for kayakers. A local kayak supplier estimated that on a typical summer weekend day, between 5 and 10 groups of kayaks are launched at Echo Cove (Fisher, 2003, personal communication). A local kayak rental shop estimated that 100 to 200 kayakers take their kayaks to Berners Bay over the course of the season, in addition to the roughly 40 kayaks the shop transports to the bay. The shop also conducts approximately six guided kayak trips per year with about five to six kayakers per trip. Their business has been increasing by about 15 percent per year since opening in 1996 (Kirkpatrick, 2003, personal communication). Most of the kayakers are there for day use and tend to travel the eastern shore of the bay to Sawmill Creek. Those on overnight trips tend to head toward the Berners Bay or Mussel Cove public-use cabins. A small number take multiday trips and camp overnight, traveling west around Bridget Point or north to the head of the bay. A few travel up the Lace River to Evelyn Lake. A limited number of raft trips travel down the Antler River. The rafts are brought in by seaplanes and launched at the river's headwater lake (Fisher, 2003, personal communication).

Although most of those using the bay are local residents, a few commercial outfitters provide guided tours. Data collected for the *Shoreline Outfitter/Guide Draft EIS* list permitted guide services that use the Tongass National Forest shorelines. Eight outfitting companies brought in an average of 97 clients per year to the shores of Berners Bay between 1997 and 2001, ranging from 48 in 1998 to 132 in 2000. Most of these visits (79 percent) were classified as "Remote Setting Nature Tours," arriving by boat or plane for fishing or for nature viewing. The remaining 21 percent were classified as "Road-Based Nature Tours," including hiking and nature viewing (Forest Service, 2002b). The *Shoreline Outfitter/Guide Draft EIS* also estimated the 1999 commercial use of Berners Bay as 29 group days and estimated that only 1.5 percent of the total recreation capacity of the area is used by commercial operators. These numbers include only commercial outfitters that have permits to use the shoreline, and thus they do not include flightseeing or charter boats that do not use the shore or outfitters that remain below the high tide line. Berners Bay was not included in the list of shoreline areas where overcrowding was a concern (Forest Service, 2002a).

Many boaters come to the bay to fish, primarily for salmon. Echo Cove is also popular for catching Dungeness crab. Anglers can also find Dolly Varden char, cutthroat trout, rockfish, and halibut. The 2000 *Southeast Alaska Commercial Recreation Provider Survey* listed saltwater fishing as the most prevalent activity for commercial outfitters throughout Southeast Alaska (ADCBD, 2001). Although waters closer to Juneau tend to be more popular with local anglers, the protected waters of Berners Bay are attractive to those with smaller skiffs (Glinn, 2003). In the Berners Bay recreation survey conducted for the 1992 FEIS, the largest number of respondents participated in fishing. Although there are no data on the total number of people fishing on Berners Bay, the shoreline outfitter/guide data for Berners Bay show an average of 22 people per year on guided fishing trips between 1997 and 2001 (Forest Service, 2002b). This number reflects just a small proportion of those fishing because many local residents launch private boats to access the bay for fishing.

Many of those visiting the bay camp out or stay overnight at one of the public-use cabins, which have become very popular destinations since their construction in the 1990s. Use of the Forest Service Berners Bay cabin has remained relatively consistent since its construction. In 1994, 671 persons visited the cabin over 153 nights, compared to 522 persons over 165 nights in 2000

(Scholten, 2002, personal communication). The two cabins at Point Bridget State Park were used by a total of 1,177 persons during the July 2001 to June 2002 period, 11 percent of whom were nonresidents. Total use of the park, including the two cabins, was 5,701 persons (Woods, 2003). The park is used for a number of recreational activities, such as hiking, dispersed camping, and beachcombing. Visitor data for the Forest Service special-use cabins are not available because the cabins are privately owned. The Echo Cove campground usually has an estimated 5 to 10 tents on a typical weekend night; many more can be seen during organized camping weekends by local groups (Clauder, 2003, personal communication). The Echo Ranch Bible Camp hosts about 3,000 to 3,500 guests per year. Schoolchildren are bussed to the camp during the summer; families use the camp for retreats during the spring and fall (Beaverson, 2003, personal communication).

Flightseeing is not as popular in the study area as it is in other parts of the Tongass National Forest. Most of the regularly scheduled fixed-wing tours go over the glaciers southeast of the study area. Some flightseeing trips go across Berners Bay to see moose (Yurko, 2003, personal communication). A few helicopter services travel across the bay to access the rivers. One such company makes approximately five trips per week. The existing mining facilities are visible from the helicopter routes and are often pointed out to visitors as an item of interest (Wilson, 2003, personal communication).

Although not as popular as fishing, hunting also occurs in the study area. The ADF&G collects data on hunting activity. During the 1990 to 2001 period, there were 36 moose hunting days per year in Game Management Subunit 1C, with an annual average of 14 moose hunters. During the same period there were 23 goat hunting days per year, with an average of 9.6 goat hunters per year. Bear hunting is the most prevalent, but the data include only successful hunters, with an annual average of 3.6 brown bear hunting days (1.3 hunters) and 14.6 black bear hunting days (6.4 hunters). There were also 1.6 trappers (marten, wolverine, wolves, otter, and beaver) per year during the same period. Game Management Subunit 1C includes all the terrain draining into Berners Bay, including the drainages of the Berners, Lace, Antler, and Gilkey rivers and Sawmill Creek (Barten, 2002, personal communication).

Hunting and trapping in the immediate project site is limited because of the difficult access, private ownership, and limited populations of game species. Trapping for wolverines is the most prevalent activity, and seven have been taken from the upper reaches of the Johnson Creek drainage over the past 2 years. Trappers have been known to bring in snowmobiles by boat, leaving them at Slate Creek Cove for the season (Barten, 2003, personal communication). Bear hunting tends to occur farther away from the mine site, along the coast. Hunting for moose and mountain goat might occur near the mine site, although the habitat is not as good as that in other areas (Forest Service, 1992).

Nonconsumptive wildlife use is another important recreational use of the area. The ADF&G considers the area a high-use area for nonhunting wildlife use, compared to other portions of the Southeast Alaska coast (Forest Service, 1998). Wildlife viewing is very popular in the spring during the eulachon run, which attracts large populations of marine mammals and birds. The Juneau Audubon Society has brought hundreds of birders and naturalists to the bay during the spring months to observe eulachon runs and migratory birds (Saunders, 2004, personal communication).

3.14 VISUAL RESOURCES

3.14.1 Visual Resources Management

The Forest Service provides standards for managing visual resources on National Forest System lands through use of its Visual Management System (VMS). The intent of the VMS is to incorporate the overall character of the existing landscape, the duration of views, distance, and perceptual variables into a system for managing visual resources. These elements are first used to establish an inventory of visual resources. Management goals for visual resources are then established through the current Forest Plan. Management goals, referred to as Visual Quality Objectives (VQOs), are based on the distance from viewers, and the land use designation. The discussion below summarizes the process for establishing these VQOs.

The inventory of visual resources begins with classifying the landscape into character types, based largely on physiographic provinces. Each given character type includes three variety classes (A, B, and C). Variety classes are established by examining features such as landforms, water forms, rock formations, and vegetative patterns, which are then compared with those commonly found in the character type. From this comparison, an area's overall degree of scenic quality and variety are classified as being distinctive, common, or of minimal variety relative to other landscapes of the character type. For example, the forested foothills below the Chilkat range might be relatively common in Southeast Alaska but would appear very distinctive in other portions of the United States.

The Forest Service identifies areas the public most often frequents and areas where visual quality is of public concern. These areas are referred to as Visual Priority Travel Routes (VPTRs) and Use Areas (UAs), and they are listed in the Forest Plan (Forest Service, 1997b). The VPTRs and UAs within the study area are shown in Figure 3-10.

The inventory and VQOs also incorporate the likely distance of viewers from a particular VPTR or UA. Distance is divided into three zones. The foreground zone is limited to distances at which detail can be perceived, usually less than 0.5 mile from the viewer. The middleground zone generally extends from the foreground to 3 to 5 miles from the viewer. The background zone extends from the middleground to as far as the eye can see.

How a landscape absorbs changes affects its Visual Absorption Capability (VAC). VAC is an estimate of the relative ability of a landscape to accept management manipulations without significantly affecting its visual character. It incorporates factors such as slope, soil color, the type and height of vegetation, revegetation potential, and existing clearings or man-made elements. There are three possible VAC ratings: low, intermediate, and high.

The Existing Visual Condition of the landscape is also taken into account in the visual management process. The Existing Visual Condition is the level of visual quality or current condition on the ground, reflecting the extent to which human alterations can be perceived in the landscape and contrast with the natural landscape patterns. The Existing Visual Condition is rated on a scale of I to VI; Type I appears to be untouched by human activities, and Type VI has disturbances in glaring contrast to the natural appearance of the landscape.

After visual resources are inventoried, VQOs are assigned to a particular area. VQOs outline the maximum degree of man-made change to be allowed in the area and the degree to which the changes may be seen or may dominate the characteristic landscape.

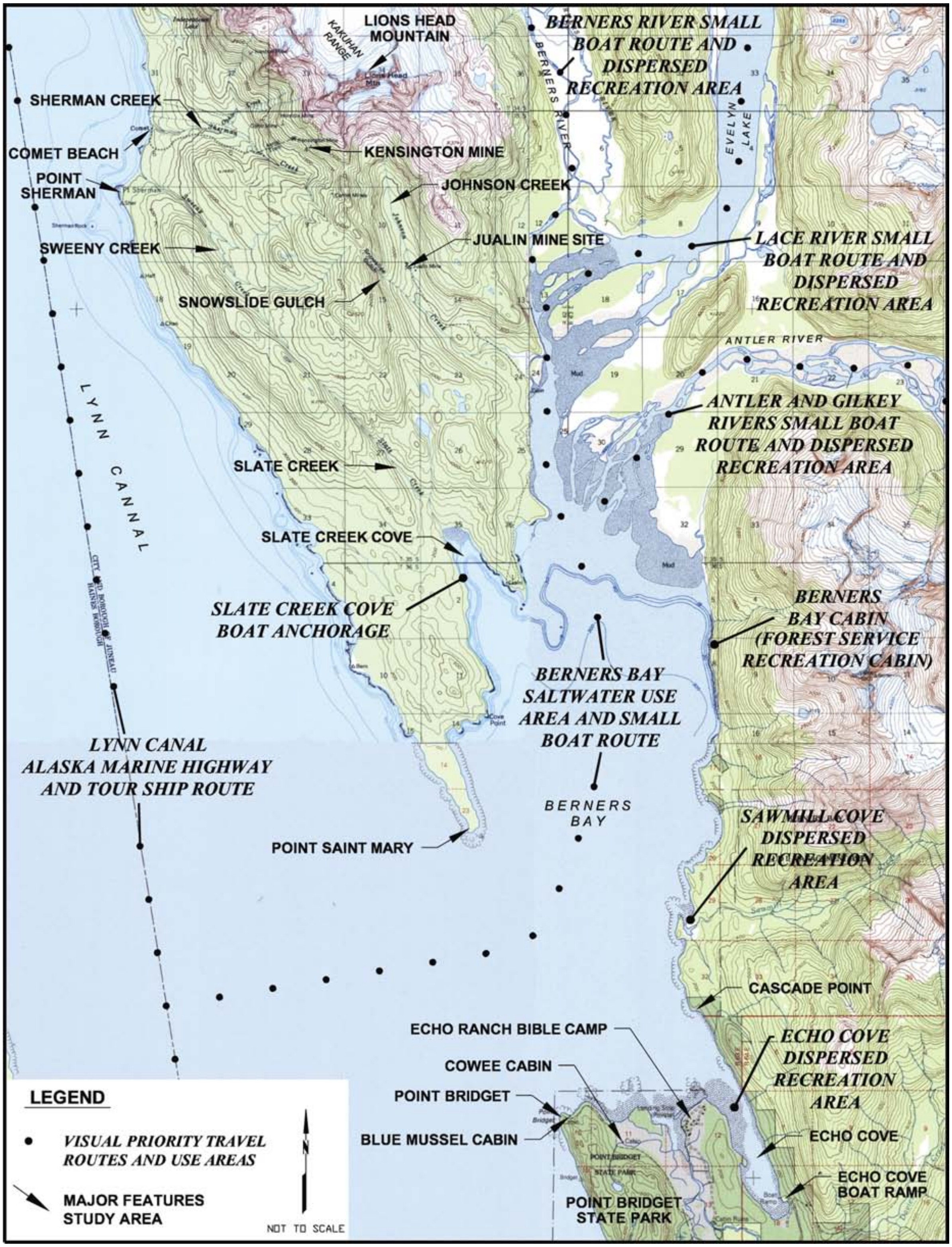


FIGURE 3-10. VISUAL PRIORITY TRAVEL ROUTES AND USE AREAS

VQOs have been established for each part of the Tongass National Forest as part of the Forest Plan, which assigned a LUD for each part of the forest. Management activities in each LUD need to meet a certain VQO, depending on the visibility and distance from VPTRs and UAs. Figure 3-10 shows the extent of each LUD in the study area. The Old-Growth Habitat LUD in the vicinity of the Slate Creek Cove marine terminal should be managed to attain a Retention VQO for all distance zones. Management activities in the Modified Landscape LUD should apply the Partial Retention VQO in the foreground distance zones and the Modification VQO in the middleground and background distance zones. Areas in the Modified Landscape LUD that are not visible from VPTRs and UAs need to conform to the Maximum Modification VQO. Table 3-32 describes each VQO.

Table 3-32
Visual Quality Objectives

Visual Quality Objective	Description	Schedule
Retention	Design activities so they are not visually evident to the casual observer.	Within 6 months after project completion.
Partial Retention	Design activities to be subordinate to the landscape character of the area.	Within 1 year after project completion.
Modification	Activities may visually dominate the characteristic landscape, but they must have visual characteristics similar to those of natural occurrences within the surrounding area or character type.	Within 1 year in the foreground zone and within 5 years in the middleground and background zones following project completion.
Maximum Modification	Activities may dominate the characteristic landscape, but when viewed as background, they should appear to be a natural occurrence.	NA

Note: NA = not applicable.
Source: Forest Service, 1997b.

3.14.2 Study Area Description

Landscape Character

The following is a summary of the description of the project's landscape character from the 1992 FEIS. The proposed mine is near three physiographic provinces: the Coast Mountains and Lower Coastal Foothills along the east side of Lynn Canal; the Alsek (Chilkat) and Fairweather Range sections of the Pacific Border Ranges province on the west side of Lynn Canal; and the canal itself, which is part of the Chatham Trough section of the Coastal Trough province. Visually, the physiographic provinces appear as three general landscape components: the water; the lower, rounded forested foothills on the canal banks and islands; and the steep, often ice-clad tall peaks behind the foothills to the east and west of Lynn Canal.

For visual management purposes, the Forest Service has combined the landscape components and portions of physiographic sections into a landscape character type, the Coast Range Visual Character Type. This type is characterized by the visual dominance of the water and tall mountain ridges and peaks (Dames and Moore, 1989b). The landforms are generally massive in scale and dissected by deep, steep-walled, U-shaped valleys. Mountain ridges are generally rounded summits, ranging from 5,000 to 7,000 feet in elevation. Higher mountains, often with sharp crests and horns, occasionally rise above these ridges, up to 9,000 feet above sea level. Large saltwater fiords are found in this character type. These are sometimes extremely steep-sided, creating great visual relief due to the abrupt change in elevation. A wide variety of geological features are also found in this unit, including cliffs, rock escarpments, smooth glacially scoured faces, jagged peaks, spires, and cirques. Shorelines vary from rocky bluffs to sand beaches. Large streams drain much of the unit, most of which are glaciated and braided. There are relatively few lakes. Vegetation varies from marshes and large grass tidal meadows in the lowlands to conifer-covered slopes or deciduous tree cover in the upper drainages, as well as a variety of alpine ecosystems found in the high country (Forest Service, 1992).

Existing Visual Condition

The 1992 FEIS also provides a detailed description of the Lynn Canal viewshed, including the landform, vegetation, and degree of human alteration. Lynn Canal is characterized by unbroken shorelines backed by forested foothills and steep, rocky, and snow-capped peaks. In the project area, the shoreline appears as a smooth, horizontal line created by the cobbled beach, uninterrupted by cliffs or large rock outcrops. Avalanche chutes, snow, and rock outcrops dominate Lions Head Mountain, which rises above the Comet Beach area. The vegetation is fairly uniform at the lower elevations, with subtle variations in pattern and color when viewed from water level. The only human alterations in the project area evident from Lynn Canal are the temporary camp buildings, which are slightly visible near Comet Beach, and the waste rock pile at the Kensington portal. Depending on the weather and sun position, the existing waste rock stockpile dominates the middleground view, contrasting with the surrounding landscape in terms of color and line. The view of the existing Kensington mine area from Lynn Canal would be classified as a Type V Existing Visual Condition because it stands out as an obvious alteration.

Berners Bay is contained by the steep slopes of Lions Head Mountain to the west and the foothills of the Coast Mountains to the east. The existing visual quality of the bay is excellent: a highly varied landscape offering strong contrasts in form, color, and shape (Forest Service, 1998). The predominant visual element is the large expanse of water. The shoreline, marked by a thin strip of light-colored, cobble beach, creates a strong horizontal element, contrasted by the repeated vertical pattern of the trees. The low-lying, forested delta at the head of the bay also adds to the horizontal character. Above the shoreline rise the heavily forested, rounded shapes of the foothills. Openings in the canopy are infrequent at the lower elevations, giving the effect of a smooth, uniform coniferous tree cover. As the steeper slopes rise above the foothills, tree cover becomes more diverse and intermittent. Stands of deciduous trees are interspersed with evergreens, rock outcroppings, alpine meadows, snowfields, and avalanche chutes. Snowslide Gulch is a prominent feature from the bay, visible above the bay's western shoreline, south of Lions Head Mountain. It has a large expanse of snow at certain times of year, as well as lighter-colored deciduous trees.

In contrast to the Kensington Mine site, the existing facilities at the Jualin Mine are not visible from Berners Bay. The facilities would be evident as human alterations only to those using the middle portions of the Johnson Creek drainage (the Johnson Creek drainage is not an identified VPTR or UA). The bay and the surrounding landscape appear relatively unaltered by human activity. There is a small clearing at Slate Creek Cove, used to access the existing road to the Jualin Mine site. The primary signs of human activity on Berners Bay, other than the boats along the water and shoreline, are clustered along the bay's southern and eastern shores. They include the Echo Cove Boat Ramp and Campground, the Echo Ranch Bible Camp, and the Berners Bay and Blue Mussel cabins. These facilities are all visually subordinate to the overall landscape character, and thus the area is classified as having a Type III Existing Visual Condition.

Variety Class

The combination of snow-covered slopes in the background, heavily forested hills in the middleground, and water in the foreground creates a strong contrast that adds to the attractiveness of the Berners Bay viewshed. Most of the viewshed would be considered a Class B landscape, or Common Variety Class. Although the viewshed contains a high degree of visual variety, it is relatively common to Southeast Alaska, and hence the Class B rating. A Class B landscape is generally typical of and common to the overall landscape province within which it lies. The exception is the Cascade Point area, which is rated Class A, or Distinctive Variety Class, because of its unique landforms, which include rugged exposed peaks, steep slopes, and rocky shoreline (Forest Service, 1998b).

Visibility from Visual Priority Travel Routes and Use Areas

Viewing conditions are the effects of lighting and weather on visibility of an area, and they vary considerably by season. Low clouds and fog cover the area during much of the year, especially during the late fall and winter, making many of the project area's major physiographic features, such as the Johnson Creek drainage and Snowslide Gulch, difficult to distinguish. On a clear day, however, these features are highly visible from the bay as part of the background view, although a ridge in the foreground screens the lower elevations of Johnson Creek. It is also possible on a clear day to see across Berners Bay from Slate Creek Cove and to distinguish existing structures at Echo Ranch Bible Camp in the background view even though it is more than 7 miles away.

A visibility analysis was conducted to identify the portions of the study area visible from the VPTRs and UAs. These include Berners Bay, as a saltwater use area and small boat route; the Echo/Sawmill cove area, as a dispersed recreation area; the Berners Bay cabin, as a Forest Service recreation cabin; and Slate Creek Cove, as a boat anchorage. The four major rivers draining into the bay (Berners, Lace, Antler, and Gilkey rivers) were designated in the Forest Plan as small boat routes and dispersed recreation areas (Figure 3-10). The Gilkey River was also recommended for designation as a Wild and Scenic River.

The visibility of the project site was determined by preparing viewshed studies from a series of points or Key Viewing Areas (KVAs) within the VPTRs and UAs. The KVAs were located approximately 0.5 mile apart along the approximate centerline of Berners Bay. Individual KVAs were also located at Berners Bay cabin, Cascade Point, Point Bridget State Park, Echo Cove, and Echo Ranch Bible Camp. Slate Creek Cove was not selected as a KVA for this analysis because a more detailed analysis was conducted from this site through photo simulation techniques. A viewshed analysis map was then created showing all the land visible from each KVA. Figure 3-11 shows the composite viewshed from the Berners Bay KVAs.

The results of the visibility analysis indicate that the Jualin Mine site is not visible from most of the KVAs. The only portion of the bay with a view of the mine site would be the upper portion of the bay, specifically the mouth of the Berners and Antler rivers, extending southeast to the Berners Bay cabin area. This area would have partially screened views of the pipeline access road and mill area. The main access road route is also within the viewshed of the bay, but it is not visible because of the existing tree cover. The Slate Creek Cove marine terminal site would be within the viewshed of Slate Creek Cove and the southern portion of Berners Bay, including the Point Bridget/Echo Cove area. The Cascade Point marine terminal site would also be visible from the southern portions of Berners Bay, including Echo Cove and Point Bridget. The Echo Cove terminal site would be most visible from points in Echo Cove.

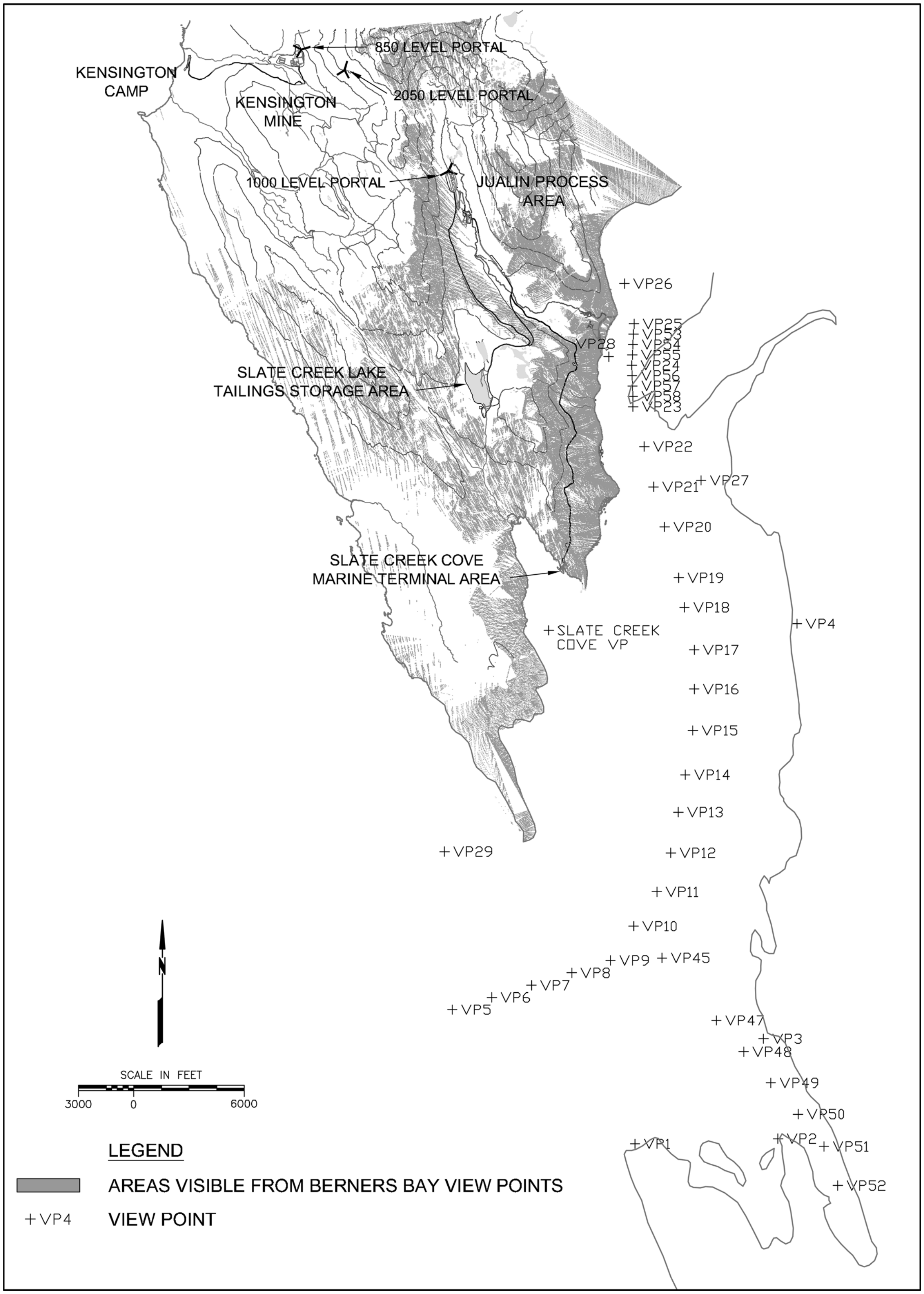


FIGURE 3-11. COMPOSITE VIEWSHED ANALYSIS

Ferries and cruise ships passing the Kensington site along Lynn Canal would also have a view of the mine site for a distance of approximately 2.5 miles. The Sherman Creek drainage is visible in clear weather from Lynn Canal, whereas the Sweeny Creek drainage, seen as a notch in the forested foothills, is screened in its lower reaches by a ridge that runs parallel to Lynn Canal.

Visual Absorption Capability

The VAC of the Kensington side of the project area is considered intermediate. In general, the tall, dense tree cover would help screen activities, but these factors would be balanced by the steep slopes, lack of natural openings, and lack of vegetative diversity, which make man-made alterations more evident. The steep, uniformly forested slopes at the lower elevations would make man-made openings very noticeable. However, the presence of natural clearings at the higher elevations would reduce the level of contrast to some extent. On the Jualin side of the project area, the low, heavily forested ridges in the foreground would help screen mining activities. The steep slopes and the presence of shorter deciduous trees in the Snowslide Gulch area, however, would give the area an intermediate VAC rating. The combination of dense tree cover and shallow slopes at Slate Creek Cove would help screen proposed management activities, except those occurring at the shoreline.

3.15 SOCIOECONOMICS

This section describes the social and economic environment potentially affected by the Proposed Action and alternative actions. A region's social and economic environment is characterized by its demographic composition, the structure and size of its economy, the quality and quantity of its housing stock, and the types and levels of public services available to its citizens. Accordingly, this study evaluates the potential effects of the proposed mine on the region's population growth, employment and income levels, business activities, housing stock, and public services, as well as environmental justice and the protection of children.

The socioeconomic environment evaluated for this draft SEIS encompasses the CBJ, Alaska. The CBJ forms the economic region of influence (ROI) and defines the geographic area in which the predominant social and economic impacts from the proposed mine would likely take place. The geographic area of the ROI was defined based on the location of the proposed mine, the probable residency of the majority of the proposed mine's workforce, and the distribution of businesses providing services to the mine (e.g., transportation services). Although the economic effects of the proposed mine would to some extent ripple throughout the Alaskan economy as a whole and reach other jurisdictions such as the Haines Borough, the preponderance of socioeconomic impacts would likely be localized, given the geographic isolation of the proposed mine and the CBJ. The baseline year for the impact analysis is 2003, although many of the economic and demographic data for the CBJ are available only through the year 2001. Wherever possible, the most recent data available are presented so that the affected environment descriptions reflect current conditions in the ROI.

3.15.1 Demographics

Established as Alaska's capital in 1906, Juneau is the largest city in southeastern Alaska and the third largest in the state. The CBJ covers 3,255 square miles (including land and water) and is home to approximately 5 percent of the state's population. The population density is approximately 11.2 people per square mile, which is slightly more than 10 times the Alaska average of 1.1 persons per square mile. The 2000 population of Juneau was 30,711, an increase of

15 percent over the 1990 population of 26,751 and a 57 percent increase over the 1980 population of 19,528. Based on the most recent Census Bureau estimates, the July 2002 population reached 30,751, or only 40 above the 2000 Census level (USDOC, Census, 2003a). The 2002 estimate represents a continued slowing of population growth. The ROI's population growth was particularly robust during the 1980s as oil revenues from the North Slope funded a large expansion of the state government in the CBJ. With decreases in production and lower prices during the 1990s, however, the CBJ's public sector growth also slowed and the CBJ's population growth rate more closely mirrored state and national growth rates, as shown in Table 3-33. Between 1991 and 1999, birth rates averaged 15.7 births per 1,000 population and death rates were estimated at 4.1 deaths per 1,000 population. Birth and death rates have fallen 47 percent and 31 percent, respectively, since 1991. Birth and death rates are substantially below the Alaska averages of 18.5 births per 1,000 population and 5.2 deaths per 1,000 population.

Table 3-33
Region of Influence and Alaska Population Changes: 1990 to 2002

Region	1990	2000	Average Annual Growth	Mid 2002 (estimate)
CBJ	26,751	30,711	1.4%	30,751
Alaska	550,043	634,892	1.4%	643,786
United States	248,709,873	281,421,906	1.2%	288,368,968

Source: USDOC, Census, 2003a.

The most recent population projections generated by the state of Alaska (ADLWD, 1998a) indicate a further slowing of the CBJ's population growth during the next 15 years. The mid-range population projections, shown in Table 3-34, indicate about a 0.6 percent average annual population increase for the period 2003 to 2018. This rate compares to an average annual growth rate of 1.4 percent during the 1990s and an average 2.3 percent annual growth rate for the past 2 decades. Population growth for the state as a whole was projected to increase by about 1.1 percent per year through the middle of the year 2018. It should be noted that these estimates represent the midpoint projections prepared by the Alaska State Labor Department during 1998. The Department also generated low- and high-range projections for the state and all boroughs. Under the low-growth and high-growth scenarios, the population of Juneau in mid-2018 would range between 33,120 and 37,248 people.

Table 3-34
Region of Influence and Alaska Population Projections for the Period 2003 to 2018

	July 2003	July 2008	July 2013	July 2018
City and Borough of Juneau	31,338	32,413	33,478	34,447
State of Alaska	656,150	693,018	733,852	776,448

Source: ADLWD, 1998.

In the year 2000, 30 percent of CBJ residents were 19 years of age and younger, 56 percent were between 20 and 54 years of age, and 14 percent were 55 years of age and older. The median age in 2000 was 35.3 years, slightly higher than the state median age of 32.4 years but identical to the national median age for both sexes. (USDOC, 2003). Racial and ethnic characterizations of the ROI are presented in Section 3.16 (Environmental Justice).

3.15.2 City and Bureau of Juneau Economic Setting

Like many Alaskan cities, Juneau developed as a result of gold mining activities. By the turn of the 20th century, the area had become a hub of gold mining activity and harbored some of the largest gold mining and milling operations in the world. Time, world wars, and labor costs, however, led to the closure of the mines by 1944. With the end of major mining activities, the local economy became more dependent on seafood harvesting and processing and government services. The region further benefited from increasing levels of federal government spending, particularly during World War II. With statehood in 1959 and the 1968 discovery of oil in Prudhoe Bay, the overall economy of Juneau (the state capital) continued to expand as a result of increased government spending (Reed Hansen and Associates, 1997). As described earlier, decreasing output of Alaskan oil and a prolonged period of stagnant oil prices during the 1990s have led to a slowdown in the growth of the Alaskan state government. Economic conditions led to state budget cuts in 2003 and 2004.

The strong growth of the tourism industry during the past 20 years, especially the cruise ship industry, has provided stability to the local economy by counteracting the volatility of the oil sector and government budget cycles. Nevertheless, for the past 4 years there has been a decrease in the number of independent travelers to Juneau and a slowdown in the growth of cruise ship visits. For example, although the number of cruise ship visitors increased by about 10 percent annually throughout the 1980s and 1990s, from 1999 to 2003 the number of cruise ship visitors per year increased by only 4 to 9 percent (Freer, 2003, personal communication). It is quite possible, however, that improving national economic conditions could spur a more robust period of growth in this sector.

Overall, the CBJ's economy has been relatively stagnant during the past several years, reflecting the national economic downturn, decrease in tourism after September 11, 2001, and several regional changes, including lower oil revenues and a slowdown in state government spending. Employment in Juneau's retail and manufacturing sectors has been trending downward since 2000; commercial construction activity has declined; and, as previously mentioned, Alaska's reliance on the oil industry has slowed growth in the public sector. The region's real per capita income has been flat or down slightly, while cost of living has remained high compared to the U.S. average. Some recent indicators, however, show the CBJ in a very slow growth trend, with the latest population, employment, income, and business sales data all showing some recent increase (McDowell Group, Inc., 2003).

Employment

As shown in Table 3-35, the primary sources of employment in the ROI in 2001 were the government, services, retail trade and construction sectors. Together these sectors accounted for 75.5 percent of the total ROI employment. The remaining six sectors provided slightly less than 25 percent of the ROI employment. Because the Census Bureau changed from the SIC to the NAICS code in 2001, it is difficult to make direct comparison for all sectors in terms of changes in employment between 1997 and 2001. Nonetheless the data indicate that overall, employment distribution among the 10 industry sectors did not change appreciably. Government, services, and retail trade were the largest generators of employment in both years.

Table 3-35
Region of Influence Employment by Industry[1]

Industry Sector	**1997 ROI Employment (Percent of Total Employment)**	**2001 ROI Employment (Percent of Total Employment)**
Agricultural Services, Forestry, Fishing, and Other	ND	ND
Mining	ND	ND
Construction	1,155 (5.4%)	1,126 (5.3%)
Manufacturing	489 (2.3%)	671[2] (3.2%)
Transportation and Public Utilities	1,357 (6.4%)	1,056[3] (5.0%)
Wholesale Trade	333 (1.6%)	ND
Retail Trade	3,273 (15.4%)	2,225 (10.6%)
Finance, Insurance, and Real Estate	970 (4%)	933 (4.4%)
Services	5,457 (25.6%)	5,809 (27.6%)
Government and Government Enterprises[a]	7,378 (34.6%)	7,581 (36%)
Total Non-Farm Employment	21,303	21,069

[1] Estimates for 1997 are based on the 1987 SIC code, while the 2001 estimates are based on the 2001 NAICS code. The services sector for 2001, for example, includes employment from the following NAICS sectors: professional, educational, health care, arts, entertainment, recreation, accommodation and food, professional, and other services except public administration.
[2] Manufacturing sector in 2001 includes information sector.
[3] The 2001 NAICS sector is transportation and warehousing; utilities are treated separately. ND=These numbers are withheld by the Bureau of Economic Analysis to avoid disclosure of confidential information.
Source: Bureau of Economic Analysis, Regional Economic Information System (REIS)

The single largest source of jobs in the ROI was the government and government enterprises, which generated 36 percent of the total employment in 2001. Because Juneau is the state capital, the majority (57 percent) of the jobs were with the state government. State government employment increased by about 3 percent between 1997 and 2001. Local government employment also increased during the same period by about 8.9 percent. As mentioned earlier, these trends have reversed since 2001 and government employment at all levels is projected to decrease in future years.

Tourism has become vital to the health of the ROI economy, generating significant employment in the services and retail sectors. The services sector was the second largest industry in the ROI, accounting for 22 percent of total employment, followed by retail trade, providing 10.6 percent of employment. Services sector employment was up 6 percent since 1997, with an additional 352 jobs. (The services industry includes establishments primarily engaged in providing a variety of services, such as hotels and other lodging places; establishments that provide personal, business, repair, and amusement services; health, legal, engineering, and other professional services; educational institutions; membership organizations; and other miscellaneous services [OSHA, 2001].) Visitors travel to Juneau on cruise ships, scheduled airlines, or the state ferry system. During the 2002 tourism season, cruise ships took more than 700,000 passengers to Juneau, and more than 150,000 visitors arrived by the airlines (CBJ, 2003). Thirty-two percent of the people employed in the services sector were employed in the hotel/lodging industry or the amusement and recreation industry. Twenty-nine percent of those employed in retail trade worked in eating and drinking establishments (ADLWD, 2003a). The tourism industry contributes an estimated $97 million in direct wages and income to Juneau's economy (AEIS, 2002).

The transportation and public utilities sector is the ROI's fourth largest industry, providing 7 percent of regional employment. Juneau is a transportation hub for Southeast Alaska, providing daily jet service to Seattle and Anchorage. Juneau has a deepwater port with sufficient docks and moorage for cargo ships, cruise liners, and fishing boats.

The fishing industry remains a prominent industry in the CBJ. Although the fishing sector is not among the largest sources of employment in the ROI (Table 3-35), many small businesses and individuals make their livelihood in the commercial fishing industry, harvesting and processing sablefish, halibut, herring, crab, and salmon. As of 2000, the ROI had more than 75 fisheries, 9 shoreside seafood processors, and 385 registered fishing vessels (AEIS, 2002). The CBJ is one of the only regions in Alaska that experienced some gains in the fishing industry during the 1990s (AEIS, 2002).

The mining industry was historically important to the early development of the ROI but no longer plays a significant role in generating employment. The mining sector is estimated to provide about 2 percent of regional employment since 1997. The majority of those employed in the mining sector work in metal mines. The Greens Creek Mine on Admiralty Island near Juneau is a large underground mining operation in the ROI that produces silver, gold, zinc, and lead. The mine is owned and operated by Kennecott Greens Creek Mining Company in partnership with Hecla Mining Company, and it employs about 250 people (Kennecott, 2003).

Industries in the ROI that experienced an increase in the number of persons employed between 1997 and 2001 are construction, transportation, wholesale trade, services, and government.

Major employers in the ROI are listed in Table 3-36.

Table 3-36
Major Employers in the Region of Influence

State of Alaska	U.S. government, including
City and Borough of Juneau	Bureau of Indian Affairs
Juneau School District	Forest Service
Bartlett Memorial Hospital	National Marine Fisheries Service
Southeast Alaska Regional Health Consortium	U.S. Coast Guard
University of Alaska	U.S. Fish and Wildlife Service
Fred Meyer Department Store	
Alaska Airlines	

Source: CBJ, 2003; Juneau Chamber of Commerce, 2003.

Labor Force and Unemployment

The ROI's annual average civilian labor force was 16,467 in 2002, a decrease of 5 percent from 1997's labor force of 17,386 (Table 3-37) (ADLWD, 2003b). The decline can be attributed to the stagnant ROI economic conditions, as previously mentioned, which reflect the national economic downturn, as well as a regional decline in the retail and manufacturing sectors, a drop in tourism after September 11, 2001, and the impact of the decline in oil production on the public sector.

The ROI's annual unemployment rate was 5.9 percent in 2002, lower than the 1997 rate of 6.3 percent but still the highest unemployment rate since 1998. For comparison, the 2002 annual unemployment rate for Alaska was 7.7 percent and for the United States was 5.8 percent (USDOL, BLS, 2003).

Table 3-37
Region of Influence Labor Force Statistics

	1997	1998	1999	2000	2001	2002
Civilian Labor Force[a]	17,386	17,059	17,209	17,105	16,822	16,467
Employment	16,289	16,178	16,354	16,261	15,990	15,494
Unemployment	1,097	881	855	844	832	973
Unemployment Rate %	6.3	5.2	5.0	4.9	4.9	5.9

[a] Presented as the annual average.

Source: ADLWD, 2003b.

Income

In 2002 the per capita personal income of the ROI was $36,086, which was higher than that of Alaska ($32,799) and the United States ($30,906) (ADLWD, 2003c; USDOC, BEA, 2003b). However, living in Alaska costs more than living in most other states. Based on the Runzheimer Plan of Living Cost Standards, where the cost of living in a standard U.S. city is indexed at 100.0, the cost of living in Juneau is 121.4, or 21.4 percent higher than the cost of living in the standard city (Fried and Robinson, 2003). Comparing selected goods and services, transportation costs are 4.8 percent higher, housing costs are 41.7 percent higher, and the costs of miscellaneous goods and services are 8 percent higher in Juneau than in the standard U.S. city (Fried and Robinson, 2003).

3.15.3 Housing

Table 3-38 shows housing occupancy type and vacancy for the CBJ and Alaska for the years 1990 and 2000. During the 1990 to 2000 period, the total number of housing units and the number of occupied housing units in the CBJ increased at somewhat higher rates than those for the state as a whole. In terms of housing, the most conspicuous difference between the CBJ and the rest of Alaska is the percentage of vacant housing. At the time of the 2000 census, only about 6 percent of the housing units in the CBJ were vacant and only about 2.6 percent (321 units) were available for rent or sale. In contrast, 15 percent of the state's total housing units were vacant and about 3.7 percent were for rent or sale. It should be noted that less than 2 percent of the housing units in the CBJ are used for recreational purposes, compared to more than 8 percent in the state. Nonetheless, in recent years housing in the CBJ has been scarcer than housing in the rest of state.

The overall availability of housing in the CBJ, however, is a reflection of the health of the economy. During boom times, net in-migration increases and housing vacancy rates can drop precipitously. More recent data indicate that the availability of housing in the CBJ has increased significantly during the past 3 years, corresponding to the region's economic slowdown. Specifically, annual surveys conducted by the Alaska Department of Labor and Workforce Development for the Alaskan Housing Finance Corporation indicate that housing vacancy rates have more than doubled since the 2000 census. Single-family rental vacancy rates in the CBJ, for example, increased from 4.4 percent during 2002 to 9.1 percent in 2003.[1] Apartment rental vacancy rates were estimated at 6.2 percent (AHFC, 2003a). Because both the 2000 census data and the 2003 Alaska state survey data are snapshots of the housing vacancy status at particular points in time, these data might not represent the housing market conditions that would be present

[1] It should be noted that the estimated vacancy rate for rental single-family residences is based on a limited survey conducted for the Alaska Housing Finance Corporation.

Table 3-38
Region of Influence and Alaska State Housing Characteristics

	City and Borough of Juneau			Alaska		
	1990	2000	Percent Change 1990 to 2000	1990	2000	Percent Change 1990 to 2000
Total	10,638	12,282	15.5	232,608	260,978	12.2
Occupied	9,902	11,543	16.7	189,915	221,600	16.7
Owner-occupied	5,764	7,356	27.6	105,989	138,509	30.7
Renter-occupied	4,138	4,187	1.2	82,926	83,091	.2
Vacant	736	739	0.4	43,693	39,378	-9.9
Percent vacant	6.9	6.0	-13	18.7	15	-19.8
For rent	179	251	40	7,717	7,036	-8.8
For sale only	90	70	-22.2	4,967	2,612	-47.4
Rented or sold, not occupied	75	56	-25	2,744	2,066	-24.7
For seasonal, recreational, or occasional use	248	185	-25.4	16,991	21,474	26.4
For migrant workers	0	11	NA	199	180	-9.5
Other vacant	144	165	14.6	11,075	6,010	-45.7

Source: USDOC, 2003b.

during construction and operation of the proposed mine. If, however, the state's population projections prove accurate, the forecast would indicate a continued slowing of demand for CBJ housing during the life cycle of the proposed mine.

The housing stock of the ROI and Alaska is newer and more costly compared to most other regions in the United States. Almost 75 percent of the housing units in Juneau were built after 1970, compared to 50 percent for the rest of the United States. The median value and gross monthly rent for owner-occupied and rental housing units in Juneau for 1999 were $179,200 and $863. The national median value for owner-occupied housing units in 1999 was $111,800, and the median gross rent was $602 (USDOC, 2003a). In terms of new housing, a total of 97 residential building permits were issued during 2002. Eighty-eight of the permits were for single-family dwellings, six were for duplexes, one was for a multi-family unit, and two were for other new residential. In addition, 14 permits were issued for mobile home setups. In total, permits were issued for 133 housing units.

3.15.4 Schools

The Juneau School District consists of seven elementary schools (kindergarten through grade 5), two middle schools (grades 6 through 8), and one high school (grades 9 through 12). Three alternative schools (Alyeska Central Correspondence, Johnson Youth Center, and Yaakoosge Daakahidi Alternative High School) also provide educational services to area students; only one, the Yaakoosge Daakahidi Alternative High School, is operated by the Juneau School District. The Johnson Youth Center is a 28-bed youth detention and treatment facility operated by the Alaska State Department of Health and Social Services, and the Correspondence School is a statewide program operated by the City of Galena School District. The Juneau School District provides two teachers and aides to those teachers for the Center. The student-teacher ratio for the school district as a whole was 16.7 in 2001–2002, although the ratio varied from school to school. During the 2001–2002 school year, the total student enrollment was 5,506 and the total number of teachers was 349. Twenty-two percent of the enrolled students were Alaska Natives. Table 3-39 presents data on individual schools (USDOE/NCES, 2003). It should be noted that recent projections by the Juneau School District forecast a decrease in school enrollment over the next several years. Total enrollment is expected to decline to about 5,300 by Fiscal Year 2006.

Table 3-39
2001–2002 School Year Public Education Statistics

School	Elementary School	Middle School	High School	Other School	Student Enrollment	Student-Teacher Ratio
Auke Bay	X				399	18.1
Gastineau	X				288	13.6
Glacier Valley	X				354	14.8
Harborview	X				465	15.5
Juneau Community Charter	X				62	20.7
Mendenhall River	X				482	15.3
Riverbend	X				413	13.8
Dzantik`i Heeni		X			727	16.6
Floyd Dryden		X			603	14.9
Juneau-Douglas			X		1,637	21.3
Johnson Youth Center				X	39	NA
Juneau District Correspondence				X	53	NA
Yaakoosge Daakahidi Alternative School				X	95	19.0
Total District					5,608	16.7

Source: USOE/NCES, 2003.

The 2001–2002 school budget was approximately $49.5 million. The Juneau School District spent $8,680 per student, with two-thirds of the budget directed to instructional activities. The state of Alaska is the largest source of revenue for the school district, contributing 52 percent of the budget in 2001–2002. Local revenues accounted for 42 percent of the school budget, and federal funds provided 6 percent of the total revenue.

The University of Alaska Southeast campus, offering academic and vocational courses, is 12 miles from downtown Juneau. Degrees are offered in more than 30 fields.

3.15.5 City and Borough of Juneau Government Finances

The CBJ government received a total of $164.9 million in revenue during 2001(ADCED, 2003). More than 81 percent of the revenue received originated from local sources, including taxes, service charges, and revenue from enterprises (e.g., public utilities). Taxes accounted for more than 35 percent of the revenue. State and federal education funds were the largest nonlocal sources of revenue in 2001, totaling $25.7 million. Government expenditures were dominated by spending for public services, education, and safety. Together, these categories of expenditures accounted for almost 90 percent of all CBJ operating expenditures during 2001. Educational services received the largest proportion of expenditures, accounting for $44.5 million of the total (34 percent), followed by expenditures for health services, which totaled $37.2 million in 2001. It should be noted that virtually all the funds for health care expenditures are from hospital receipts.

3.15.6 Community Services

Law Enforcement

The Juneau Police Department provides law enforcement services in the CBJ. The service area covers 3,248 square miles. The department employs a chief of police, an assistant chief, a captain, 2 lieutenants, 7 sergeants, 35 police officers, 5 community service officers, and other support staff (Freer, 2004).

Fire Protection

Five fire districts serve the Capital City Fire/Rescue Department. Stations are located in Juneau, Douglas, the airport/Mendenhall Valley, Lynn Canal, and Auke Bay. Staffing of captains, lieutenants, and volunteer firefighters ranges from 10 to 30 per station. Each fire or rescue district recruits its own volunteers from community members surrounding a particular station. As the demographics of the population have changed over time, it has become increasingly difficult to attract community members to serve as volunteers (Freer, 2004).

Ambulance Services

Capital City Fire/Rescue/Medevac, Airlift Northwest/Air Ambulance, Greens Creek Emergency Medical Service, and the U.S. Coast Guard Rescue Coordination Center provide ambulance services in the Juneau area. Although Capital City Fire/Rescue/Medevac operates primarily within the boundaries of Juneau, requests for Medevac or other specialized rescue assistance often requires staff to respond outside the CBJ's legal boundaries. For example, during the summer requests are frequently received to assist ill tourists on cruise ships in Skagway or Glacier Bay.

Health Care

Health care in Juneau is available at the Bartlett Regional Hospital, Southeast Alaska Regional Health Corporation (SEARHC) Medical/Dental Clinic, and several private health-care providers. The Bartlett Regional Hospital, a 56-bed center operated by the CBJ, offers a wide range of health-care services including emergency room care. The SEARHC operates one of the largest ambulatory care facilities in Alaska, including a full-service dental clinic, radiology and pharmacy departments, and a laboratory. The newly opened clinic offers regular pediatric, orthopedic, ear-nose-throat, and other specialty clinics. In addition, the CBJ has one assisted living and nursing care center with a total of 55 beds. Mental health services are offered by the Juneau Alliance for the Mentally Ill and other private providers. Limited mental health services are available to Alaska Natives through SEARHC.

Municipal Water Supply

The Last Chance Basin well field on Gold Creek and Salmon Creek Reservoir provide the municipal water supply for Juneau area residents and businesses. The water is treated and piped to more than 90 percent of Juneau's households. The water demand is 5 million gallons per day (Alaska Department of Commerce and Economic Development, 2002). Households not hooked into the municipal water supply use individual wells as their potable water source.

Wastewater Treatment Facilities

Eighty percent of households in Juneau are connected to the borough's piped sewage treatment system. The sewage receives secondary treatment, and then the sludge is incinerated. Households not hooked into the municipal sewage treatment system maintain individual septic tank systems (Alaska Department of Community and Economic Development 2003).

Solid Waste

A private firm provides refuse collection for local residences and businesses and also operates the landfill and incinerator. Juneau has a sludge site and a hazardous waste collection facility. Recycling programs are available through local organizations.

3.16 ENVIRONMENTAL JUSTICE

On February 11, 1994, President Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*. The Executive Order is designed to focus the attention of federal agencies on the human health and environmental conditions in minority and low-income communities. Environmental justice analyses are performed to identify potential disproportionately high and adverse human health or environmental effects from proposed federal actions and to identify alternatives that might mitigate potential impacts. Data from the U.S Department of Commerce *2000 Census of Population and Housing* (USDOC, Census, 2003b) were used for this environmental justice analysis. Minority populations included in the census are identified as Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, persons of two or more races, persons of other race, and Hispanic or Latino. Poverty status, used in this SEIS to define low-income status, is reported as the number of persons with income below the poverty level. The 2000 census defines the poverty level as $8,794 or less of annual income for an individual and $17,603 or less of annual income for a family of four.

The demographic profiles of the socioeconomic ROI and the state of Alaska differ from the profile of the rest of the continental United States, especially with respect to minority populations. Whereas American Indians and Alaska Natives account for less than 1 percent of the nation's population, they account for 11.4 percent of the ROI's population and 15.6 percent of the state's population. In contrast, although African Americans account for 12.8 percent of the nation's total population, they constitute only 0.8 percent of the ROI population (Table 3-40).

Overall, the ROI has a lower percentage of minority residents compared to Alaska but a slightly higher percentage of minorities compared to the rest of the nation. In 2000, 25.3 percent of the ROI population was of a minority race or ethnicity and 3.4 percent of the population was of Hispanic or Latino origin. Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, persons of two or more races, and persons of other race were totaled to obtain the percent of the population that was of a minority race or ethnicity. (Persons of Hispanic or Latino origin may be of any race and therefore are totaled separately to avoid double counting.) In Alaska, 30.6 percent of the total population was of a minority racial group and 4.1 percent was of Hispanic or Latino origin. For the United States, 24.8 percent was of a minority racial group and 12.5 percent was of Hispanic or Latino origin.

The U.S. Census Bureau bases the poverty status of families and individuals on 48 threshold variables, including income, family size, number of family members under the age of 18 and over 65 years of age, and amount spent on food. In 1999, 6.0 percent of the ROI residents were classified as living in poverty, which is 3.4 percent lower than the poverty rate of the state of Alaska and 7.3 percent lower than that of the United States as a whole (Table 3-40).

Table 3-40
Race, Ethnicity, and Poverty Status (Percent)

	ROI	Alaska	United States
White	74.8	69.3	75.1
Black or African American	0.8	3.5	12.3
American Indian and Alaska Native	11.4	15.6	0.9
Asian	4.7	4.0	3.6
Native Hawaiian and Other Pacific Islander	0.4	0.5	0.1
Other	1.1	1.6	5.5
Two or More Races	6.9	5.4	2.4
Hispanic or Latino[a]	3.4	4.1	12.5
Persons Below Poverty Level[b]	6.0	9.4	13.3

[a] Persons of Hispanic origin may be of any race.
[b] Percent of persons living below poverty level is for 1999.
Source: USDOC/Census, 2003b.

3.16.1 Protection of Children

Executive Order 13045, *Protection of Children from Environmental Health and Safety Risks*, requires federal agencies, to the extent permitted by law and mission, to identify and assess environmental health and safety risks that might disproportionately affect children. Children are not permitted in or around the area of the Kensington Mine. The mine is in a remote location with no nearby commercial or residential developments. The mine does not present a health or safety risk to children.

3.17 CULTURAL RESOURCES

Cultural resources are properties with heritage value at the local, regional, or national level, and they include archaeological sites, buildings, and traditional cultural properties. Known cultural resources in the project vicinity range from traditional Tlingit Indian occupations of the late prehistoric period to the ruins of 100-year old mines and sawmills now descending into the archaeological record. The Lynn Canal and Berners Bay areas, as part of greater southeastern Alaska, could hold archaeological sites as old as 10,000 years before present (B.P.).

3.17.1 Prehistory

Archaeological evidence confirms that humans had arrived in Southeast Alaska by about 10,000 years ago. Both the Ground Hog Bay 2 site near Glacier Bay (Ackerman, 1996; Ackerman et al., 1979) and the Hidden Falls site on Baranof Island (Davis, 1989) were occupied about 9,500 to 9,000 years ago (Hamilton and Goebel, 1999). Stone artifacts from the two occupations reflect microblade, flake core, and biface reduction technologies, and they include tools such as bifaces, scrapers, choppers, and gravers (Ackerman, 1996). Similar artifacts from the Thorne River site on Prince of Wales Island date to about 7,500 years ago (Holmes et al., 1989). The earliest human remains found in Southeast Alaska come from On Your Knees Cave on Prince of Wales Island, radiocarbon-dated to 9,730 +/- 60 years B.P. (Dixon et al., 1997). Though lacking radiocarbon confirmation, the nearby Rice Creek site on Heceta Island is thought to be about 9,000 years old (Ackerman, 1996; Ackerman et al., 1985), and a short distance away the Chuck Lake site has yielded dated deposits of 8,200 to 7,300 years B.P. and 5,200 years B.P. (Ackerman et al., 1985).

A break in the archaeological record of British Columbia around 5,000 years ago (Carlson, 1996) is mirrored in Southeast Alaska (Ackerman, 1992), after which people along the northern Pacific shore began to develop the complex marine adaptation loosely termed the Northwest Coast cultural tradition. A hallmark of the stone technology from this later period is grinding to manufacture implements instead of chipping them into shape, and ground slate tools became widely used for many different functions (Clark, 1979). A pattern of large permanent villages with seasonal camps developed among the prehistoric people, and territorial boundaries—though continually shifting—were very important. A wide range of site types has been recorded from this late prehistoric period, including large village sites with evidence of substantial plank houses (Campbell, 1984), middens (organic deposits enriched by household refuse), rockshelters (Irish et al., 1993; Mobley, 1984; Reger and Campbell, 1986), petroglyphs (Mobley, 1996; Stevens, 1974), fish traps (Mobley and McCallum, 2001), forts (Moss and Erlandson, 1992), and bark-stripped trees called culturally modified trees (Lewis and Mobley, 1994; Mobley and Eldridge, 1992). Most known sites reflect an increasingly complex and denser population in Southeast Alaska, growing ultimately into the Tlingit and other coastal groups such as the Tsetsaut and Eyak (Moss, 1992).

Northern Southeast Alaska saw a population boom about 3,500 years ago, judging from the archaeological record of such places as Admiralty Island (Mobley, 1994). The Lynn Canal and Berners Bay area reflect the regional pattern in having few (in this case no) documented early sites. One confirmed prehistoric site is at Chilkoot Lake, at the head of Chilkoot Inlet, with an age of about 800 years (McMahan, 1994). In the Juneau vicinity three prehistoric sites have been radiocarbon-dated to between 500 and 800 years old: the Indian Point site (49JUN701) at Auke Bay (Mobley and Betts, 1997), the Tlingit fort (49JUN239) of *Auke Nu* (Moss and Erlandson, 1992), and a basketry fish trap (49JUN453) at Montana Creek (Betts, 1998). On the east side of Lynn Canal is 49SKG139, a cache pit near Dayebas Creek with a radiocarbon date of 450 +/- 90 years B.P. (Wessen et al., 1994). Other prehistoric deposits are likely to exist in the archaeological record of east Lynn Canal and Berners Bay, perhaps in the soils underlying documented Native historic sites.

3.17.2 Ethnohistory

The project area is at the traditional boundary between two major Tlingit Indian territories. The Auke Tlingit historically claimed Berners Bay, the northern part of Admiralty Island, most of Douglas Island, and most of Admiralty Island's Seymour Canal (Goldschmidt and Haas, 1946; Arndt et al., 1987). The Chilkoot, or Haines group, of the Chilkat Tlingit (rather than the Klukwan group) claimed all of Lynn Canal south to Berners Bay (Goldschmidt and Haas, 1946). Thus the project area, at the junction between Berners Bay and Lynn Canal, is also at the boundary between the Auke and Chilkoot tribes. The Chilkoot used Lynn Canal for hunting and trapping and for gathering crabs, cockles, and seaweed. The rugged east shore, however, precluded much camping below Chilkoot Inlet, and the west shore afforded only three good habitation spots: at Pyramid Harbor in Chilkat Inlet, at Sullivan Island across from Eldred Rock, and—farthest south and closest to the project area—at the mouth of the Endicott River (Goldschmidt and Haas, 1946). The Chilkat paddled and sailed past what is now the Kensington

Mine and Lions Head Mountain, but they do not appear to have spent as much time ashore there as elsewhere. In the immediate project vicinity, the one locality with traditional cultural significance to the Chilkat Tlingit is Point Sherman on Lynn Canal, which is referenced in the story of a vision quest by the *Lukaaxadi* shaman *Geek'ee* (Bowser, 1998).

Berners Bay has a more hospitable shoreline than Lynn Canal. It not only was used for hunting, trapping, fishing, berry-gathering, and other subsistence purposes but also was the reported location of permanent Auke settlements. Villages were located at the mouth of Lace River, and between Lace River and Berners River, according to oral history accounts (Goldschmidt and Haas, 1946). No Auke villages in Berners Bay are mentioned by the Petroff (1884) subsegment to the 1880 Alaska census, however, and historically the central village for the Auke Tlingit was at Auke Bay (Thornton, 1997). Berners Bay might have been occupied earlier by Chilkat Tlingit families (Goldschmidt and Haas, 1946). Archaeological evidence for traditionally used places in Berners Bay is largely lacking, and only a few sites have been entered into the statewide Alaska Heritage Resource Survey (AHRS) inventory. The grave and associated petroglyph of Berners Bay Jim (49JUN040) has been repeatedly sought and not found (Brown, 1993; Moss, 1981; Stevens and Partnow, 1972; Wessen et al., 1994). The Slate Creek Cove Site (49JUN103), formerly known as Slate Creek Village, has not been archaeologically confirmed (Sealaska Corporation, 1975; Wessen et al., 1994). Berners Bay Village and Petroglyph (49JUN062), on the east side of Berners Bay, has been documented (Bureau of Indian Affairs, 1982; Gee, 1983a; Rawlinson, 1979; Sealaska Corporation, 1975; Stevens and Partnow, 1972), and a shell midden (49JUN673) not far away was radiocarbon-dated to the historic period (Wessen et al., 1994). Both have been judged eligible for inclusion in the National Register of Historic Places (Table 3-41). Also on the east side of Berners Bay is 49JUN710, a site determined eligible for the National Register and containing 159 culturally modified trees, depressions, and a midden (Forest Service, 1998). Culturally modified trees have been found elsewhere around the edge of Berners Bay, indicating traditional Native forest use (Forest Service, 1998; Mobley, 1988; ICRC, 2003; Wessen et al., 1994), but no samples have been tree-ring-dated.

Table 3-41
Identified Cultural Resource Sites in the Area of Potential Effect and Their National Register Eligibility

AHRS #	Site Name	Eligibility
JUN-103	Slate Creek Cove Site	Eligible
JUN-022	Jualin Mine District	Eligible
JUN-928	Berners Bay Historic Mining District	Eligible
JUN-929	Jualin Mine Wharf	Eligible
JUN-930	Lower Jualin Mine Camp	Eligible
JUN-931	Upper Jualin Mine Camp	Eligible
JUN-932	Jualin Mine Tram	Eligible
JUN-945	Comet/Bear/Kensington Mining District	Eligible
JUN-033	Comet Landing	Not eligible
JUN-240	Comet/Bear/Kensington Millsite	Eligible
JUN-946	Comet/Bear/Kensington Railroad	Eligible
JUN-947	Comet Mine	Eligible
JUN-948	Comet Mine Tram	Eligible
JUN-949	Kensington Mine	Eligible
JUN-721	Kensington Mine Adit Bunkhouse	Not eligible
JUN-722	Kensington Mine Adit Generator Building	Not eligible

Table 3-41
Identified Cultural Resource Sites in the Area of Potential Effect and Their National Register Eligibility (continued)

JUN-950	Trite Road	Not eligible
JUN-951	Bear Mine	Eligible
JUN-953	Bear-Kensington Mines Tram System	Eligible
JUN-969	Johnson Prospect	Not eligible
JUN-970	Eureka Prospect	Not eligible
JUN-952	Ophr-Sherman Creeks Wood Site	Not eligible
JUN-954	Ivanhoe/Horrible Mining District	Eligible
JUN-956	Horrible Mine Workings	Eligible
JUN-957	Mellen Millsite	Eligible
JUN-958	Portland Millsite	Eligible
JUN-959	Portland Millsite- Horrible Mine Tram	Not eligible
JUN-960	Mellen Millsite- Ivanhoe Tram System	Eligible
JUN-961	Lynn Canal Mining Co. Horrible Mine Tram	Eligible
JUN-933	Indiana Mine	Eligible
JUN-934	Gold King Prospect	Not eligible
JUN-935	Mystery Lode Prospect	Not eligible
JUN-936	Johnson Creek Prospect	Not eligible
JUN-937	Yankee Boy Prospect	Not eligible
JUN-940	Valentine Prospect	Not eligible
JUN-941	Snowslide Gulch Prospect	Not eligible
JUN-942	Hoggatt Creek Prospect	Not eligible
JUN-943	Thomas Prospect	Not eligible
JUN-944	Fremming Prospect	Not eligible
JUN-962	Hope Prospect	Not eligible
JUN-963	Mexican Prospect	Not eligible
JUN-964	Ophir Prospect	Not eligible
JUN-965	Cumberland Prospect	Not eligible
AHRS #	**Site Name**	**Eligibility**
JUN-966	Elmira Prospect	Not eligible
JUN-968	Seward Prospect	Not eligible
JUN-971	Northern Belle Mine	Eligible
JUN-928	Berners Bay Historic Mining District	Eligible
JUN-952	Ophir-Sherman Creeks Wood Site	Not eligible

The National Register eligibility of specific Tlingit places as Traditional Cultural Properties (TCPs) in the study area was investigated in 1997 (Bowser, 1998) and 2003 (Mobley, 2003), involving archival research and public meetings with Chilkat, Chilkoot, and Auke tribal representatives. Point Sherman may be eligible as a TCP based on its association with *Geek'ee*'s vision quest (Bowser, 1998).

3.17.3 History

George Vancouver and his crew named and charted Lynn Canal and Berners Bay in 1794, living to write about their confrontation with 100 to 200 Chilkat men in canoes, armed with "not only spears, but with seven muskets, and some brass blunderbusses, all in most excellent order"

(Vancouver, 1984). A few years later what would become the Russian American Company moved its headquarters to Sitka, on the Pacific side of Baranof Island, but the company's direct contact with mainland Natives like the Chilkat and Auke Tlingit was limited (Arndt et al., 1987). Historical records of Lynn Canal and Berners Bay are scarce until after 1867, which begins Alaska's American Period. In 1878 a Northwest Trading Company post was established at Chilkoot Inlet near the beginning of an old Tlingit trail into the interior, followed in 1881 by a Presbyterian mission built close by, forming a settlement that together became known as Haines (Orth, 1967). Alaska's third salmon cannery (preceded in 1878 by facilities at Klawock and old Sitka) was the Chilkat Packing Company built at Chilkat Inlet in 1882, followed the subsequent year by the Northwest Trading Company's cannery at Pyramid Harbor on Chilkat Inlet, followed yet again in 1889 by construction of the Chilkat Canning Company at Chilkat Village (MacDonald, 1951). The commercial economy grew considerably when the Klondike and other interior Alaskan and Yukon gold rushes were accessed from the Lynn Canal settlements of Haines, Dyea, and Skagway, but that was almost 10 years later, in 1898.

Juneau's history, in contrast, centered around mining during the 1880s and 1890s, and no canneries were built until later, at Auke Bay in 1916 and Juneau in 1918 (MacDonald, 1951). By then the Juneau area had for decades been part of a major mining district known as the Juneau Gold Belt, containing almost 200 documented prospects and 5 historically important mines worthy of separate discussion by Redman et al. (1991). Within 2 years of the original 1880 Juneau gold discoveries, numerous prospects and claims had been staked nearby, and development had begun on the enormously successful and long-lived (1880 to 1944) Alaska Juneau Mine, and the Treadwell Mine (1882 to 1917) across Gastineau Channel at Douglas (Orth, 1967; Redman et al., 1991). A third mine of the five singled out by Redman et al. (1991) is the Herbert Glacier Prospect, 5 miles north of Auke Bay. The last two of the five mines—the Jualin Mine and the Kensington Mine—are particularly pertinent to the Kensington Gold Project.

In 1895, on the north side of Berners Bay beneath the peak known since 1867 as Lions Head (Orth, 1967), prospectors discovered gold-bearing quartz veins that would become the Jualin Mine (Brooks, 1916). Production began the following year under Mellon and Herbert Hoggatt, with brother Wilford becoming mine superintendent and postmaster in 1899. Wilford Hoggatt left the mine job in 1906 to assume the office of Alaska's Territorial Governor (Roppel, 1972). Facilities built during the early years of operation included a corduroy road from Berners Bay to the "Lower Camp" mine up Johnson Creek, boarding house, bunkhouse, office, warehouse, and blacksmith shop (Brooks, 1916). Higher-elevation workings known as the "Upper Camp" were developed by Belgian investors in 1912 after several years of low or no production, involving construction of a wharf, tramway, bunkhouse, flume, pipeline, and new pump systems, and installation of the first semi-diesel generators in Alaska (Redman, 1991). Even higher than the Upper Camp was the 10-stamp Indiana mill (Mobley, 1988). But overall production was good only from 1915 to 1917, and soon after the Jualin Mill burned down. When the last gold was produced in 1928, the cumulative total production of 37,913 ounces of gold and 12,640 ounces of silver amounted to $791,754 worth of metal (Redman et al., 1991).

Quartz veins in the Jualin Diorite exposed on the Lynn Canal side of Lions Head were first explored in 1887 as the Bear Mine (Redman et al., 1991). The nearby Comet Mine saw significant development in 1892, and during the next 8 years construction of a 2.5-mile railroad, 6,000-foot tram line, and 40-stamp mill allowed production of 22,485 ounces of gold worth $444,057 (Redman et al., 1991). The Bear Mine was connected by tram to the Comet Mill in 1895, and in 1895 rich veins at a higher elevation, called the Kensington Mine, were connected by tram line to the top of the Bear Mine tram line (Redman et al., 1991). All three claims—the

Bear, Comet, and Kensington—were eventually consolidated into one mining property, but litigation, financing, and other difficulties resulted in little and sporadic development work after 1900.

3.17.4 History of Archaeological Investigations

Known historic sites (all associated with early mining history) are more common in the study vicinity than known traditional or prehistoric Native sites. Cultural resource studies in the 1980s and 1990s inventoried and evaluated some of the Kensington (here taken to include the Bear and Comet facilities) and Jualin mining features. Comet or Comet Landing (49JUN033), the shoreside facility containing the mill, wharf, railroad terminal, and an additional 11 structures, along with the old Kensington mill site (49JUN240) a couple miles away, were judged ineligible to be included in the National Register of Historic Places in 1983 (Gee, 1983b, 1983c). Subsequent cultural resource surveys of the old Kensington Mine facilities (Gilman, 1992; Hall, 1988, 1991b; Hall and Lobdell, 1991; Iwamoto, 1990, 1996; Philibert, 1990; Ream, 1987) have added information about new features, but only two additional AHRS numbers were assigned. The Kensington bunkhouse (49JUN721) and the Kensington generator shed (49JUN722) were both judged ineligible for the National Register in 1997. A coastal cultural resource inventory for judging the feasibility of the Juneau Access Road (Wessen et al., 1994) added a number of additional structures and features to the list of those recorded previously at the Comet Mine (Gee, 1983a; Hall, 1988). Wessen et al. (1994) also recorded the Point Sherman Light Station (49JUN087), judged ineligible for the National Register in 1995.

By 2003 the Kensington Mine had several AHRS numbers assigned during the course of several cultural resource studies, and all features evaluated were determined ineligible for the National Register. In contrast, the Jualin Mine had only one AHRS number and underwent fewer cultural resource investigations, and determination of eligibility was only partially completed. The AHRS number JUN-022 referred to the entire Jualin Mine complex: the wharf in Slate Cove, the 5-mile tram route from there to Johnson Creek, the Lower Camp, and the Upper Camp. A 1988 cultural resource survey for a new road across Forest Service and patented land to access the upper Jualin deposits recorded one culturally modified tree, the tramway, the pilings of the Slate Creek Cove wharf and a nearby oil tank foundation, building ruins and other features of the Upper Camp, the Indiana Mill above the Upper Camp, and part of a 1913–1919 road built by Frank Fremming to access separate claims (Mobley, 1988). A subsequent cultural resource inventory (Price, 1992) added few details, but Wessen et al. (1994) revisited some of the Jualin features and added site JUN-677—the “West Slate Bay Dock”—which the investigators surmised was associated with the Jualin wharf on the opposite side. They also recorded a hand-dug well and other domestic features (JUN-678) at the mouth of Johnson Creek, attributed to Gudman Jensen (Wessen et al., 1994). The dock in Slate Bay was judged ineligible for the National Register in 1995; the Johnson Creek well was not evaluated. Mobley (1988) suggested that the Jualin features (excluding the culturally modified tree and Fremming Road) be evaluated as parts of a contextual whole, in keeping with more recent approaches to historic mine evaluation in the Tongass National Forest (Bruder, 2002; Mobley, 2001).

Berners Bay has seen commercial hand-logging and some modern clear-cutting in the 20th century (Davis, 1985; Moss, 1981), as well as remote habitation (a cabin ruin at Echo Cove described by Wessen et al. [1994] has been designated JUN-672), but even some of these might be associated with the mining industry. The remains of a sawmill (JUN-675) at Sawmill Creek are likely those of the Knowell Mining and Milling Company (Moss, 1981; Wessen et al., 1994), which consolidated the Bear, Comet, and Kensington mines in the late 1890s (Redman et al., 1991). A shipway (JUN-676) and cabin (JUN-674) near Sawmill Creek are also likely associated with the sawmill (Wessen et al., 1994). All three sites were judged National Register-eligible in 1995.

3.17.5 Archaeological Inventory and Evaluation

In 2003 the Forest Service contracted Integrated Concepts and Research Corporation (ICRC) to conduct an archaeological inventory and evaluation of the area of potential effects for Coeur Alaska's proposed Kensington Gold Project. ICRC conducted the fieldwork in mid-August 2003 and assembled a Section 106 report. Using a combination of archival research, helicopter reconnaissance, and pedestrian survey with shovel-testing, ICRC inventoried numerous known and undocumented historic mining features on both the Jualin and Kensington sides of Lions Head Mountain. The result was a thorough reorganization of the site inventory into three mining systems, all of which are included in the larger Berners Bay Mining District (JUN-928) (see Table 3-41):

- The Jualin Mine District (JUN-022) containing four contributing properties—the wharf (JUN-929), Lower Camp (JUN-930), Upper Camp (JUN-931), and tram (JUN-932).
- The Comet/Bear/Kensington Mining District (JUN-945) containing eight properties—the Comet/Bear/Kensington millsite (JUN-240), Comet/Bear/Kensington railroad (JUN-946), Comet Mine (JUN-947), Comet Mine tram (JUN-948), Kensington Mine (JUN-949), Bear Mine (JUN-951), Bear-Kensington mines tram system (JUN-953), and Northern Belle Mine (JUN-971).
- The Ivanhoe/Horrible Mining District (JUN-954) containing three properties—the Mellen millsite (JUN-957), the Portland millsite (JUN-958), and the Lynn Canal Mining Company's Horrible Mine tram (JUN-961).

Despite the proximity of the Indiana Mine (JUN-933), it was not included as part of the Jualin Mine District because of questions about whether it had ever produced any gold. Another 17 small mines or prospects were identified as separate features and given separate AHRS numbers. By locating new mining features, breaking down the known mine systems into separate locales, and organizing many of the separate sites into three historic mining districts, ICRC's 2003 survey added 43 new AHRS sites to the inventory. ICRC also searched for the Slate Creek Cove Site (JUN-103) and, like researchers before, found little more than stumps and scarred trees. The site has been determined eligible, but the name has been changed from Slate Creek Village to Slate Creek Cove Site.

ICRC (2003) cited all four eligibility criteria, in various combinations, to suggest that many of the historic mining sites and all the mining districts in the project area are eligible for the National Register of Historic Places. Criterion A, requiring an "association with events that have made a significant contribution to the broad patterns of our history," is satisfied by the larger mines' major gold production in the early decades of the Juneau Gold Belt district. Criterion B, requiring "association with the lives of persons significant in our past," was brought to bear in the persons of local miner Bart Thane and then soon-to-be Territorial Governor Wilford B. Hoggatt, both of whom had financial and managerial involvement in some of the mines. Criterion C, requiring "embodiment of the distinctive characteristics of a type, period, or method of construction, or representation of the work of a master, or possession of high artistic values," was considered applicable to some features because they are typical of the standard mining systems of a century ago. Criterion D, for sites "having yielded, or having the ability to yield, information important in prehistory or history," was invoked for properties having the potential for archaeological investigation of historic mining systems. With each property's significance established, ICRC went on to judge each property's integrity according to the federally established criteria of location, design, setting, materials, workmanship, feeling, and association.

Properties judged eligible for the National Register in ICRC's (2003) evaluation are the Jualin Mine District and its 4 constituent properties, the Ivanhoe/Horrible Mining District and 3 of its 6 constituent properties, the Berners Bay Mining District, and the Comet/Bear/Kensington Mining District and 8 of its 14 constituent properties. Of the remaining individual properties, only the Indiana Mine is separately considered eligible for the National Register; all the others are judged ineligible.

3.18 NOISE

This section contains the criteria, terminology, background, and guidelines for noise effects associated with the Kensington Gold Project. Noise effects from the proposed project were assessed in the 1992 FEIS. Hart Crowser, Inc. (1997) conducted a noise impact study of the Kensington Mine area in February 1997. Since 1997 the project area has expanded to include Slate Creek Cove, East Fork Slate Creek, and the historic Jualin Mine site.

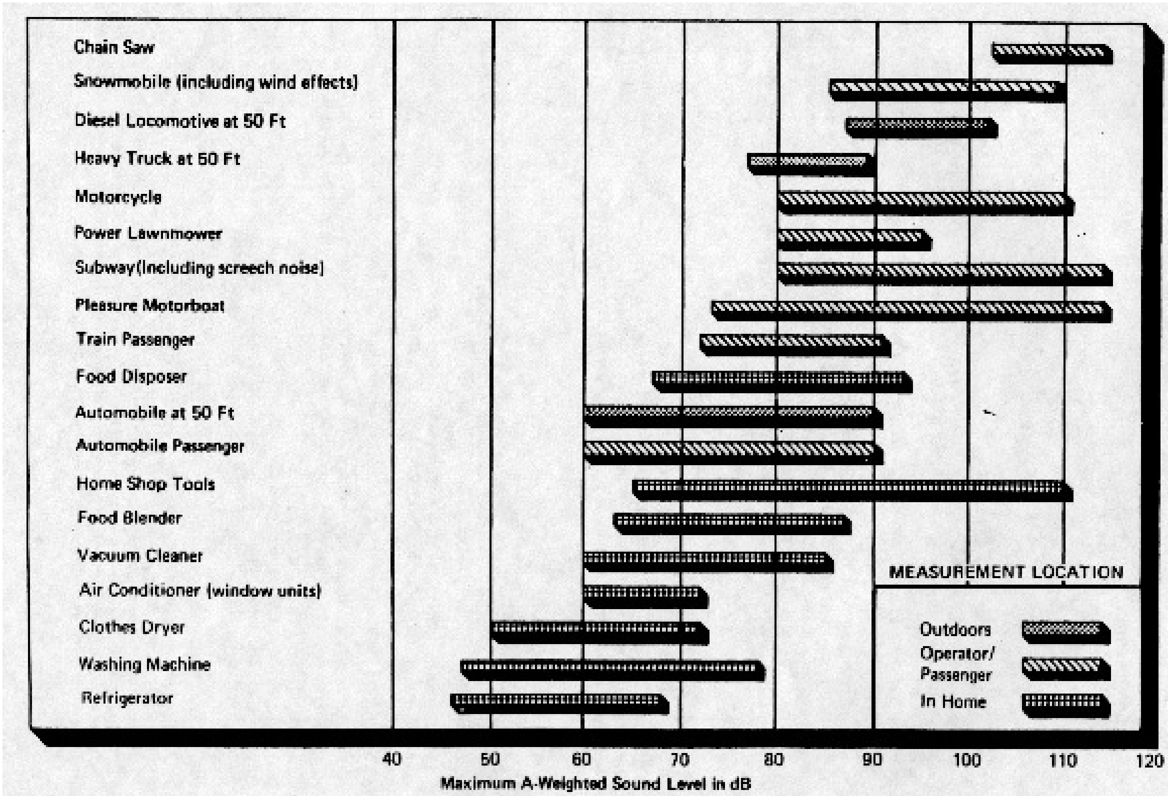
Noise is generally defined as unwanted sound. It can affect the human environment by interfering with speech, interfering with sleep, causing hearing loss, and causing physical or mental stress. Because a person's response to noise is subjective, the perception of noise varies from person to person.

Humans can detect and respond to a wide range of sound intensities and frequencies. One's ability to hear sound depends greatly on the frequency of the sound. To measure sound on a scale that approximates the way people hear, more weight must be given to the frequencies that people hear best. A logarithmic decibel (dB) scale is used to quantify sound intensities. The USEPA recommends using an "A-weighted" scale when analyzing noise impact levels. Figure 3-12 shows the range of noise levels expressed as "A-weighted decibels" (dBA) produced by various sources. A quiet whisper produces about 30 dBA of sound; normal conversation, approximately 47 dBA; and a chain saw, in excess of 117 dBA.

3.18.1 Terminology

Noise, traveling through an outdoor environment from a source to a receiver, decreases with increasing distance between the source and the receiver. Noise levels typically decrease by approximately 6 dBA with each doubling of distance, depending on the characteristics of the source and the conditions over the path the noise travels. In addition, noise levels from various sources are not additive; rather, noise levels at the receiver are related to the loudest noise from the various sources. Noise levels can be reduced if a solid barrier, such as a man-made wall, a building, or natural topography (e.g., stand of trees, forest, uneven topography), is located between the source and the receiver. Trees and open areas are expected to provide a degree of noise attenuation; conversely, calm water can sustain noise levels (Hart Crowser, 1997).

Environmental factors, such as wind, water, precipitation, and humidity, can affect noise levels at the source and at the receiver. Hart Crowser (1997) modeled natural noise attenuation by atmospheric absorption at a temperature of 27 °F and 81 percent relative humidity, the average December conditions in Juneau. This was assumed to be the worst-case scenario, resulting in atmospheric absorption of 1 to 2 dBA by the project area boundary. Increased humidity, above



Source: USEPA, 1979, cited in NPC, 2003.

FIGURE 3-12. TYPICAL RANGE OF COMMON SOUNDS

81 percent, increases atmospheric noise attenuation. Wind also significantly affects noise, both increasing and decreasing noise levels at the receiver, depending on the wind direction at the receiver.

Ambient noise in a given environment is the combination of all noise sources, including the sounds of interest. For environmental noise studies, ambient noise levels are typically described using A-weighted equivalent noise levels (L_{eq}) over a specified time period. The equivalent noise level is defined as the single steady-state noise level that has the same acoustic energy as the actual, time-varying noise signal during the same time period. The day-night average noise level (L_{dn}) is a single numeric descriptor that represents the constantly varying sound level during a continuous 24-hour period.

3.18.2 Background Noise Levels

Existing ambient noise levels at the Kensington Gold Project site are affected by the following sources (Hart Crowser, 1997):

- Natural background sounds from wind, rain, and flowing streams
- Overflights by commercial aircraft traveling between Juneau, Skagway, and Haines
- Lynn Canal marine traffic
- Existing operations and maintenance at the Kensington site

The 1992 FEIS reported that background noise measurements taken at the Quartz Hill Mine site near Ketchikan ranged from 32 dBA at an inland lake to 42 dBA along the shoreline (Forest Service, 1992). The Quartz Hill site's topography is similar to that of the Kensington site. The Forest Service (1992) recommends the following background levels for use in predictive noise modeling:

- Coniferous forest and no wind: 30 dBA
- Coniferous forest and moderate winds: 45 dBA
- Shoreline, calm sea and surf: 45 dBA
- Loud waterfall: 60 dBA

Based on these published noise levels, the assumed background values for the Kensington Gold Project site are as follows (Hart Crowser, 1997):

- Comet Beach: 45 dBA
- Facility boundary with coniferous forest (assuming prevailing light winds): 35 dBA
- Goat habitat along ridgetops (assuming moderate prevailing winds): 45 dBA

3.18.3 Guidelines and Standards

Federal

USEPA identified an outdoor noise standard to protect against effects on public health and well-being. Allowing a 5-dB margin of safety, the outdoor level should be L_{dn} = 55 dBA (NPC, 2003).

In addition, the Forest Service has established federal guidelines for noise increases in recreational areas above existing background levels (Table 3-42). Forest Service noise adjustments are based on the recreational classification of the affected area. The Forest Service did not intend that these recommended allowable noise increase values be interpreted as strict numerical limits. Instead, potential noise impacts in recreational areas are to be assessed case by case, accounting for factors such as noise duration and the time of day when the noise would occur.

Table 3-42
Recommended Maximum Noise Impacts in Recreational Areas

Recreational Site Classification	Recommended Allowable Noise Impact in dBA[a]
Primitive Area	1
Semi-Primitive Areas	
Trail Camps	5
Undeveloped Roadside Camps	10
Semi-Modern Areas	
Roadside Campgrounds	20
Highly Developed Campgrounds	40

[a] Recommended impact noise levels are for Forest Service-designated important receptor points within a given area.
Source: Forest Service, 1980.

The Mine Safety and Health Administration (MSHA) regulates worker exposure noise standards for sources originating from mining and ore-processing operations (Forest Service, 1992). The allowable MSHA noise standards are as follows:

- 8-hour exposure: 90 dBA
- 2-hour exposure: 100 dBA
- 15-minute exposure: 115 dBA

3.19 TRANSPORTATION

The following discussion provides a brief description on the modes of transportation employed within the general study area.

3.19.1 Juneau

As described in the 1992 FEIS and the 1997 SEIS, the CBJ is the only state capital not accessible by highway. The CBJ is served from the outside by both air and water. The Juneau International Airport and adjacent float plane lake provide support facilities for daily passenger and cargo jet services, as well as for several air taxi operators. The Alaska Marine Highway System provides scheduled ferry service between Juneau and Bellingham, Washington, as well as feeder service between Juneau and other southeastern ports. Alaska Marine Lines and Northland Service provide freight service between Juneau and Seattle. Alaska Marine Lines also provides scheduled passenger service between Juneau and Seattle and other communities in Southeast Alaska. Cruise ships also routinely stop at Juneau.

The Glacier Highway runs approximately 40 miles north from downtown Juneau, terminating at Echo Cove. The highway is maintained year-round through approximately mile 25.

3.19.2 Haines

Haines is one of the most accessible communities in Alaska. It has scheduled air and ferry service, as well as a road link to the Alaska Highway System. The Alaska Marine Highway System provides passenger and vehicle service to Haines approximately five times per week. Ferry schedules and capacity to Haines are more than adequate to meet the off-season demand. During the summer, however, vehicle space is frequently booked long in advance. Alaska Marine Lines and Northland Services provide routine delivery of general cargo. Cruise ships also frequently stop in Haines.

3.19.3 Lynn Canal

Lynn Canal is part of the Inside Passage route and is the primary shipping lane north out of Juneau. This canal is used for marine transportation in the region, including barge traffic, freight ships, fishing vessels, cruise ships, pleasure craft, and marine ferries. Comet Beach can be reached directly from Lynn Canal. Access to Slate Creek Cove from Lynn Canal would require traversing approximately 4 miles across the northwest portion of Berners Bay.

3.19.4 Berners Bay

Berners Bay is approximately 40 miles north of Juneau. Both Cascade Point and Echo Cove are in the southeast portion of Berners Bay. Echo Cove has a boat ramp and serves as a primary access point to Berners Bay.

The amount of recreational boat use in Berners Bay is difficult to quantify because data are generally limited to anecdotal information although some estimates are presented in Section 3.13.3 (Existing Recreation). Personal observations, comment letters, and persons contacted about recreational opportunities indicate use of the bay by sightseers, fishermen, hunters, campers, and bird-watchers. Kayaks, skiffs, airboats, and catamarans are among the types of watercraft that have been reported. A Forest Service crew, as part of their work activities, recorded observations of boat activities in Berners Bay during portions of 2003 and 2004 (Forest Service, 2004b). Kayaks and skiffs were the boats most frequently observed by the field crew, although large airboats and jet boats used for sightseeing were also seen. The number of boats and passengers observed during any one day ranged from no boats and no passengers to 10 boats and approximately 32 passengers. The Juneau Audubon Society also annually charters a catamaran to observe birds and wildlife during the eulachon run. Since 2002, commercial gillnet fishermen have operated in the bay for 3 to 4 days a week over a 4- to 6-week period from early September to mid-October.

3.20 SUBSISTENCE

Section 810 of the *Alaska National Interest Lands Conservation Act* (ANILCA) requires that federal agencies with jurisdiction over lands in Alaska evaluate the potential effects of proposed land-use activities on subsistence uses and needs. ANILCA defines subsistence uses as the "customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption such as food, shelter, fuel, clothing, tools; for transportation; for the making and selling of handicraft articles out of fish or wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade." ANILCA requires an assessment of Forest Service actions on subsistence activities.

Subsistence is important to rural Alaska residents for a number of reasons. Such residents may rely on subsistence to supplement or replace income derived from seasonal employment or to take advantage of renewable natural resources that are less expensive than store-purchased products. For some cultures, the harvest, use, and redistribution of subsistence resources is an integral part of cultures and social value systems. Residents of the CBJ are classified as non-rural, and therefore they do not qualify as subsistence users under ANILCA. Fishing by CBJ residents is considered a sport and a personal use activity regulated by ADF&G. Use of the area surrounding the Kensington Gold Project by non-CBJ residents could constitute subsistence use.

Marine and terrestrial habitats in Southeast Alaska support a variety of species that are considered important to subsistence. Marine subsistence species consist of marine mammals (primarily harbor seals), halibut, herring, eulachon, all five species of northwest salmon, shellfish, and crabs. Terrestrial species important to subsistence include black and brown bear, Sitka black-tailed deer, moose, mountain goat, and furbearers (Forest Service, 1992).

Community deer maps, available in the Forest Plan, depict current and traditional areas of use by many communities within Southeast Alaska (Forest Service, 1997b). The current data (1987 to 1994) are based on data collected by ADF&G based on wildlife assessment areas. The Kensington side of the project area falls within wildlife analysis area 2408. The Berners Bay drainage, including the Jualin side of the project area, is within wildlife analysis area 2409. The maps do not indicate any use of the project area for deer hunting by either subsistence communities or residents of the CBJ.

The 1992 FEIS indicated that the Kensington Gold Project did not occur within a region of prime subsistence activity, either in the past or at the time of its publication. There is nothing in the

Forest Plan or the planning record to indicate that conditions have changed since publication of the 1992 FEIS.

Section 4

Environmental Consequences

SECTION 4.0
ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This section presents the results of the analysis of potential impacts from the four alternatives considered in this Final SEIS. The discussions focus on how each alternative would affect each of the resources described in Section 3. The extent to which the different resources are discussed is based on the comments made during the scoping process and the significant issues identified during scoping. As discussed in the introduction to Chapter 3, the relationships and connectivity among the individual resources are difficult to quantify although their importance cannot be overlooked. The reader should keep in mind that although the following discussion presents impacts in terms of individual resources, the impacts on some resources, particularly in terms of habitat or food sources, could produce more wide-ranging effects. This section identifies these linkages to the extent practicable.

This section discusses the direct, indirect, and cumulative impacts, as well as irreversible and irretrievable commitment of resources, for each alternative. The direct and indirect impacts are addressed within the discussions of individual resources; cumulative effects are also described by resource, but in a separate section.

The discussions that follow are organized to present the impacts of each alternative on each resource without a great deal of redundancy where effects would be common to all or most alternatives. Therefore, each section briefly explains the important aspects of the individual resource, identifies the indicators used to compare alternatives, and discusses the potential impacts. The discussions of potential impacts are structured so that impacts common to all alternatives are presented first. In cases where impacts are common to Alternatives B, C, and D, the discussions of Alternatives A and A1 are presented first, followed by a discussion of impacts common to Alternatives B, C, and D, followed by a discussion of impacts unique to Alternatives B, C, and D.

4.2 AIR QUALITY

This section discusses the potential impacts of atmospheric emissions from the five project alternatives on air quality and visibility. The air pollutant sources and activities associated with each alternative are explained, and the expected air pollutant emission rates are examined. The potential environmental impacts caused by each alternative are discussed and compared with state and federal standards. The indicator for this resource is the amount of emissions.

4.2.1 Effects of Alternatives A and A1

The potential impacts from air pollutant emissions associated with Alternatives A and A1 are discussed for both construction activity and production activity.

Construction

The potential impacts on air quality during the construction phase of the project are expected to be low and mitigated in part by the frequent precipitation in the area. Emissions from construction operations would be short-term and limited to confined areas. Construction-related emissions would result from temporary use of diesel generators, slash burning, and fugitive dust from construction of the process area and dry tailings facility (DTF). Particulate emissions due to construction-related activities would not exceed 9 tons per year (TRC, 1990). The total disturbed surface area subject to wind erosion would be approximately 50 acres, and the period of exposure would be less than 1 year.

Operation

Total pollutant emissions during the operational phase of the Kensington Gold Project would be greater than those during construction. During operation, primary pollutant emission sources associated with Alternatives A and A1 would include the following:

- Mining sources (emissions from underground operations and ore handling and storage)
- Haul road (vehicle emissions and dust)
- DTF (dust from wind erosion)
- Power plant (emissions from diesel generators)
- Borrow pits and screening plant (vehicle emissions and dust from wind erosion)

Air quality impact analyses were completed to estimate air impacts from operation of the project's emission sources. Pollutant emission rates were computed using standard emission factors (TRC, 1990, 1995). Particulate emissions from the tailings facility were calculated based on the structures at maximum size.

Alternative A would use three 3.3-megawatt (MW) diesel generators. The total electricity load required is estimated at 68,400,000 kilowatts (kW) per hour per year (Coeur, 1995). Because the generators are diesel-powered, they would produce emissions. Potential pollutant emissions from stack-type sources, fugitive sources, and all sources (including the generators) were calculated for all alternatives and are shown in Table 4-1. Overall, fugitive emissions would be minimized by the wet climate; applications of water during dry periods; or chemical suppressants, if appropriate, as specified by the Alaska Department of Environmental Conservation (ADEC).

Table 4-1
Estimated Emissions for All Alternatives

	Alternatives A and A1[a]			Alternatives B and C			Alternative D		
Pollutant	**Stack Sources (tons/yr)**	**Fugitive Sources (tons/yr)**	**Total (tons/yr)**	**Stack Sources (tons/yr)**	**Fugitive Sources (tons/yr)**	**Total (tons/yr)**	**Stack Sources (tons/yr)**	**Fugitive Sources (tons/yr)**	**Total (tons/yr)**
Particulate matter less than 10 microns	29.8	50.4	80.2	29.3	43.6	72.9	29.8	43.6	73.4
Nitrogen oxides	244.8	358.9	603.7	243.4	365.5	608.9	247.2	365.5	612.7
Sulfur dioxide	156.1	35.2	191.3	103.1.1	36.2	139.3	104.9	36.2	141.1
Carbon monoxide	37.0	154.4	191.5	35.0	119.2	154.2	35.6	119.2	154.8
Volatile organic compounds	29.5	29.2	58.7	29.2	29.4	58.6	29.7	29.4	59.1
Lead	3.0E-6	3.0E-6	6.0E-6	1.00E-06	2.55E-06	3.55E-06	1.00E-06	2.55E-06	3.55E-06

[a] Exact loading not determined for Alternative A1 but assumed to be somewhat lower than that of Alternative A.

Criteria air pollutant emissions from equipment used for transporting personnel to and from the mine site were also estimated. Under Alternatives A and A1, personnel would be transported to the site by helicopter, followed by a short bus trip from the landing pad to the mine site. Personnel would be housed at the site for 1 week before being replaced. It is expected that 2 to 3 daily round-trip helicopter flights would be required (12 round trips per week), as well as 12 weekly round trips by bus from the heliport to the employee housing. Table 4-2 shows the estimated emissions expected from personnel site access operations for all alternatives.

Table 4-2
Estimated Personnel Access Emissions for All Alternatives

Pollutant	Helicopter, Crew Shuttle Boat, and Bus Emissions (tons/yr)	
	Alternatives A and A1	Alternatives B, C, and D
Particulate matter less than 10 microns	0.5	0.7
Nitrogen oxides	3.4	11.2
Sulfur dioxide	0.4	0.5
Carbon monoxide	1.0	4.1
Volatile organic compounds	0.1	1.0

Although modeling was not completed for Alternative A, a similar alternative was modeled as part of the Air Quality Permit Modification (TRC, 1995, 1996a), and the results were presented in the 1997 SEIS (Forest Service, 1997a). The difference in air emission sources between Alternative A and the modeled alternative is that the modeled alternative includes haul truck emissions for transporting tailings to the DTF, whereas in Alternative A tailings are transported by a pipeline. The modeled scenario also includes a generator at the DTF, which would not be required under Alternative A. Thus, the predicted pollutant emissions and resulting air concentrations for Alternative A would be similar to but less than those in the modeled scenario. Table 4-3 compares modeled concentrations and pollutant background values with federal and state ambient air quality standards. Table 4-4 compares modeled concentrations of nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) with Prevention of Significant Deterioration (PSD) Class II increment levels. The air quality dispersion modeling indicates that the ambient concentrations resulting from emissions from all alternatives would be below federal and state air quality standards and PSD increments.

Table 4-3
Comparison of Modeled Pollutant Concentrations With Ambient Air Quality Standards (including background)

Pollutant	Averaging Period	Maximum Estimated Concentration ($\mu g/m^3$)			USEPA/ADEC Air Quality Standard ($\mu g/m^3$)
		Alternatives A and A1	Alternatives B and C	Alternative D	
Nitrogen dioxide	Annual	20.8	24.3	24.8	100
Carbon monoxide	1-hour 8-hour	365.2 99.2	333.8 71.5	340.5 72.9	40,000 10,000
Particulate matter less than 10 microns	24-hour Annual	65.8 25.4	27.7 6.2	28.2 6.3	150 50
Sulfur dioxide	3-hour 24-hour Annual	325.8 115.2 4.93	146.2 47.8 12.6	149.1 48.1 12.8	1,300 365 80

Table 4-4
Comparison of Modeled Pollutant Concentrations With PSD Class II Increments

Pollutant	Averaging Period	Maximum Estimated Concentration ($\mu g/m^3$) Alternatives A and A1	Alternative B and C	Alternative D	PSD Increment ($\mu g/m^3$)
Nitrogen dioxide	Annual	16.8	21.3	21.7	25
Sulfur dioxide	3-hour	153.8	136.4	139.1	512
	24-hour	42.2	40.6	41.4	91
	Annual	4.9	10.0	10.2	20

Air pollutant emissions can impair visibility and obscure visually significant features and areas from recreational viewers. Tour ships using Lynn Canal have views of unbroken shorelines, backed by forested foothills and steep, rocky, and snow-capped peaks. The screening model VISCREEN was used to determine whether emissions of nitrogen dioxide and particulate matter from activities at the Kensington Gold Project would impair visibility from Lynn Canal.

VISCREEN is designed to calculate visual effects parameters for a plume as observed from a given vantage point. The calculated parameters are then compared to screening criteria. This model is a screening tool for estimating worst-case visual impacts on Class I areas. Examples of Class I areas include some designated national parks and wilderness areas. The nearest Class I area to the Kensington Gold Project is Denali National Park, which is approximately 550 miles to the northwest.

The Federal Land Manager's Air Quality-Related Values Work Group (FLAG), has identified screening criteria for determining whether a pollutant plume can be perceived compared against natural conditions. These screening criteria are a plume contrast greater than 0.05 (absolute value) and a change in the color difference index (Delta-E) greater than 2.0 (FLAG, 2000). These screening thresholds, discussed further below, were used to assess the potential visibility impairment from the Kensington Gold Project.

VISCREEN was used to show the visual effects of emissions from the operation on views of the shoreline from tour ships. The observer in the modeling scenario was placed in the center of Lynn Canal looking toward the shore and the Kensington site. Point emissions of nitrogen oxides and particulate matter were modeled using worst-case meteorological conditions.

Both Delta-E and plume contrast were used to determine whether the plume would be perceptible to the human eye. Delta-E is used to specify the perceived magnitude of color and brightness change between the plume and the background. A plume might also be visible if it contrasts with the sky or terrain. Visibility research has determined that the threshold for plume perceptibility is a Delta-E of 1.0 and a plume contrast of 0.02. VISCREEN used the FLAG screening criteria of Delta-E greater than 2.0 and a plume contrast greater than 0.05. The values given from the visibility screening performed for the Kensington site show that the plume would be barely perceptible and below the given screening limits.

The VISCREEN results show no significant deterioration of visual quality when looking from Lynn Canal toward the mine. Table 4-5 provides the maximum visual impacts and the corresponding FLAG Class I screening criteria. Using worst-case assumptions, the model predicted a slight visibility impact from the plume. The worst case for this model is a calm day with minimal heating from the sun.

Table 4-5
Maximum Visual Impacts

	Delta-E		Plume Contrast	
Background	Criterion	Plume	Criterion	Plume
Sky	2.00	1.44	0.05	-0.024
Terrain	2.00	1.07	0.05	0.022

As mentioned previously, the potential impacts that emissions would have on visual quality were not modeled for Alternative A but were analyzed for a similar scenario in the 1997 SEIS. Because the modeled scenario included more emission sources (trucks) than the scenario proposed under Alternative A, it was determined that the modeled version adequately represented a worst case for Alternative A.

The impacts from Alternative A1 would be very similar to those presented under Alternative A. The extent of disturbance as a source of fugitive dust would be similar at any given time under both alternatives. The lower production rate under Alternative A1 would result in lower emissions from crushing and grinding operations, but because emission controls would be in place under either alternative, the difference in the end would be minimal.

Point source emissions would be slightly less under Alternative A1 because less equipment would be operating at the DTF. Point source emissions from generators would be similar to those under Alternative A. The duration of impacts would be less given the shorter life span of Alternative A1.

4.2.2 Effects of Alternatives B, C, and D

Potential air quality impacts associated with Alternatives B, C, and D are similar. The primary differences between these alternatives and Alternative A that affect air quality are the location of the processing facilities, the location and type of tailings disposal facility, the size of the waste rock storage pile, the location of the ore-crushing operations, the number and location of generators, and the methods and location of site access. Each of these differences is discussed in this section. Construction activities and production operations are addressed.

Construction

An analysis of proposed operations at the Kensington site estimated that pollutant emissions during construction would be less than 9 tons of particulates per year (TRC, 1990). Considering the scale of the operations in the analysis, only a minor variance in emissions among the alternatives would be expected for construction activities. However, for Alternatives B, C, and D most of the construction emissions would originate in the Johnson Creek drainage, from Slate Creek Cove to the Jualin Mine 1,000-foot adit where the processing facilities would be located. Construction emissions for Alternative A would be primarily within the Sherman Creek drainage; construction of the process area would occur in the vicinity of the Kensington Mine 850-foot portal. Impacts from construction emissions would be short-term and localized. The exposure time during construction activities would be less than 1 year.

Diesel generators would be used as a temporary power supply during construction activities. Air pollution impacts from these temporary generators would be minimal.

Slash burning could be used during the construction phase, which would produce smoke emissions. The burning would be limited to the construction months and would be confined to small, controlled areas to ensure fire safety. Slash burning would have to comply with open burning regulations imposed by ADEC to reduce airborne pollutants (18 AAC 50.065).

Operation

Pollutant emissions and resulting air quality impacts during production for Alternatives B, C, and D would be similar to those for Alternative A, except for several differences that would primarily affect the location of the emissions. These differences are discussed below.

Location of Process Area Facilities. The process area would be built within the Johnson Creek drainage, near the Jualin Mine 1,000-foot adit. Under Alternatives A and A1, the facilities would be constructed within the Sherman Creek drainage. As discussed in Section 3, Affected Environment, the wind regimes within these two drainages are significantly different. The predominant wind flow in the Johnson Creek drainage is from the north through northeast. This wind regime would initially carry air pollutants southward from the process area and in the general direction of Berners Bay.

Tailings Impoundment. The subaqueous design of the tailings storage facility (TSF) would result in a reduction in fugitive dust emissions because no tailings would be exposed to wind erosion compared with the DTF. Air pollutant emissions from the TSF are expected to be insignificant.

Waste Rock Storage Pile. Proposed waste rock storage would include a 31.5-acre pile near the Kensington 850-foot portal, with an additional storage area of 4.8 acres available near the Jualin process area. The size of this storage area is more than two times the size of the waste rock storage pile under Alternatives A and A1. The increased size of this storage pile would result in increased fugitive dust emissions from wind erosion although still less than emissions from the DTF. Fugitive dust emissions would be minimized by the wet climate; application of water during dry periods; or chemical suppressants, if appropriate, as specified by ADEC.

Borrow Area. Existing sand and gravel quarries near the Jualin process area would be expanded and developed. The total area would be 7.2 acres, less than the 43 acres of borrow area associated with Alternatives A and A1. Fugitive dust emissions from the borrow area would be minimized by the wet climate; application of water during dry periods; or chemical suppressants, if appropriate, as specified by ADEC.

Ore-Crushing Operations. Ore-crushing operations would occur on the surface under Alternatives B, C, and D, rather than underground. It is estimated that roughly 30 percent of particulate emissions generated underground would be deposited within the mine rather than being released through the portal (TRC, 1991). Thus, particulate emissions would be expected to increase with surface crushing operations. Dust collection control devices are proposed for the crushing systems and would reduce particulate emissions.

Diesel Generators. Under Alternatives B, C, and D three diesel-powered reciprocating generators would be located at the process area, and smaller generators would be located at Comet Beach (one generator), Slate Creek Cove marine terminal (one generator), and the TSF (one backup generator). With reduced power needs, emissions from the generators would be lower than those in Alternatives A and A1, for which ADEC has approved the use of three 3.3-MW generators in the process area. Pollutant emissions from the generators would be controlled in accordance with State of Alaska permit requirements. It is expected that the 3.3-MW generators would be equipped with selective catalytic reduction (SCR) or another best control technology to reduce nitrogen oxide emissions.

Personnel Site Access. Air emissions from site access under Alternatives B, C, and D would occur from the crew shuttle boat transporting personnel from Cascade Point or Echo Cove to Slate Creek Cove and from bus transport from Juneau to Cascade Point/Echo Cove and from the marine terminal to the mine facilities. An estimated three to five crew shuttle round trips per day would be necessary (Earthworks, 2002a).

Air emissions from the crew shuttle must comply with federal emission standards. The pollutant emissions released would be dispersed quickly because the boat would move constantly during its run between Cascade Point or Echo Cove and Slate Creek Cove.

Both tailpipe and road dust emissions would be generated from personnel transport from the marine terminal to the mine facilities. Road dust emissions would be minimized by the wet climate. In addition, fugitive dust would be controlled by using water during dry periods or chemical suppressants, if appropriate, as specified by ADEC.

Criteria pollutant emissions were estimated for bus travel from Juneau to Cascade Point or Echo Cove, followed by the crew shuttle trip to Slate Creek Cove and then the bus ride to the mine site. Dust emissions from tires during travel from Slate Creek Cove to the mine site are expected to be minimal because of the wet climate and therefore were not calculated. Table 4-2 included the estimated emissions expected from site access for Alternatives B, C, and D.

Supply Deliveries. Barge deliveries would shift from Comet Beach to the marine terminal at Slate Creek Cove under Alternatives B, C, and D. It is expected that three to four barge deliveries would be required per week, with access through Berners Bay to the marine terminal. Air pollutant emissions from the tugboats as they are docked would be shifted from Comet Beach to Slate Creek Cove. Emissions from the tugboat engines must comply with federal emission standards.

Fugitive Emissions. The total surface disturbance associated with Alternatives B, C, and D would be less than that of Alternative A, reducing the potential for fugitive emissions.

Dispersion modeling was completed to estimate the impacts on air quality from emissions associated with Alternative B, the proposed action (TRC, 2003). The modeling was completed for particulate matter less than 10 microns (PM_{10}), NO_2, SO_2, and carbon monoxide (CO) using the USEPA Industrial Source Complex Short-Term 3 (ISCST3) model. Meteorological data used as input to the model included data collected from 1995 through 1998 at the Jualin Mine site and upper air data from Yakutat, Alaska. Modeled concentration values were calculated at receptor points along the mine's claim boundary at 750-foot intervals, and from the claim boundary out to 3 miles in all directions at 1,500-foot intervals. Table 4-3 compared modeled concentrations and pollutant background values with federal and state ambient air quality standards. Table 4-4 compared modeled concentrations of NO_2 and SO_2 with PSD Class II increment levels. The air quality dispersion modeling indicates that the ambient concentrations resulting from Alternative B emissions would be below federal and state air quality standards and PSD increments.

4.2.3 Effects of Alternative C (TSF Diversion)

A main difference between Alternative B and Alternative C that would affect air quality is the need for a dam on Upper Slate Lake to facilitate the flow of water through the diversion around the TSF. Construction air emissions would be slightly higher than those under Alternative B because of construction of the dam and diversion channels. Fugitive dust would be controlled with water during dry periods or with chemical suppressants, if appropriate, as specified by ADEC.

The tailings water recycling system, which would require power from a diesel generator, is not included in Alternative C. During operations, the total emissions under Alternative C, therefore, would be lower than those under Alternative B, and ambient concentrations would be below federal and state standards and PSD increments.

4.2.4 Effects of Alternative D (Modified TSF)

The main difference between Alternatives B and D that would affect air quality is the reverse osmosis system that would be used to treat the TSF effluent prior to discharge. This system would require approximately 2 percent greater power generation and produce a corresponding increase in air emissions for Alternative D. All predicted concentrations would still be lower than the applicable air quality standards and increments.

4.2.5 Summary

Tables 4-1 and 4-4 summarized the air quality emissions associated with all alternatives. Although there are slight difference among alternatives, the impacts are generally comparable and emissions under all alternatives comply with applicable air quality standards. Under Alternatives A and A1, the emissions plume from the generators could be slightly visible from Lynn Canal. No such plume-related impacts are expected under Alternatives B, C, and D because of the distance from Berners Bay users and the topography.

4.3 GEOLOGY AND GEOCHEMISTRY

This section discusses the potential impacts of the project alternatives on the geochemical behavior of ore, waste rock, and tailings produced during project operations. The differences among the alternatives related to geochemical issues involve the location and size of waste rock dumps, the method of tailings disposal, and the location of the tailings disposal facility.

4.3.1 Effects of Alternative A

Alternative A consists of the currently approved project (Forest Service, 1997a). Under this alternative, a minimum of 25 percent of the tailings produced would be used to backfill underground mine workings. Tailings not used as backfill would be dewatered and disposed of in the DTF located between Sweeny and Sherman creeks. All waste rock would be used for construction of the DTF. A temporary 15-acre waste rock storage area would be located outside the Kensington 850-foot portal in the Sherman Creek drainage to hold waste rock prior to its being hauled to the DTF.

Acid generation from the tailings would be unlikely, as indicated by the NP:AP ratio, which ranges from 83 to 166. This lack of acidification potential is partially attributed to the fact that sulfur, particularly sulfide, would partition to the flotation concentrate during processing. The flotation concentrate would subsequently be moved off-site. Column leach testing and analysis of tailings decant water indicate that leachate from the tailings would be of good quality with circum-neutral pH and low metal concentrations.

As discussed in Section 3, all waste rock sampled to date has high (> 3) NP:AP ratios, indicating that acid production would not occur due to placement of this material in a weathering environment. Data collected during meteoric water mobility test (MWMT), toxicity characteristic leaching procedure (TCLP), and synthetic precipitate leaching procedure (SPLP) testing of waste rock indicate that the potential for metals mobility is also very low. No adverse impacts on the environment have been observed in the vicinity of historical waste rock dumps. Therefore, environmental impacts due to weathering of waste rock in the temporary dump and use in DTF construction would be negligible.

As discussed in Sections 3.3.1 and 3.3.2, the ore body is also not expected to be acid-generating and there has been no evidence of acid generation in the mine water data collected to date. Some metals could be observed in the mine drainage, particularly during full-scale mining activities, but the discharge would be treated to ensure compliance with water quality-based National Pollutant Discharge Elimination System (NDPES) permit limits. Meeting these limits has not been a concern over the past 5 years. Previous data show that upon cessation of active mining, the mine water would become neutral and metals levels would be below permit limits without treatment (see Section 4.6).

4.3.2 Effects of Alternative A1

Alternative A1 would produce a minimal amount of waste rock, all of which would be used in DTF construction. As noted under Alternative A, the waste rock would not produce acid and would have low metals mobility. As a result, there would be no geochemical impacts from its use in DTF construction.

4.3.3 Effects Common to Alternatives B, C, and D

From a geological and geochemical perspective, Alternatives B, C, and D are similar to Alternative A. The main differences are the elimination of the DTF in favor of a subaqueous TSF located in Lower Slate Lake and the development of a tunnel between the Kensington and Jualin portions of the project area (Coeur, 2001). Elimination of the DTF would necessitate the creation of permanent waste rock dumps. A 31.5-acre waste rock dump would be located near the Kensington mine portal in the Sherman Creek drainage, and a 4.8-acre dump would be located near the Jualin access tunnel in the Johnson Creek drainage.

The potential for acidification and metal release from tailings in the TSF would be low. Although a higher-grade ore would be mined under Alternatives B, C, and D, the residual sulfur content would generally be below levels expected to produce acid. In addition, because the tailings would be submerged, it is possible that the magnitude of impacts predicted by laboratory tests that were open to the atmosphere (applicable to Alternatives A and A1) would be reduced because the tailings would be isolated from an oxidizing, weathering environment. Appendix A includes a detailed discussion of acid generation potential for Alternatives B, C, and D.

The geochemical behavior of the waste rock placed in each dump is expected to be the same as that discussed for Alternative A. One dump might contain a higher percentage of waste rock removed close to the ore body compared to the other dump; therefore, one dump could have a greater net sulfide content than the other. However, because of the overall low sulfide content and neutralizing character observed during acid-base accounting testing of waste rock, this potential difference is not expected to result in environmental impacts.

4.3.4 Summary

No geochemical impacts are predicted under any of the alternatives because there is no potential for generation of acid drainage from the waste rock or tailings and metals mobility is very limited. See Section 4.6 for further discussion of effects on surface water quality.

4.4 GEOTECHNICAL STABILITY

Two aspects of geotechnical stability associated with the alternatives under consideration in this Final SEIS are of potential concern. First, the failure of one of the project facilities (e.g., DTF, TSF, or access roads) would have negative effects on other resources in the immediate vicinity and potentially downstream. The second geotechnical aspect concerns avalanches, mass wasting, and rockslides and their potential to damage project components and, secondarily, to cause impacts on other resources.

The potential for the geotechnical failure of any of the tailings disposal facilities is extremely low. The operator would need to obtain additional information prior to completing the design of the DTF or TSF. Such information would include detailed foundation investigations, stability analyses, and seepage analyses. The final design is ultimately subject to review and approval by the State Dam Safety Engineer pursuant to the requirements of 11 AAC 93.150–93.201. Safety requirements for the design reflect the level of potential local seismic activity. Therefore, facilities would be designed to withstand the likely maximum seismic event. The construction of the DTF or TSF would require regular inspection and documentation to ensure that the design criteria are carried through the construction process. In the unlikely event of a failure of one of these facilities, the failure would likely occur in the form of slumping of the structure rather than as a catastrophic failure that would result in the release of tailings from either facility. Since long-term financial assurance would be required in each case, such a failure could be addressed as needed at some point in the future.

Avalanche, mass wasting, and rockslide hazards can be overcome by locating facilities out of the likely pathways of such occurrences and properly designing structures and foundations. The terrain surrounding the process area under all alternatives is relatively steep, and some project components could be exposed to these hazards. The following sections provide additional detail specific to each alternative.

4.4.1 Effects of Alternative A

Avalanche Hazard

Portions of the proposed facilities at the Kensington process area, including stormwater diversion ditches and the mine portal, would be subject to moderate to high risk of avalanche exposure. The operator has committed to having equipment available to remove debris from an avalanche, should one occur, and other measures to mitigate this risk. Further detail is provided in the 1997 SEIS.

Tailings Disposal

During preparation of the 1997 SEIS, a worst-case failure scenario that entailed the potential release of tailings to Sherman and Sweeny creeks and Lynn Canal was identified. Potential impacts of such a scenario vary depending on the location and extent of a failure; however, possible impacts include tailings loading in these creeks and in Lynn Canal, associated damage to these ecosystems, and loss of riparian habitat. The operator has committed to stringent operational and monitoring protocols that would diminish the likelihood of a catastrophic failure of the DTF; furthermore, a stabilizing earthen berm would be installed around the lower perimeter of the DTF. The installation of the berm would mitigate any stability concerns and minimize potential for failure of the DTF.

Subsidence

Subsidence is a phenomenon that is associated with the collapse of underground mine workings. It ultimately manifests itself at the ground surface through broad-based settlement or more dramatic collapse features. Surface effects associated with Alternative A are not expected for a number of reasons. First, the uppermost areas in the mine are nearest to the ground surface, and they are more than 140 feet below the surface as shown in Figure 2-13. In addition, because the proposed mine extends through a narrow-vein ore body, most of the mine workings are much deeper below the ground surface. Furthermore, the rock is considered "good" to "very good" quality, meaning that it has high strength, is not extensively fractured or weathered, and is likely to remain intact in and around the mine workings. Under Alternative A, at least 25 percent of the tailings would be backfilled, further reducing the likelihood of subsidence.

4.4.2 Effects of Alternatives A1, B, C, and D

The potential for subsidence-related effects would be even lower than that under Alternative A because of the reduced extent of the mine workings throughout the mine, as well as the proposed backfilling with 40 percent of the tailings.

4.4.3 Effects of Alternative A1

The avalanche hazard under Alternative A1 would be the same as that described for Alternative A. The probability of failure of the DTF would also be the same as that under Alternative A although the extent of the impact could be less, depending on the size and nature of the failure.

4.4.4 Effects Common to Alternatives B, C, and D

The Jualin side of the property has terrain subject to avalanche danger, much the same as the Kensington side of the property, which was documented in the 1997 SEIS. For Alternatives B, C, and D, the primary risk of avalanche damage is associated with the tailings delivery pipeline, which could endanger project components and result in environmental impacts. The pipeline crosses Snowslide Gulch, a known avalanche chute. The occurrence of a significant avalanche at this location could rupture the tailings pipeline and result in a release of tailings, which could enter Johnson Creek and, subsequently, Berners Bay. The operator has, however, designed the pipeline to be buried through this reach and would install a check dam upstream of the pipeline alignment to further help mitigate avalanche risk.

Based on available data, the proposed tailings dam site should be geotechnically stable with relatively shallow slate bedrock. The bedding plane orientation, which is steeply dipping and perpendicular to the dam axis, indicates the need for foundation grouting to alleviate seepage. Muskeg deposits would be removed from the footprint of the dam to avoid differential settlement. Muskeg soils would be stored in stockpiles along with topsoil for future use in reclamation.

The design of the dam would be reviewed and approved by the State of Alaska under its dam safety program. If the dam was constructed, a note of financial commitment would need to be in place to ensure that maintenance would be continued in perpetuity.

4.4.5 Effects of Alternative C

Alternative C includes the installation of diversion ditches and a flow-routing structure to reduce runoff inflows into the TSF during operations. The ditches would be installed along the entire north, extreme northwest, and entire east sides of Lower Slate Lake, causing additional disturbance. The flow-routing structure would be a temporary dam installed at the outlet of Upper Slate Lake that hydraulically connects the northwest and east diversions, allowing the runoff to bypass the TSF.

The presence of a second dam (in comparison to Alternative B) to provide diversion capability results in a finite increase in risk of a dam failure. However, failure of the diversion dam would not result in an imminent threat to the stability of the tailings dam. Foundation conditions for the diversion dam have not been specifically investigated, but it is expected that the conditions are similar to those of the tailings dam foundation. The diversion channels would not be vulnerable to avalanches but would have a potential for failure due to blockage or overtopping. Any releases associated with such failures would be contained within the TSF and would not cause additional impacts.

4.4.6 Effects of Alternative D

Alternative D would be similar to Alternative C in that a diversion would carry the flow from Mid-Lake East Fork Slate Creek around the TSF. The diversion would consist of a 20-inch pipeline and a small dam on Mid-Lake East Fork Slate Creek to direct the water from the creek into the pipeline. The dam would be designed to pass flows in the creek exceeding the design criteria. Overflows from the dam would collect in the TSF. The dam on Mid-Lake East Fork Slate Creek would be small enough that it would not present a geotechnical concern. The pipeline would need to be maintained to prevent blockages but again would not be large enough to be a geotechnical concern and would not be vulnerable to damage from avalanches.

4.4.7 Summary

Under all alternatives, there is minimal risk of geotechnical failure associated with tailings disposal. The berm constructed around the DTF under Alternatives A and A1 would prevent failure, and the TSF under Alternatives B, C, and D would be constructed to meet the State of Alaska's dam safety requirements. The operator would be required to monitor stability both during operations and after closure. Although the mine workings are more extensive under Alternative A than under the other alternatives, there is no potential for surface impacts due to subsidence because of the rock stability and the depth to the workings (as well as the backfill under all alternatives).

Avalanches, mass wasting, and rock slides would have the potential to affect individual components under any of the alternatives. Under Alternatives A and A1, the adit and storm water diversions could be subject to avalanche hazards. However, these facilities could be cleaned up following an event and environmental impacts would not be expected. Under Alternatives B, C, and D, the Amended Plan of Operations calls for burying the tailings pipeline to mitigate any potential avalanche threat. Therefore, impacts on the environment from issues related to geotechnical stability are not expected.

4.5 SURFACE WATER HYDROLOGY

This section describes impacts on surface water hydrology that might occur from implementing the Proposed Action and alternatives. Water quality impacts are described in Section 4.6, Surface Water Quality. The primary indicator for surface water hydrology is a change in stream flow regime or location of stream segments resulting from mine-related activities. The integrity of stream habitat is discussed in Section 4.9, Aquatic Resources: Freshwater.

As described in the Surface Water Hydrology part of Section 3, watersheds potentially affected by the Proposed Action and alternatives include Johnson Creek, Slate Creek, and Sherman Creek. Included in the Sherman Creek watershed discussion is a small "terrace area" watershed that would contain the DTF associated with Alternatives A and A1. Alternatives B, C, and D would affect Johnson and Slate creeks, as well as Sherman Creek. Overall, all alternatives would physically disturb only a small portion of the total area within each watershed. Relative land disturbance is summarized in Table 4-6.

Table 4-6
Land Disturbance by Watershed for All Alternatives

Disturbance (in acres)	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Total surface disturbance	268.6	187.1	195.5	215.5	197.4
Percent of total watershed acreage disturbed[a]	3.0%	2.1%	2.2%	2.4%	2.2%

[a]The total watershed acreage (8,891 acres) represents the combined drainage areas of the Sherman Creek watershed (2,681 acres), Slate Creek watershed (2,600 acres), and Johnson Creek watershed (3,610 acres).

Some impacts described in this section would occur only during the period of mining and processing because most mine-related facilities would be removed and reclaimed at the end of the mining and processing period. The TSF would not be removed, but it would be reclaimed to approach the biological conditions that existed before tailings were deposited.

4.5.1 Effects of Alternative A

Alternative A would result in mine-related disturbances confined to the Sherman Creek watershed and the adjacent terrace area watershed, which would contain the DTF. These drainages flow westward to the marine waters in Lynn Canal. The following list describes mine-related facilities by watershed under Alternative A:

- ***Sherman Creek watershed.*** Kensington Mine adits and underground workings, process and office area, slurry pipeline and haul road from the mill to the DTF, Kensington access road, settling/treatment ponds near the process area, temporary 15-acre waste rock storage pile near the process area, Ophir Creek diversion around the process area, one replaced bridge over South Fork Sherman Creek, two new bridges over Upper Sherman Creek, new bridge over Ivanhoe Creek, sand/gravel quarries and till borrow site near the process area, infiltration gallery in Upper Sherman Creek, and mine water discharged to Sherman Creek.
- ***Terrace area watershed.*** The DTF, diversion above the DTF, water pump-back system to mill, and runoff and seepage from the DTF collected in a settling pond and discharged to Camp Creek.

Under Alternative A, the infiltration gallery would remove about 0.52 cubic feet per second (cfs) from Upper Sherman Creek for purposes of mine makeup water and domestic needs. This water would come from alluvium adjacent to the creek; however, it is surmised that this shallow groundwater is directly connected to surface flow in the creek.

The water withdrawals are permitted under water rights issued by the State of Alaska. These water rights include provisions for maintaining minimum instream flows that are protective of beneficial uses. Table 4-7 describes the minimum instream flow requirements for Sherman Creek to be measured at a gauging station downstream of the infiltration gallery and upstream of outfall 001 under all alternatives.

Table 4-7
Minimum Instream Flow Requirements
for Upper Sherman Creek (Alternative A)

Time Period	Minimum Flow (cfs)
December–February	2
March	3
April–September 15	4
September 16–November 15	5
November 15–November 30	3

As discussed by SAIC (1997), measured stream flows in Upper Sherman Creek have ranged from 1.1 cfs to 32.7 cfs. When the operator could not obtain flows from Upper Sherman Creek because they were below minimum levels, the water supply would be supplemented by mine water.

Dewatering of underground mine workings might reduce flow in the very upper reaches of streams in the Sherman Creek watershed (see Figure 2-14). The interconnection of bedrock groundwater with surface water is not well known. The lack of springs in this area, however, suggests that groundwater is not a major source of recharge to local streams. The settling ponds, sand/gravel quarries, and till borrow area might temporarily reduce minor surface flow to the Upper Sherman Creek watershed; however, these depressions would later be reclaimed to allow runoff to flow through.

Treated mine water and runoff diverted from around the process area would be discharged to Sherman Creek. An initial rate of about 4.0 cfs is estimated from groundwater flow into the production-scale underground mine workings, most of which would be discharged into the Sherman Creek watershed. This rate, however, is expected to reach a lower steady-state rate of about 1.0 cfs after the first year or two of mining, by which time groundwater held in fracture storage would have drained. Flow measurements of water draining from the settling ponds during the period 1987 to 1995 ranged from 0.16 to 1.71 cfs, with a mean of 0.85 cfs (Forest Service, 1997a).

Surface water runoff diverted around the process area and the DTF would move the location of ephemeral surface flow in these areas. A portion of Ophir Creek would be diverted to Ivanhoe Creek, which would result in the temporary loss of natural flow in about 0.5 mile of the Ophir Creek channel. These diversions are not expected to significantly affect flow regimes in the Sherman Creek and terrace area watersheds. New or reconstructed bridges over several stream channels in the Sherman Creek watershed would have no adverse effect on surface water flow conditions.

4.5.2 Effects of Alternative A1

Alternative A1 would require the same water withdrawal from Upper Sherman Creek as that proposed under Alterative A. ADNR would again permit water withdrawals and require that the operator maintain minimum instream flows downstream of the infiltration gallery. The withdrawals would occur for 10 years instead of the 12 years under Alternative A. Similarly, the steady-state mine water discharge would be reduced by an unspecified volume from the 1.0-cfs flow predicted for Alternative A.

Under Alternative A1, there could be reduced mine water generation because of the lower production rate. This volume has not been determined; however, as noted above for Alternative A, groundwater does not appear to be a major source of recharge to local streams. The smaller borrow areas would proportionately lessen the minor impacts on surface flow, and the reduced tailings disposal requirements would reduce required diversion of ephemeral drainage flows around the DTF.

4.5.3 Effects Common to Alternatives B, C, and D

Under Alternatives B, C, and D the process area would be located at the Jualin Mine area in the Johnson Creek watershed and the TSF in Lower Slate Lake. Johnson and Slate creeks flow southward to marine waters at Berners Bay. These alternatives would still result in some mine-related activities in the Sherman Creek watershed. The following is a list of mine-related facilities by watershed for Alternatives B, C, and D:

- ***Sherman Creek watershed.*** Kensington Mine adits and underground workings, treated mine water discharge to Upper Sherman Creek, waste rock pile, settling/treatment ponds near mine adits, and existing Kensington access road.
- ***Johnson Creek watershed.*** Jualin Mine adit and tunnel, upgraded Jualin access road, infiltration gallery in Johnson Creek, process and office area, waste rock storage pile near process area, two existing sand/gravel quarries (expansion) and two new quarries, and diversion channel above Jualin Mine adit and process area.
- ***Slate Creek watershed.*** The TSF, including a dam at the lake outlet area, slurry pipeline, access road, and discharge from the TSF to East Fork Slate Creek.

One hydrologic impact on the Sherman Creek watershed from Alternatives B, C, and D would be the initial addition of approximately 4.0 cfs of flow from the treated mine water discharge. Over the long term, the steady-state discharge would decrease to about 1 cfs. This discharge would be the same as the mine water discharge described for Alternative A.

The infiltration gallery in the middle reach of Johnson Creek would result in removal of about 0.3 cfs of water under Alternatives B and D and about 0.52 cfs under Alternative C for purposes of mine operations (makeup water) and domestic needs. This water is connected with surface flows within the creek. The ADNR would permit water withdrawal for beneficial uses, and minimum instream flows would need to be maintained. Table 4-8 describes the minimum instream flow recommendations for Johnson and East Fork Slate creeks to be measured at gauging stations downstream of the infiltration gallery in Johnson Creek and the TSF in East Fork Slate Creek. The minimum instream flow requirements will be established by the state before the plan of operations is finalized.

Table 4-8
Proposed Minimum Instream Flow Requirements for
Johnson and East Fork Slate Creeks (Alternatives B, C, and D)

Time Period	Minimum Flow (cfs)	
	Johnson Creek	East Fork Slate Creek
January	6.3	2.7
February–March	3.0	3.5
April	3.5	1.9
May–August	14.1	2.2
September–October	23.4	5.7
November–December	6.3	2.7

Note: The instream flow requirements for East Fork Slate Creek below the TSF would be either the above values (when finalized by the state) or the corresponding inflow to the TSF, whichever is less.
Source: ADNR, 2003.

Table 3-9 shows that flow measurements in Johnson Creek during 2000–2001 were consistently well above the minimum instream flow requirements although the amount of long-term data is limited. If water withdrawals needed to be limited to meet instream flow requirements, the operator would use mine water for the makeup water supply. Under Alternatives B and D, this source could be supplemented by the tailings water reclamation system.

Dewatering of underground mine workings could reduce flow in the middle reach of Johnson Creek. However, there is no evidence that groundwater is a major source of recharge to surface water flow.

A 0.5-mile-long channel would be constructed around the Jualin Mine adit and process area bench in the Johnson Creek drainage. This channel would collect runoff from undisturbed areas and discharge to Johnson Creek below the process area. This would cause temporary rerouting of runoff within the same watershed but would not affect downstream flows. Any runoff from inside the process area would be directed to collection sumps and pumped into the mill circuit during operations and thus would result in a slight reduction of overland flow into Johnson Creek during operations.

The pipeline access road could cause an increase in surface water runoff because of a lessened capability for infiltration of precipitation along the corridor. This increase in runoff would be minor given the relatively small area of road surface within the affected watersheds containing Johnson Creek, East Fork Slate Creek, and Spectacle Lake.

The upgrades of the 5-mile access road and two existing bridges over Johnson Creek would require some instream work. These upgrades would be completed according to the requirements of ADNR Title 41 permits, thereby ensuring that no impacts on surface water hydrology would occur.

4.5.4 Effects of Alternative B

The Amended Plan of Operations states that the TSF would be operated such that discharges from the facility would be similar to the natural stream flow and meet the minimum flow requirement. As discussed in Section 4.6.5, however, lake water quality modeling shows that NPDES limits would not always be met. As a result, without additional treatment of the TSF discharge, there could be periods when the facility would have to cease discharging, resulting in no flow downstream in East Fork Slate Creek.

The increase in size of Lower Slate Lake from 20 acres to a maximum of 56 acres during the period of tailings disposal would result in a minor additional loss of surface water to evaporation.

Alternative B includes a recycling pipeline to return water from the TSF to the mill circuit. The pipeline would be adjacent to the slurry pipeline, within the disturbance footprint of the pipeline access road. The pipeline is not expected to affect surface water hydrology.

4.5.5 Effects of Alternative C

A 1.2-mile-long diversion channel constructed around the TSF would keep overland flows and flow in Mid-Lake East Fork Slate Creek from entering the impoundment under Alternative C. The diversion system around the TSF would include a dam at the Upper Slate Lake outlet area to allow adequate head for flow within the diversion channel. The diversion would temporarily change the location of surface water flow from the natural Mid-Lake East Fork Slate Creek channel between the two lakes to a man-made diversion channel around the TSF. Therefore, an estimated 95 percent of the flow in Mid-Lake East Fork Slate Creek would be captured in the diversion during the period of tailings disposal. The surface water flow in East Fork Slate Creek below the diversion channel would not be expected to change because the diversion would maintain the discharge of natural flow rates. This assumes minimal seepage losses of surface water from the diversion channel to the subsurface. Inputs to the TSF would come from only a small portion of undiverted overland flows, precipitation falling on the TSF itself, and the process water component of the tailings slurry.

For this alternative, water in the TSF would be discharged only when it met NPDES permit limits. The volume of discharge would be less than or equal to net precipitation in the catchment area for the TSF (inside the diversion). Net precipitation is the total precipitation minus evaporation over a given period of time (typically 1 month). Regardless of whether discharges were occurring, downstream flows would not be affected because of the diversion.

Under Alternative C, the surface area of Upper Slate Lake would almost double because of the construction and operation of the diversion dam. These increased evaporative losses, however, would be minor compared to the volume of water lost to evaporation throughout the watershed.

4.5.6 Effects of Alternative D

Under Alternative D, natural surface flow in East Fork Slate Creek would not be affected because Mid-Lake East Fork Slate Creek would gravity flow via the diversion pipeline around the TSF. In addition, the treated effluent from the TSF would always meet NPDES permit limits and could be discharged continuously to the diversion pipeline.

Under Alternative D, the coffer dam feeding the diversion would be constructed in Mid-Lake East Fork Slate Creek rather than at the outlet from Upper Slate Lake. Alternative D, therefore, would not affect the hydrology of Upper Slate Lake.

4.5.7 Summary

Table 4-9 summarizes the impacts of each alternative on surface water hydrology. Under all alternatives, impacts associated with water withdrawals would be limited by state permit requirements to maintain minimum instream flows. Under Alternative B, the operator might not be able to meet these requirements because the discharge is not projected to comply at all times with the effluent limitations in the NPDES permit. This is not a concern under Alternatives C and D because under those alternatives the diversions would provide sufficient, unaffected flow downstream of the TSF.

Table 4-9
Summary of Impacts on Surface Water Hydrology for All Alternatives

Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Water withdrawals	0.52 cfs from infiltration gallery in upper Sherman Creek.	Same as Alternative A.	0.3 cfs from infiltration gallery in Johnson Creek (demand slightly reduced because of recycling).	0.52 cfs from infiltration gallery in Johnson Creek.	Same as Alternative B.
Diversions	Four diversions totaling 2.3 miles. Only Ophir Creek diversion directly affects stream flow. All diversions except around DTF removed at closure. Potential impact on Ivanhoe Creek because of increased flows from Ophir Creek diversion.	Same as Alternative A with smaller diversion around the smaller DTF.	One 1,500-foot diversion above the waste rock disposal/850-foot adit area on the Kensington side and 2,500-foot diversion around the process area on the Jualin side. 0.75 mile total diversions.	Same as Alternative B plus two 2,550-foot diversions constructed around the northern and eastern portions of the TSF. 1.75 miles total diversions.	Same as Alternative B, plus a 2,500-foot pipeline diversion constructed around TSF. 1.25 miles total diversions
Stream flow	Potential impact on instream flows during critical flow period in Sherman Creek between withdrawal and discharge point. Limited by state requirements for maintaining instream flows necessary to maintain fish habitat. Mine drainage would provide alternative water supply. Discharge of mine drainage to Sherman Creek would increase average stream flow 1.3 cfs.	Same as Alternative A.	Potential impact on instream flows in Johnson Creek drainage from the infiltration gallery (water supply). Limited by state requirements for maintaining instream flows necessary to maintain fish habitat. Potential elimination of flow in lower East Fork Slate Creek if discharge not allowed under NPDES permit. Discharge of mine drainage to Sherman Creek would increase average stream flow 1.3 cfs.	Same as Alternative B, except no TSF impacts because diversions maintain flow in lower East Fork Slate Creek. Mid-Lake East Fork Slate Creek flow eliminated and Upper Slate Lake increased to 20 acres.	Same as Alternative B, except no flow impacts associated with TSF because treatment system ensures compliance with NPDES permit limits.

4.6 SURFACE WATER QUALITY

This section describes impacts on surface water quality that might occur from implementing any of the alternatives. The primary indicator for surface water quality is a change in the chemical characteristics of stream segments resulting from mine-related activities. Sediment/turbidity is also included as a key water quality indicator parameter.

Mine-related activities that could affect surface water quality include mine drainage and discharge; tailings disposal; runoff from waste rock storage piles; accidental spills of chemicals, fuel, or tailings; construction and operation of roads and diversion channels; and development of quarries for gravel, sand, and till. Many of the impacts described in this section would occur only during the period of mining and processing. During and after reclamation, most structures would be removed or reclaimed such that natural conditions for surface water quality are restored.

As described in the Surface Water Hydrology section in Section 3, watersheds potentially affected by the Proposed Action and alternatives include the Johnson Creek, Slate Creek, and Sherman Creek watersheds. Included with the Sherman Creek watershed discussion is the small terrace area watershed that would contain the DTF associated with Alternatives A and A1. Alternatives B, C, and D would affect Johnson and Slate creeks, as well as Sherman Creek.

4.6.1 Effects Common to All Alternatives

Treated Mine Water Effluent

Treated mine water would be routed through a pipe and discharged into a sediment pond designed to control runoff from the process area (under Alternatives A and A1 only) and the waste rock piles (all alternatives). The flow rate from the sediment pond would vary depending on the volume of the discharge from various storm events and the quantity of the discharge from the mine water treatment plant. The rate of discharge from the treatment plant would vary with the mine dewatering rate, which is estimated to range between 600 and 1,000 gallons per minute (SRK, 1996d).

The mine water discharge would likely be lower (by an unspecified volume) under Alternative A1 than under Alternative A because of the reduced production rate and lower than under Alternatives B, C, and D because there would be no Jualin access tunnel.

Mine water would be discharged to Sherman Creek through the existing NPDES-permitted outfall 001. Impacts on Sherman Creek are not expected as a result of the discharge of treated mine water. Table 4-10 provides a summary of the projected discharge characteristics and water quality-based NPDES permit limits for freshwater discharges from the process area pond. These limits are modified from the limits in the 1997 SEIS, primarily reflecting the State of Alaska's revisions to the state water quality standards. The water quality standards for several metals are based on hardness because the toxicity of the metal to aquatic life depends on the hardness of the water. The current NPDES permit provides for "tiered" discharge limits, thereby allowing the operator to determine the applicable limits based on the instream hardness downstream from the discharge at the time of sampling. This approach is expected to be retained in the reissued NPDES permit. There is no evidence to suggest that variability in hardness itself could affect aquatic life. The untreated mine water quality is based on long-term data from monitoring station 101 collected before 1997. These data were used in the water quality analysis for the 1997 SEIS and reflect several periods of extensive exploration and initial development activities in the mine. Appendix A provides a detailed discussion on how projected NPDES permit limits were determined for the mine water discharge.

As indicated in Table 4-9, the treatment plant could be operated to achieve compliance with all indicated discharge limits. The treatment technology proposed (precipitation and settling followed by filtration) would remove virtually all metals present as insoluble species. Thus, the effluent characteristics shown are based on the soluble concentrations detected in the station 101 discharge (Montgomery Watson, 1996b). The projected metal concentrations are conservative in that most soluble metal concentrations at station 101 were non-detect values. Other existing facilities use the same technology to achieve reductions in soluble metals (through adsorption and coprecipitation of soluble species). If operational monitoring indicated that higher-than-anticipated levels of metals were present in soluble (dissolved) form, some preconditioning (e.g., sulfide or borohydride addition) could be used to reduce metal solubility and achieve the discharge concentrations shown.

Table 4-10
Anticipated NPDES Effluent Limitations and Projected Discharge Quality for Mine Drainage Under All Alternatives

Parameter	Units	Monthly Average Limit (Hardness: 50/100/200 mg/L)[a]	Daily Maximum Limit (Hardness: 50/100/200 mg/L)[b]	Untreated Mine Drainage Station 101, 90th Percentile Conc.	Treated Mine Drainage, Outfall 001	Projected DTF Area Discharge
Aluminum	µg/L	71.2	142.9	550	< 71.2[c]	771.2
Ammonia	µg/L	1.72	3.45	<1.7[d]	<1.7[d]	1.56
Arsenic	µg/L	50	100	3.2	1.7	2.46
Cadmium	µg/L	0.13/0.22/0.37	0.26/0.44/0.74	ND (0.2)	ND (0.2)	ND (< 3.0)
Chromium	µg/L	8.0	16.0	ND (10)	ND (10)	ND (< 20)
Copper	µg/L	3.6/7.0/13.4	7.3/14.0/26.9	20	3.6[e]	6.92
Iron	µg/L	819	1,643	1,570	278[f]	NA
Lead	µg/L	1.1/2.6/6.3	2.2/5.2/12.6	3	1[f]	0.88
Mercury	µg/L	0.01	0.02	ND (< 0.05)	ND (< 0.05)	ND (< 0.2)
Nickel	µg/L	23.8/42.6/77.0	47.6/85.42/154.4	ND (< 10)	ND (< 10)	5.22
Nitrate	mg/L	10	20	< 10[d]	< 10[d]	1.56
pH	s.u.	6.5–8.5	6.5–8.5	6.8–8.3	6.8–8.3	6.8–8.3
Selenium	ug/L	4.1	8.2	ND (< 5)	ND (< 5)	0.09
Silver	µg/L	0.6/2.0/6.7	1.2/4.1/13.4	0.21	0.1[f]	0.08
Sulfate	mg/L	200[g]	200[g]	<200[g]	<200[g]	NA
TDS	mg/L	1,000	1,000	787	< 800	< 1,000[h]
TSS	mg/L	20	30	Variable	< 20	< 20[i]
Zinc	µg/L	33/60/107	67/120/216	23	10	33

Note: TDS = total dissolved solids; TSS = total suspended solids; ND = not detected in any samples; parenthetical value shows lowest detection limit; NA = data not available to perform analysis.
[a] Monthly average limitations apply to the mean of all samples collected during a month.
[b] Daily maximum limits would be applied to any one sample.
[c] Based on theoretical hydroxide solubility at pH 6–6.5.
[d] Values assume continued implementation of the explosives BMP plan.
[e] Based on theoretical hydroxide solubility at pH 8.5.
[f] Value assumes removal of the metal through adsorption and/or coprecipitation.
[g] The sulfate limits apply only to sulfate associated with magnesium and sodium. Since most of the sulfate in the mine drainage is associated with calcium, the limits should easily be met.
[h] There are no data to specify TDS levels in DTF effluent. However, TDS levels in the DTF are expected to be less than 1,000 mg/L. As a worst-case scenario, waste rock runoff could have TDS comparable to mine drainage, 787 mg/L. Reclaimed area runoff and coarse till drainage are not expected to have elevated levels of TDS and should be well below 1,000 mg/L.
[i] The proposed DTF settling pond system is specifically designed to meet the TSS limits.

Ammonia and nitrate previously were detected in the mine drainage at levels above projected permit limits during periods of blasting. In response, under the requirements of the previous NPDES permit, a best management practice (BMP) was developed for blasting operations. Implementation of the BMP would continue to be required in the reissued NPDES permit. The BMP would include the use of insoluble blasting agents and good housekeeping practices. Similar practices have proven successful in limiting ammonia and nitrate concentrations at existing mines. Ammonia was generally not observed in the discharge during exploration and blasting activities in 1998, after implementation of the explosives BMP. The few detected levels were well below the applicable permit limits.

Optimal removal of aluminum, unlike removal of other metals, occurs in the pH range 6 to 6.5 standard units (s.u.) An additional stage might need to be added to the mine drainage treatment process to provide these pH levels and ensure that aluminum limits are met. Although aluminum limits are not included in the current NPDES permit, aluminum has been monitored and levels have ranged from 8.68 to 40.5 µg/L. Those are below the anticipated permit limits but do not reflect periods of full-scale mining activity.

As described in the 1997 SEIS, the State of Alaska promulgated site-specific water quality criteria for total dissolved solids (TDS) in Sherman Creek that apply to the discharge of the mine water. These criteria do not apply to Slate Creek or Johnson Creek.

Recent studies in Alaska, as reported in Stekoll et al. 2003, show that TDS levels of 250–500 mg/L may cause chronic effects on fertilization of anadromous fish eggs and fry emergence. Such fish populations (coho, pink, and chum salmon) are found in Lower Sherman Creek below the fish barrier. The critical periods for anadromous fish spawning in Lower Sherman Creek are summer and early fall. At these times, the projected mine effluent flows (1.3–2.2 cfs) generally receive the greatest dilution in lower Sherman Creek. As shown in Table 3-8, the dilution in comparison to average monthly flows is typically much greater than 10:1. Based on TDS background levels of less than 100 mg/L and mine drainage TDS levels of less than 800 mg/L, the "mixed" water in Lower Sherman Creek would have TDS levels well below 250–500 mg/L and no TDS-related adverse effects on anadromous fish are anticipated. Monitoring data for Lower Sherman Creek during 1998–2003, as summarized in Table 3-15, indicate no TDS levels above 100 mg/L except one value of 200 mg/L during December 1998. That is, all TDS levels during summer and early fall with the current mine water discharge rate of 0.2–0.8 cfs have been below 100 mg/L.

The potential for long-term acid drainage and associated metal loadings is a concern at many other mine sites. Mine drainage data collected for the past 11 years at Kensington, however, give no indication of potentially acidic conditions. Even though the mining plan under Alternatives B, C, and D involves a higher gold grade, the geology of the ore body for all alternatives includes almost entirely non-acid-generating materials. The available geochemical data are discussed in detail by SAIC (1997) and in Appendix A.

As discussed above, the treated mine drainage would be combined with runoff from the facilities in the vicinity of the 850-foot adit. Assuming that the mine drainage represents the worst-case composition of waste pile runoff, the combined waste rock and uncontaminated process area runoff would not exceed water quality standards. In addition, the operator tested the waste rock for acid rock drainage generation potential. Acid-base accounting is the method commonly used to determine the potential for acid generation in rock versus neutralization potential. Acid-based accounting results for representative waste rock samples showed neutralization potential-to-maximum potential acidity ratios of 4.5:1 to 672:1; most samples had ratios greater than 10:1. Material with a ratio greater than 3:1 is generally accepted as non-acid-generating material.

Under the NPDES permit, effluent from the treatment system could not exceed a total suspended solid (TSS) daily maximum level of 30 mg/L and a monthly average of 20 mg/L. TSS concentrations in the influent to the treatment plant would vary depending on the volume and quality of the runoff inflow. The treatment system is a proven technology for solids removal that has been used at many other municipal and industrial facilities to successfully meet comparable permit limits. Data collected from 1998 to 2001 show TSS levels in the discharge well below the permit limits. Sediment loadings from the treatment system that meet the NPDES permit limits are not expected to affect Sherman Creek. The finer (nonsettleable) sediments that could be released would remain entrained by normal flow velocities in Sherman Creek and be discharged to Lynn Canal.

Turbidity in water is caused by the presence of suspended matter, such as clay, silt, and finely divided organic matter. Alaska's water quality standards require that turbidity in the discharge not exceed 5 nephelometric turbidity units (NTU) above natural conditions when natural conditions are 50 NTU or less, and not cause more than a 10 percent increase in turbidity when natural conditions are greater than 50 NTU, not to exceed a maximum increase of 25 NTU. Natural turbidity levels in Sherman Creek are well below 50 NTU. The key standard, therefore, for compliance purposes is the requirement not to increase turbidity more than 5 NTU above background. Although turbidity and TSS are fundamentally different parameters, both are reduced by the same treatment technologies. In evaluating compliance with the turbidity standards at outfall 001 under all alternatives, it is useful to separately consider the two components of the discharge: the treated mine drainage and the storm runoff. During dry weather, the only component of the discharge from outfall 001 is mine drainage. Although the untreated mine drainage might be high in turbidity, treatment would include chemical precipitation and clarification, followed by filtration. Turbidity levels in the discharge, therefore, are expected to be indistinguishable from background conditions.

During minor rainfall events, the discharge from outfall 001 would be a mixture of stormwater runoff and treated mine drainage. The treatment system at outfall 001 would include polymer addition and settling, which should reduce turbidity in the stormwater. Minor rainfall events are not expected to significantly disturb materials in the drainage area. In addition, the very low turbidity level of the treated mine drainage would dilute storm runoff. These factors should ensure instream compliance with the water quality standard for turbidity.

Under major rainfall events, stormwater runoff would dominate the discharge at outfall 001. Although the levels of turbidity in the process area runoff are expected to increase, the polymer dosage applied to the runoff in the treatment ponds would be increased as well. Tests conducted on simulated high-rainfall runoff indicated that turbidity could be reduced with polymer addition to 6 NTU under laboratory conditions (Great Western, 1996). Based on these results and the natural turbidity levels of 1 to 2 NTU in Sherman Creek, the turbidity standard should be met downstream of the outfall.

Although turbidity analyses have not been performed at the outfall, the 1998 to 2001 effluent data show the treatment system is highly effective in removing virtually all solids from the discharge. Based on these data, it is assumed that the turbidity standard has consistently been met under all dry and wet weather conditions.

4.6.2 Effects of Alternative A

Erosion and Sediment

The potential for erosion and sediment loading to surface water downgradient of disturbed areas would be highest during construction activities, and during high-intensity precipitation events and snowmelt runoff. Construction of the following facilities would have the greatest potential for increases in sedimentation: access roads and pipeline corridors, including stream crossings; mill and office facilities; infiltration gallery; waste rock piles; quarries for sand, gravel, and till; and the DTF, including the berm.

The magnitude of sediment increases to drainages from the facilities listed above would be minor if sufficient BMPs were adequately implemented within and along the perimeter of disturbed areas. Such BMPs would be developed and implemented as part of NPDES permit requirements for stormwater discharges. Detention ponds or basins would be used to remove sediment from disturbed area runoff water prior to discharge to streams or drainages. These basins would be designed to contain and allow infiltration of runoff from a 100-year, 24-hour storm event. Other possible BMPs include diversion ditches, silt fences, straw bales, slash windrows, and revegetation.

DTF Effluent Quality

Under Alternative A, effluent from the DTF would be discharged to Camp Creek. Modeling was performed to estimate the water quality of effluent that would be expected to be discharged from the DTF sediment pond. The model combined leachate or estimated water quality data from all expected sources, including reclaimed area runoff, coarse till drainage, tailings drainage, and waste rock runoff, with anticipated flows. Reclaimed area runoff is expected to be uncontaminated and has been characterized using data collected for ephemeral drainages in the vicinity of the DTF. Coarse till drainage characteristics were projected based on coarse till leachate analyses. Tailings drainage could represent either residual moisture from the milling process or infiltration through the pile. Tailings drainage was characterized using mill water produced during the 1996 and 1998 pilot tests by the operator and flotation tailings leachate analyses. The highest values for each parameter from these tests were included in the effluent characterization. As discussed previously, mine drainage from active exploration activities prior to 1997 is assumed to be the worst-case composition of waste rock runoff. Table 4-11 summarizes estimates of flow rates occurring from each source. These flows would vary depending on actual precipitation events and monthly and annual variations in precipitation. Table 4-10 (last column) provides the worst-case scenario for water quality discharges from the DTF. All concentrations are below the applicable water quality-based limits except for the monthly average copper and zinc concentrations (at a hardness of 50 mg/L) and all limits for aluminum. Downstream hardness would exceed 200 mg/L, and the higher limits for copper and zinc based on elevated hardness would apply. Low residual ammonia and nitrate levels in the discharge would be ensured by the blasting BMP required by the NPDES permit.

Table 4-11
Estimated Average Discharges from DTF Embankment

Contributing Source	Anticipated Quarterly Flows (gpm)				
	Jan, Feb, Mar	Apr, May, Jun	Jul, Aug, Sep	Oct, Nov, Dec	Annual Average
Waste rock runoff	91.7	45.3	93.7	213.0	111
Tailings drainage	2.9	5.0	5.0	8.4	5
Coarse till drainage	28.8	6.7	27.8	156.0	55
Reclaimed runoff	89.0	9.6	19.2	57.8	44
Quarterly totals	212	67	146	435	215

The 1997 SEIS concluded that the projected discharge quality at the outfall under Alternative A would meet water quality-based NPDES permit limits. The discharge would have been monitored under the NPDES permit to ensure compliance with these limits. If the pollutant levels were higher than projected, USEPA would have required the operator to undertake measures to meet permit limits, including providing treatment like the system used for mine drainage. The analysis, however, did not consider aluminum, and aluminum limits were not included in the permit. Although a detailed analysis has not been performed, it is anticipated that aluminum limits might not be met because of the high aluminum levels (0.57 to 14.6 mg/L) observed in the projected coarse till drainage. As a result, a water treatment system to remove aluminum might need to be added to the DTF design. Such a system would involve adjusting the pH of the discharge to 6 to 6.5 s.u. to precipitate and settle out excess aluminum.

Finally, Table 4-12 summarizes the estimated annual mass loadings of selected pollutants on an annual basis for the tailings disposal facilities under each alternative. These estimates are based on average annual flows and predicted pollutant concentrations. Based on the DTF cover design and the leachate and geochemical data presented in SAIC (1997), the DTF is not expected to be a significant source of metals loadings after closure.

Table 4-12
Estimated Annual Mass Loadings from Tailing Disposal During Operations Under Each Alternative

Parameter	DTF Discharge Alternative A (lb/year)	DTF Discharge Alternative A1 (lb/year)	TSF Discharge Alternatives B–D (lb/year)
Total Ammonia	1,275	319	2748
Nitrate	1,168	292	<48,219
Aluminum	578	145	96
Arsenic	1.9	0.46	3.9
Cadmium	0[a]	0 [a]	0.1
Chromium VI	0[a]	0 [a]	9.5
Copper	5.1	1.3	8.1
Iron	NA	NA	3,811
Lead	0.66	0.16	2.4
Mercury	0[a]	0 [a]	0.05
Nickel	4.0	1.0	8.6
Selenium	0.06	0.01	2.8
Silver	0.06	0.01	0.09
Zinc	24.5	6.1	52.2

[a]These values are based on no detection of the pollutants in any of the samples used to characterize the effluent.

Accidental Spills

Accidental spills of chemicals and fuel on roadways could affect surface water quality because the access and haul road would parallel Sherman Creek and include several stream crossings. Diesel fuel would be transported by truck from the facilities at Comet Beach to the process area in the Upper Sherman Creek watershed (Forest Service, 1997a). Lynn Canal water quality could be adversely affected by spills at the dock facility. In either case, the impacts on surface water quality would be short-lived because materials would be cleaned up or would simply pass through the system. The freshwater and marine aquatic and transportation resources parts of this section provide more details on the potential for and impacts of accidental spills of chemicals and fuel.

In addition, dewatered tailings would be piped from the mill to the DTF. This pipeline is adjacent to a bermed haul road. Accidental spills of these materials, if they were to occur with sufficient volume, could adversely affect surface water quality downstream from the spill site. Spilled tailings would have more of a solids impact than a chemical impact, although there could be localized areas of elevated aluminum concentrations. In either case, the impacts on surface water quality would again be short-lived because materials would be cleaned up or would simply pass through the system. The operator would have to remove any tailings solids deposited in the stream and address habitat-related effects. The freshwater and marine aquatic and transportation resources parts of this section provide more details on the potential for and impacts of accidental spills of tailings materials.

Within the mill, the concrete floor would be sloped to sumps so that any spillage could be recovered and returned to the processing circuit. Required processing reagents would be prepared and stored in the building. Therefore, any spillage of reagents in the mill building would likely be very small and easily recovered by the sumps.

The Spill Prevention, Countermeasures and Control (SPCC) Plan required by USEPA would include specific measures to be implemented in case of spills. Spill response equipment would be located at the Comet Beach dock facility, in the process area, and at the midpoint of the haul road.

4.6.3 Effects of Alternative A1

Under Alternative A1, the DTF would contain 4.5 million tons of tailings. The individual components of the DTF discharge flow would be approximately 75 percent lower than those under Alternative A, and the total discharge volume would be about 50 gpm. The DTF discharge characteristics would be the same as those projected for Alternative A; i.e., neither discharge would cause exceedances of applicable water quality criteria (except, potentially, aluminum criteria) and there would no adverse impacts on surface water quality. A treatment system to remove aluminum might have to be added to the DTF design. Similarly, the mine water discharge rate could be reduced by an unspecified volume. The discharge composition, however, would be the same under Alternatives A and A1, and neither would cause exceedances of applicable water quality criteria in Sherman Creek.

4.6.4 Effects Common to Alternatives B, C, and D

Erosion and Sedimentation

A 0.5-mile-long diversion channel would be constructed around the Jualin Mine adit and process area bench in the Johnson Creek drainage to direct any runoff from undisturbed areas back to tributary channels of Johnson Creek. This runoff water would have no adverse effects on water quality. Any runoff from inside the process area would be directed to collection sumps and pumped into the mill circuit during operations.

A 3.5-mile-long, 20-foot-wide access road and pipeline corridor would be constructed from the process area to the TSF. The pipeline access road might result in increased erosion potential; however, proper implementation of BMPs would minimize sedimentation to the watersheds containing Johnson Creek, East Fork Slate Creek, and Spectacle Lake.

The upgrade to the Jualin access road, including the two existing bridges over Johnson Creek, could produce impacts on water quality in Johnson Creek in the form of increased sedimentation. The upgrade activities would require some instream work, which would be conducted according to ADNR Title 41 permit requirements. Like the new access road described above for the TSF, proper implementation of BMPs during road upgrade activities would result in little to no sediment increase in affected drainages.

Water quality impacts in the form of erosion and sedimentation could also result from construction activities, including the process area and tailings dam, under Alternatives B, C, and D. The proper use of BMPs would prevent or minimize any increase of sediments in the Johnson or Slate creek drainages.

Accidental Spills

Fuel and process chemicals (flotation reagents and scale inhibitors) would be transported by truck along the Jualin access road during mine operation. Use and on-site storage of these materials would decrease for Alternatives B, C, and D because of the elimination of the personnel camp, the reduced mining/processing rate, and the increased reliability of site access, which would allow more frequent delivery of materials. An accidental spill of fuel and chemicals along a roadway, if sufficient in volume, could enter Slate Creek, Johnson Creek, or a tributary channel. The use of isotainers under Alternatives B, C, and D would limit the likelihood and volume of a diesel fuel spill. Any spill would be cleaned up and would therefore be of short duration and size. Long-term effects from a spill would not be expected. The aquatic and transportation resources parts of this section provide more details on the potential for and impacts of accidental spills of fuel and chemicals.

If an accidental spill of tailings from the pipeline were to occur, tailings could enter the streams or lakes, causing sedimentation impacts. Most of the pipeline would, however, be located a quarter-mile or more from surface water such that spilled tailings would not generally reach the drainages. Because any spill would be cleaned up, any impacts resulting from a spill from the tailings pipeline would be short-term and limited in extent. Any small amount of tailings remaining following a spill would not be expected to affect water quality in any of the water bodies.

As under Alternative A, the concrete floor in the mill would be sloped to sumps so that any spillage could be recovered and returned to the process circuit. Required processing reagents would be prepared and stored in the building. Therefore, any spillage of reagents in the mill building would likely be very small and easily recovered by the sumps.

The SPCC Plan required by USEPA would include specific measures to be implemented in case of spills. Spill response equipment would be located at the Slate Creek Cove dock facility, the Cascade Point dock facility, in the process area, and at the midpoint of the haul road.

4.6.5 Effects of Alternative B

TSF Effluent Quality

Under Alternative B, all the flow of East Fork Slate Creek and runoff from the areas surrounding the TSF would be managed in the TSF. Discharge of process (tailings) water from a tailings impoundment is not allowed under 40 CFR Part 440. The regulations, however, allow for an exception from the discharge prohibition for net precipitation into a tailings impoundment. As a result, under Alternatives B, C, and D, only the volume of natural flows associated with precipitation into the TSF may be discharged. The TSF would discharge through an NPDES-permitted outfall to Slate Creek below the embankment. The projected characteristics of the discharge are presented in Table 4-13.

A simulation model was developed to determine the range of projected discharge characteristics from the TSF during the life of the mine. The model includes the following inputs:

- Tailings water chemistry
- Background East Fork Slate Creek water quality
- Precipitation, hydrology, and runoff
- Operational factors (i.e., production rate, backfill, and recycling of water from the mill)

Table 4-13
Anticipated NPDES Effluent Limitations and Projected Effluent Quality for the TSF Under Alternative B

Parameter	Units	Monthly Average Limit (Hardness: 25 mg/L)[a]	Daily Maximum Limit (Hardness: 25 mg/L)[b]	Projected TSF Discharge		
				Min	Mean	Max
Aluminum	µg/L	71	143	403	567	742
Ammonia	mg/L	1.3	1.8	0.184	0.391	0.613
Arsenic	µg/L	50	100	0.003	0.041	0.608
Cadmium	µg/L	0.08	0.16	0.002	0.012	0.022
Chromium	µg/L	7.98	16	0.77	1.29	1.85
Copper	µg/L	1.9	3.7	0.51	0.99	1.50
Iron	µg/L	819	1,643	414	582	762
Lead	µg/L	0.44	0.89	0.05	0.26	0.48
Mercury	µg/L	0.01	0.02	0.0008	0.0042	0.0078
Nickel	µg/L	13.2	26.45	0.93	1.44	1.99
Nitrate	mg/L	10	20	< 10[c]	< 10[c]	< 10[c]
pH	s.u.	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5
Selenium	µg/L	4.0	8.1	0.06	0.27	0.51
Silver	µg/L	0.19	0.37	0.894	0.935	0.973
Sulfate	mg/L	250	250	12	48	86
TDS	mg/L	500	500	97	147	200
Zinc	µg/L	18.4	37	10.0	13.6	17.3

[a] Monthly average limitations apply to the mean of all samples collected during a month.
[b] Daily maximum limits would be applied to any one sample.
[c] Values assume continued implementation of the explosives BMP.

A key factor in the model is the volume of water available to mix with the tailings process water in the lake. This volume is directly correlated to precipitation (both rain and snow), which is a variable in the model. Monthly precipitation distributions over the life of the mine were developed based on long-term records of precipitation at sites in the area comparable to the TSF. For each model run, the model selected a precipitation value for each month during the life of the mine from the distribution. In the 1,000 runs completed for this analysis, low and high flow conditions, as well as typical flow conditions, were observed. A full range of discharges from the lake was characterized.

Discharge chemistry is a function of two model inputs, tailings water characteristics and East Fork Slate Creek background water quality. Representative tailings were generated in 1996 and 1998 from pilot-scale milling operations. Tailings water chemistry was then determined after solids were allowed to settle. Background water quality was determined from 3 years of sampling from East Fork Slate Creek. In each model run, the tailings water and background water quality were “mixed” based on their relative flows to calculate the expected discharge quality.

The mixed water quality was then compared to the anticipated NPDES permit limits (Table 4-13). As discussed in the analysis of the mine water effluent and Appendix A, the draft NPDES permit limits are developed to be protective of downstream aquatic life. As also noted above, some of the metals limits are hardness-dependent. For the TSF, the natural flows contributing to the discharge are always much greater than the tailings water. The natural flows have low hardness, and therefore the water quality-based limits for hardness-dependent pollutants are the most protective levels that can be determined.

In 1998 pilot-scale testing, aluminum levels in the tailings water were higher than background levels. However, it is expected that if the pH of tailings water was reduced to near-neutral conditions in the TSF, excess aluminum would precipitate and settle out. As a result, aluminum levels in the mixed water would be indistinguishable from background. However, background aluminum levels in East Fork Slate Creek exceed the applicable water quality standard. There is no evidence to suggest that these levels adversely affect aquatic life. Furthermore, the USEPA research on which the standard was developed acknowledges that many "high-quality" waters have aluminum levels above the standards (USEPA, 2002). The State, however, has not proposed a site-specific, background-based criterion for aluminum. Therefore, the discharge is expected, at times, not to comply with water-quality based permit limitations for aluminum. In addition, although the concentration of silver associated with the tailings is below the limits, the background levels for this pollutant also sometimes exceed the limits.

The key factor for Alternative B is ensuring that the discharge would meet water quality-based effluent limits at all times. Continuous discharge must occur to meet instream flow requirements (to protect aquatic life) below the TSF. Each of the 1,000 model runs completed represents precipitation and discharge conditions that could occur during the 10-year life of the mine. As discussed above, there are periods when the discharge is not projected to meet NPDES permit limits for aluminum and silver (and possibly for lead). Although the discharges are predicted to be consistent with natural conditions in the lake (for silver and aluminum), it is likely that a treatment system (e.g., reverse osmosis or sulfide precipitation) would have to be installed to reduce metals concentrations to below NPDES permit limits. A detailed description of the water quality model and analyses is provided in Appendix A.

The tailings flow to the TSF would have high solids and turbidity levels. The impoundment, however, would be designed to maximize settling. The discharge from the TSF would be required to meet the same TSS limits as the mine drainage discharge. Modeling described by Tetra Tech (2004) shows that TSS levels in the discharge could exceed 660 mg/L without the use of flocculants. Flocculants are a proven method to enhance settling. It is not possible, however, to determine whether flocculant addition to the TSF would be sufficient to ensure compliance with the permit limits. Similarly, it is possible that the State's instream turbidity standard might not be achieved. As a result, the operator could also have to provide additional solids removal by reverse osmosis or ultrafiltration treatment.

Geochemical testing of the tailings indicates that they are not a source of long-term releases of metals. The tailings would be covered by at least 9 feet of water in the TSF to ensure limited exposure to oxidation, as well as to minimize the potential for metal releases. The testing results generally show flux of metals from water that contacts the tailings back into the tailings themselves. It is expected, therefore, that at closure virtually all the lake water would comply with applicable water quality standards protective of aquatic life. Water entrained in the tailings at the bottom of the lake could have elevated concentrations of copper and lead, although the expected higher hardness of this water would mitigate any potential adverse effects. As a result, the deposited tailings would not adversely affect water quality and aquatic organisms at closure. See Section 4.9 and Appendix C.

4.6.6 Effects of Alternative C

TSF Effluent Quality

Water quality for the TSF discharge under Alternative C was modeled in the same way as Alternative B. Water quality-based limits must be met at the discharge point to ensure no adverse downstream impacts. Model inputs are the same as those for Alternative B, except that natural flows into the TSF are lower because Upper East Fork Slate Creek flow would be diverted around the TSF and a diversion would also be constructed along the western boundary of the TSF to divert runoff from adjacent slopes. The water quality modeling results for Alternative C are presented in Table 4-14.

Table 4-14
Anticipated NPDES Effluent Limitations and Projected Effluent Quality for the TSF Under Alternative C

Parameter	Units	Monthly Average Limit (Hardness: 25 mg/L)[a]	Daily Maximum Limit (Hardness: 25 mg/L)[b]	Projected TSF Water Quality		
				Minimum	Mean	Maximum
Aluminum	µg/L	71	143	442	935	1,209
Ammonia	mg/L	1.3	1.8	0.233	0.856	1.202
Arsenic	µg/L	50	100	0.06	0.14	0.62
Cadmium	µg/L	0.08	0.16	0.005	0.033	0.049
Chromium	µg/L	7.98	16	0.89	2.46	3.33
Copper	µg/L	1.9	3.7	0.63	2.11	2.86
Iron	µg/L	819	1,643	454	960	1,241
Lead	µg/L	0.44	0.89	0.10	0.72	1.06
Mercury	µg/L	0.01	0.02	0.0017	0.012	0.017
Nickel	µg/L	13.2	26.45	1.1	2.6	3.4
Nitrate	mg/L	10	20	< 10[c]	< 10[c]	< 10[c]
pH	s.u.	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5	6.5–8.5
Selenium	µg/L	4.0	8.1	0.11	0.76	1.13
Silver	µg/L	0.19	0.37	0.785	0.849	0.964
Sulfate	µg/L	250	250	21	127	187
TDS	mg/L	500	500	109	259	342
Zinc	µg/L	18.4	37	11	21	27

[a] Monthly average limitations apply to the mean of all samples collected during a month.
[b] Daily maximum limits would be applied to any one sample.
[c] Values assume continued implementation of the explosives BMP.

For this alternative, the key factor is that the operator would not be required to "hold" too much water in the TSF when the dilution from natural inflows is not sufficient to ensure compliance with water quality-based effluent limits. Instream flow requirements would always be met because of the flow in the diversions. Results of 1,000 model simulations of operations through the life of the mine show extended periods when water in the lake would not meet the effluent limitations. As a result, the model shows that the volume of water that would have to be held would exceed the capacity of the TSF. Similar to Alternative B, therefore, it is likely that additional treatment would have to be installed to protect downstream water quality.

Under Alternative C, the TSF conditions would be much more conducive to settling because the TSF would be operated as a closed system. Polymer addition and BMPs would be used, as needed, to improve settling. The tailings discharge could also be retained in the TSF longer to further enhance settling. Based on the modeling results in Tetra Tech, 2004, however, whether TSS limits would be met at the discharge point is still uncertain, and additional solids removal could be required.

Erosion and Sedimentation

Construction and operation of the 1.2-mile diversion might cause some increased sedimentation in East Fork Slate Creek because of the newly constructed channel in glacial sediments. Implementation of BMPs would reduce this impact.

4.6.7 Effects of Alternative D

TSF Effluent Quality

Alternative D includes a pipeline diversion of Mid-Lake East Fork Slate Creek around the TSF. The TSF would manage tailings water, as well as runoff from undiverted areas. TSF effluent would be treated using reverse osmosis to ensure compliance with water quality-based effluent limitations. The TSF effluent would discharge to the pipeline flow prior to flowing into East Fork Slate Creek below the dam.

TSF water quality was modeled using the same method used for Alternatives B and C to determine influent quality to the treatment plant. Treatment performance was then projected to describe discharge quality as shown in Table 4-15. For all parameters other than TSS, aluminum, lead, silver, iron, and zinc, the untreated water in the TSF meets applicable water quality-based effluent limits. For TSS, polymers and other BMPs that can remove larger particles would enhance settling in the TSF. Reverse osmosis would further remove particles as small as 0.001–0.0001 μm, ensuring compliance with the TSS permit limits. Reverse osmosis has been shown to remove 95 percent of the aluminum and 96–98 percent of the lead from influent waste streams. Similarly, the reverse osmosis system would also provide the iron, silver, and zinc removal required to meet the effluent limits. Note that in tailings samples, iron and lead are found primarily in solid rather than dissolved form; i.e., the high degree of solids removal provided by reverse osmosis further ensures compliance with the effluent limitations. As a result, the levels of all pollutants in the discharge would be well below the permit limits.

4.6.8 Summary

Tables 4-10 through 4-15 summarize the surface water quality impacts associated with mine water and tailings disposal discharges from all alternatives. Alternatives A, A1, and D would comply with all applicable water quality standards intended to protect downstream aquatic life. Under Alternatives B and C, it is likely that additional metals and solids treatment would have to be added to meet discharge limits.

There is a potential for sediment-related impacts associated with construction and operation of mine facilities, in Sherman Creek under all alternatives and in Johnson and Slate creeks under Alternatives B, C, and D. These impacts would be minimized or avoided by proper use of BMPs.

Table 4-15
Anticipated NPDES Effluent Limitations and Projected Quality for the TSF Under Alternative D

Parameter	Units	Discharge Chemistry (mean/max)	Daily Maximum Limit (Hardness 25 mg/L)[a]	Monthly Average Limit (Hardness 25 mg/L)[b]
pH	s.u.	6.8–8.3	6.5–8.5	6.5–8.5
TSS	mg/L	< 20	30	20
TDS	mg/L	212 / 296	500	500
Sulfate	mg/L	94 / 154	250	250
Total Ammonia	mg/L N	0.66 /1 .01	1.8	1.3
Nitrate	mg/L N	< 10 / < 10[c]	20	10
Aluminum	ug/L	<71	143	71
Arsenic	ug/L	0.15 / 0.62	100	50
Cadmium	ug/L	0.024 / 0.040	0.2	0.1
Chromium VI	ug/L	2.0 / 2.9	16	8
Copper	ug/L	1.61 / 1.9	3.7	1.9
Iron	ug/L	<800	1,700	800
Lead	ug/L	<0.5	0.9	0.5
Mercury	ug/L	0.01 / 0.01	0.02	0.01
Nickel	ug/L	2.1 / 3.0	26	13
Selenium	ug/L	0.56 / 0.93	8.1	4.0
Silver	ug/L	<0.2	0.4	0.2
Zinc	ug/L	<18	37	18

[a] Daily maximum limits would be applied to any one sample.
[b] Monthly average limits apply to the mean of all samples collected during a month.
[c] Values assumed continued implementation of the explosives BMP.

4.7 GROUNDWATER HYDROLOGY

This section describes impacts on groundwater hydrology that might occur from implementing the Proposed Action and alternatives. The primary indicator for groundwater hydrology is a change in groundwater flow conditions (e.g., flow quantity and rate, depth to water, and recharge-discharge relationships) resulting from mine-related activities. Currently, groundwater collects in existing underground workings and discharges to the surface through the Kensington 850-foot adit in the Sherman Creek watershed.

Since groundwater typically flows in directions similar to surface water flow, groundwater flow is discussed in this section by watershed. As noted in the Surface Water Hydrology section (Section 3.5), the watersheds potentially affected by the Proposed Action and alternatives are the Johnson Creek, Slate Creek, and Sherman Creek watersheds. Included in the Sherman Creek watershed discussion is the terrace area watershed that would contain the DTF associated with Alternatives A and A1. Alternatives B, C, and D would affect the Johnson Creek and Slate Creek watersheds, as well as Sherman Creek.

4.7.1 Effects of Alternative A

Underground mine drainage would continue to cause changes in groundwater flow direction and recharge rates in the vicinity of active mine workings. Groundwater levels would decline over a wider area with expansion of underground workings. Groundwater in the vicinity of the Kensington and Jualin mines would flow toward the underground workings. The zone of influence would be limited because of the low overall permeability of the rock and steep topography of the area.

An average initial rate of 4.0 cfs is estimated for groundwater flow into the production-scale underground mine workings, most of which would be discharged at the surface via the Kensington 850-foot adit in the Sherman Creek watershed. Long-term flow of groundwater from the Kensington Mine adit would probably decline to a steady-state condition of less than 1.0 cfs after removal of the groundwater in fracture storage. These impacts on groundwater hydrology would be localized and minor, especially given that groundwater is not used in the area.

The infiltration gallery in Sherman Creek would result in removal of about 0.52 cfs for purposes of mine makeup and domestic water needs. The infiltration gallery would be built in shallow groundwater in alluvium along Sherman Creek; however, this water likely is in direct communication with surface water in the creek. ADNR would permit water withdrawal for beneficial uses and establish minimum instream flows. The settling ponds, sand/gravel quarries, and till borrow area might intercept some shallow perched groundwater in the Upper Sherman Creek watershed; however, these effects, if any, would be minor. Operation of the DTF is expected to have no significant impact on groundwater hydrology because the facility would be constructed on the ground surface.

4.7.2 Effects of Alternative A1

The reduced production rate and the increased backfill would lessen mine water generation and pumping rates by an undetermined volume, and the smaller borrow areas could also intercept less shallow groundwater flow. This could reduce the "localized and minor" impacts on hydrogeology associated with Alternative A. As noted above, the DTF would be constructed on the surface and would have no impacts on groundwater flow under Alternative A or A1.

4.7.3 Effects Common to Alternatives B, C, and D

Groundwater hydrology impacts associated with Alternatives B and C would be similar to those described above. An exception is the infiltration gallery for water supply, which would move to Johnson Creek. Approximately 0.3 cfs under Alternatives B and D and 0.52 cfs under Alternative C of shallow groundwater that is in direct communication with surface water would be removed from Johnson Creek alluvium. Discharge of excess water from the Kensington Mine adits would continue in the Sherman Creek watershed.

Limited measurements of stream flow along East Fork Slate Creek by Konopacky Environmental (1995a) in mid-July 1994 show that there was no substantial change in East Fork Slate Creek flow from points above and below Lower Slate Lake. The lake, therefore, appears to provide minimal contribution to downgradient groundwater flows, and no significant impacts are expected under Alternatives B, C, and D.

4.7.4 Effects of Alternative C

One aspect of Alternative C that might have a minor effect on groundwater hydrology is the operation of the 1.2-mile diversion channel around Lower Slate Lake. Any impacts on groundwater flow (through increased infiltration and recharge) would be minimal because the diversion would be designed to carry water around the TSF efficiently and maintain natural flows in lower East Fork Slate Creek.

4.7.5 Summary

Under all alternatives, there would be some localized impacts associated with construction of the mine workings, and the infiltration galleries in Sherman Creek (under Alternatives A and A1) and

Johnson Creek (under Alternatives B, C, and D). Similarly, tailings disposal would have minimal impacts because the DTF would be constructed on the ground and Lower Slate Lake (the TSF) does not generally contribute to downgradient groundwater flow.

4.8 GROUNDWATER QUALITY

This section describes impacts on groundwater quality that might occur from implementing the Proposed Action and alternatives. The primary indicator for groundwater quality is a change in the chemical characteristics of groundwater resulting from mine-related activities.

Activities that could affect groundwater quality include underground mine workings; infiltration of groundwater from the DTF and TSF; infiltration of precipitation through waste rock storage piles; and accidental spills of chemicals, fuel, or tailings.

4.8.1 Effects Common to All Alternatives

Chemical changes to groundwater in underground mine workings often occur as the water is exposed to oxygen. In general, mine water that discharges from the Kensington Mine 850-foot adit in the Sherman Creek watershed has had elevated levels of TDS, sulfate, nitrate, and some metals, mostly as a direct result of exploration activities and from exposure of underground workings to groundwater and oxygen.

The mine water has a neutral pH (6.5–8.5 s.u.), and TDS concentrations are in the range of 25 to 1,270 mg/L (see Table 4-10 and Section 3.8). Concentrations of total aluminum, arsenic, iron, manganese, nickel, and zinc were above laboratory detection limits in some mine water samples (SAIC, 1997). Nitrate concentrations ranged from 0.01 to 39 mg/L. The 1997 SEIS (Forest Service, 1997a) notes that higher metal and nitrate concentrations in samples of mine water generally occurred during periods of exploratory drilling/blasting and adit work in the mine. Nitrate (and ammonia) levels have been reduced by implementation of explosives BMPs. Concentrations of some metals would be expected to decrease after mining ceases and groundwater flow reaches steady-state conditions. The mine discharge water would be monitored after cessation of mining and treated as long as necessary to meet effluent limits.

4.8.2 Effects of Alternative A

Approximately 25 percent of the tailings (the coarse fraction) would be pumped into the underground mine workings for backfill. Tests of this material show no indication of acid-generating potential or significant increases in metal concentrations (see Section 4.3, Geology and Geochemistry). This would also be true for the DTF, where no impacts on groundwater quality are expected. The tailings facility would have a collection pond immediately downgradient of the embankment, which would intercept some shallow seepage. Collected water would be discharged to Camp Creek at or below specified effluent limits. Table 4-9 shows the expected quality of this discharge water. The water quality would be monitored to determine the need for seepage water quality-control measures after final reclamation.

Seepage through waste rock in the temporary waste rock pile and DTF could reach groundwater in those immediate areas. As discussed in Section 4.3, testing shows very low potential for poor-quality leachate, including acid drainage, from the waste rock and tailings (SAIC, 1997).

Sewage would be collected from the process area complex near the Kensington Mine, distributed to a central septic system, and discharged to a leach field. Use of a properly designed treatment system is not expected to affect groundwater quality in the Sherman Creek watershed.

An accidental spill of fuel or chemicals could affect the quality of shallow groundwater in the Sherman Creek watershed. The quantities of these materials transported to and used at the mine site would not be large (i.e., tens to several hundreds of gallons), and therefore a spill would not adversely affect groundwater unless it occurred in an area with a shallow water table. A pump-and-treat system, or other appropriate remediation system, could be installed to clean up any significant spills that reached groundwater.

4.8.3 Effects of Alternative A1

Because Alternative A would have no adverse effects on groundwater quality, the reduced mine life and production rate under Alternative A1 would also not affect groundwater quality. The smaller DTF would generate proportionately less leachate, while there would always be leachate from the permanent waste rock disposal. Test data, however, show that the tailings and waste rock would not be acid-generating and would have low metals mobility even for the higher-grade mining scenario under Alternative A1.

4.8.4 Effects Common to Alternatives B, C, and D

Groundwater quality impacts associated with Alternatives B, C, and D would be similar to those described in the previous section. An exception is the TSF in the East Fork Slate Creek watershed. The projected tailings water characteristics are described in Tables 4-13 through 4-15. As discussed in Section 3.8, no background groundwater quality data are available for the TSF area. Based on proximity, however, its groundwater quality is expected to be comparable to groundwater quality in the Sherman Creek drainage, as summarized in Appendix G. Although detailed comparisons have not been made, the mean and maximum concentrations of constituents found in Sherman Creek monitoring wells are consistently comparable to or higher than those observed in the tailings water. Tailings generally are not a source of leachable metals, nor do they exhibit acid-generation potential (see Section 4.3). Also, as described above, Lower Slate Lake does not appear to recharge the underlying groundwater. This is likely due to the fine-grained nature of the glacial sediments underlying the lake basin. The fine-grained nature of tailings material (i.e., 10–20 percent < 0.01 millimeter) would also form a low-permeability layer on the bottom of the lake under Alternatives B, C, and D. As a result, the TSF would not adversely affect groundwater quality.

An accidental spill of fuel or chemicals would be more likely to occur in the Johnson Creek watershed than in the Sherman Creek drainage under Alternatives B, C, and D. Sewage would be collected from the process area complex near the Jualin Mine and distributed to a central septic system and leach field. The proper design and operation of this system would prevent impacts on groundwater quality in the Johnson Creek watershed.

Under Alternatives B, C, and D, approximately 40 percent of the tailings (the coarse fraction) would be pumped into the underground mine workings for backfill. Tests of this material show no indication of acid-generation potential, and the leachate has low metal concentrations (see Section 4.3).

4.8.5 Summary

Under all alternatives, no impacts on existing groundwater quality would be expected.

4.9 AQUATIC RESOURCES: FRESHWATER

Alternatives A and A1 would affect freshwater aquatic resources only in the Sherman Creek drainage; Alternatives B, C, and D would affect freshwater aquatic resources in the Sherman, Slate, and Johnson creek drainages. Sherman Creek would receive mine drainage from settling ponds at an initial rate of about 4.0 cfs, decreasing to a steady-state flow of about 1.0 cfs or less after the first year or two of mining. This would occur for all alternatives.

Impacts could result from changes in water quality resulting from discharge of mine water, diversion of existing channels, withdrawal of water for the milling process, and disposal of tailings. The following indicators have been used to evaluate potential impacts on freshwater aquatic resources.

- Integrity of freshwater habitat
- Water withdrawal
- Water quality
- Sedimentation

4.9.1 Effects of Alternative A

Integrity of Freshwater Habitat

Under Alternative A, when the mine site is fully developed, diversions would reduce flows in Ophir and Ivanhoe creeks, but mine discharges would cause flow increases in Sherman Creek. Overall, flow in the Sherman Creek watershed would be expected to increase by less than 15 percent during the mine operation. Adverse impacts on the stream channel have not been observed to date. The discharge to Sherman Creek was initiated in 1998, and future impacts are not expected. The diversions would cause the loss of habitat for approximately 100 to 200 Dolly Varden char.

Six small stream systems in the terrace area would be directly affected by construction of the DTF. These systems are ephemeral and do not support fish populations (Konopacky, 1996c). Macroinvertebrate populations are sparse and transitory, and loss of these resources would likely have a negligible impact on fish populations within the project area.

Haul roads would require five stream crossings. All road construction activities would be timed to avoid critical periods for anadromous fish. Because Sherman Creek supports pink, coho, and chum salmon, construction would need to be avoided from June 1 through August 1 (Forest Service, 1997a). The proposed crossing of an unnamed tributary to Lower Sherman Creek would be a culvert. This tributary is usually dry and flows only during storm events. This crossing would not affect aquatic resources; however, appropriate Forest Service BMPs would be used, and the culvert would be installed when the tributary is dry.

The remaining four stream crossings under Alternative A—one over South Fork Sherman Creek, two on Upper Sherman Creek, and one on Ivanhoe Creek—would be bridges. Appropriate BMPs would be implemented during construction to minimize erosion and other impacts. However, the potential exists for scouring and erosion around the footings during high-flow events. Scouring could increase downstream sedimentation and affect spawning gravels and the feeding behavior of anadromous fish. The use of bridges, compared with other crossing methods, would reduce the potential for channelization, bed erosion, down-cutting at the crossings, and degradation of aquatic habitat at and below these crossings.

Water Withdrawal

Under Alternative A, water would be withdrawn at a rate of approximately 0.52 cfs from shallow alluvium in the Upper Sherman Creek drainage. These withdrawals would follow minimum instream flow requirements developed by ADF&G and authorized under a water right issued by ADNR. Withdrawals would be restricted during periods of critical flow, which should minimize adverse effects associated with flow reductions.

Water Quality

Stream Discharges. Under this alternative, mine drainage and mill site runoff would be discharged to Sherman Creek and water from the DTF settling pond would be discharged to Camp Creek. Each of these discharges would need to meet water quality criteria-based discharge limits established under the NPDES permit. Because these discharge limits are designed to protect aquatic life, adhering to them should prevent impacts on aquatic organisms in these drainages. In addition, EVS (1997) conducted a series of toxicity studies on rainbow trout using synthetic Kensington Mine effluent and found no significant reductions in rainbow trout survival or growth. The current NPDES permit requires chronic toxicity testing at outfall 001; all results have shown no toxicity attributable to the effluent.

Data indicate that elevated metal levels exist in tissue from Dolly Varden char downstream from the previous sediment pond outfall to the Ophir Creek tributary (Konopacky Environmental, 1996a). It has not been determined whether these higher levels of metal concentrations in fish tissue are a result of exposure to the discharge from the existing settling ponds, recent exploration activities in that part of the drainage relative to other parts of Sherman Creek, or naturally occurring higher levels of metals in that part of the drainage relative to other subdrainages. The treated mine water discharge is expected to continue to have lower levels of metals than the mine discharge had when fish tissue samples were collected and analyzed. Given this expectation, levels of metals in Dolly Varden char tissue should not increase above those previously detected.

Accidental Spills. Tailings would be transported between the process area and the DTF through a slurry pipeline. The potential for a spill from the pipeline to reach Sherman Creek is limited in that the pipeline is adjacent to a well-bermed haul road. If a spill of tailings were to reach Sherman Creek, the potential impacts would in part be similar to those caused by an increase in fine sediment. Increases in the suspended solids and sediment deposition could affect fish feeding behavior and spawning gravels until flushed out of the system. In addition, the levels of aluminum in tailings water exceed the State of Alaska's acute water quality criteria for aluminum. Therefore, in the immediate vicinity of the tailings spill, any fish could be lost due to aluminum exposure. The exact area affected and potential populations lost would depend on the size and location of the spill. Outside the immediate vicinity of the spill, concentrations of aluminum would quickly drop to ambient levels due to dilution and pH neutralization. Aluminum levels in the tailings solids would be generally consistent with natural sediment conditions, and no exposure impacts are predicted.

Fuel and processing chemicals would be transported by truck throughout the operation of the mine. Although spill containment equipment would be located at several sites and available for rapid deployment, chemicals or fuel could enter Sherman Creek or a tributary very quickly in the event of a major spill. Such an event could result in a significant number of mortalities of fish, embryos, macroinvertebrates, or periphyton within the stream. The type of oil and the timing of the release influence the severity of oil's effects on fish. Light oils and petroleum products (like gasoline or diesel fuel) can be acutely toxic to fish, but the toxic event is generally short-lived. Heavier oils might not affect fish at all or, in the cases of fish in larval or spawning stages, might be quite detrimental

(NOAA, 2002). Chemicals or fuel would not be expected to persist for long periods because most of the material would be quickly transported downstream and discharged into Lynn Canal. Small concentrations would likely persist in stream sediments for longer periods, depending on the material spilled. They could continue to affect aquatic life beyond the period immediately following the spill. The size and location of the spill and the effectiveness of the cleanup would determine the extent of long-term contamination resulting from a spill. It is likely that when conditions are favorable, recruitment from upstream and downstream sources would reestablish the aquatic community in the affected area.

The probability of a fuel truck accident and spill is 0.036 percent (1 in 2,777) per year or 0.5 percent (1 in 200) over the life of the project (estimated to be 14 years, including construction, under this alternative). The maximum consequences of a spill of this nature would be approximately 5,000 gallons of diesel fuel spilled into Sherman Creek. The probability of a tailings pipeline accident and spill is 0.14 percent (1 in 714) per year or 2 percent (1 in 50) over the project life. The maximum consequences of this spill would be 270,000 gallons of tailings slurry spilled into Sherman Creek.

Sedimentation

Sediment resulting from construction and, to a lesser extent, from mine operations, could be carried into Sherman Creek. BMPs would minimize impacts on water quality, habitat, and stream biota from erosion and sedimentation. For the process area and the DTF, the settling ponds are designed to collect all the settleable materials. Remaining suspended sediments in settling pond effluents, which are required to meet effluent solids limits, would not be expected to result in significant impacts on spawning gravels or aquatic habitats.

Minimal levels of impacts on aquatic biota that could occur from minor amounts of sedimentation would likely be undetectable with any form of biological monitoring. Peterson et al. (1985) indicated that significant impacts from siltation or sedimentation could reduce salmon egg survival, juvenile salmonid overwintering, and benthic invertebrate abundance. Incubating salmon eggs can be particularly sensitive to increases in fine sediments, especially from increased levels that occur late in the incubation phase (i.e., late winter). It is expected that any sedimentation impacts would be relatively short-term (1–2 years). Given that the drainage has a steep gradient and occasional large flows to "flush" the system, impacts on the anadromous fisheries in Lower Sherman Creek would not be likely.

4.9.2 Effects of Alternative A1

Under Alternative A1, water withdrawals and related effects would be comparable to those under Alternative A. The projected decrease in flows in Ivanhoe and Ophir creeks would also be comparable to those under Alternative A because the same diversions would be required. The increased flow in Sherman Creek would be less than the 15 percent projected increase under Alternative A. This would have no effect on aquatic life.

Even though the DTF would be smaller, the ephemeral drainages it would affect do not support aquatic life populations; i.e., the effects on habitat and fish populations would be the same as those for Alternative A.

The risk of a fuel spill would be 0.013 percent (about 1 in 7,692) per year or 0.13 percent (about 1 in 769) during the mine life, and the risk of a tailings spill would be 0.13 percent (about 1 in 769) per year or 1.3 percent (1 in 77) during the mine life. The maximum spill volumes and potential impacts are the same as those under Alternative A.

4.9.3 Effects Common to Alternatives B, C, and D

Under Alternatives B, C, and D, mine drainage would be treated the same as under Alternative A. However, most operations would occur within the Johnson Creek drainage (access roads and process area) and the Slate Creek drainage (access roads and the TSF). The same indicators as described under Alternatives A and A1 were used to compare the potential impacts.

Integrity of Freshwater Habitat

Alternatives B, C, and D would require a stormwater diversion channel above the Jualin Mine portal and process area bench and would discharge to Johnson Creek. Stormwater discharged from the diversion would not affect fish or other aquatic organisms.

Alternatives B, C, and D include tailings disposal in Lower Slate Lake through a slurry pipeline from the mill. For the purposes of this analysis, it is expected that all fish and most other aquatic life (such as macroinvertebrates, periphyton, and zooplankton) in Lower Slate Lake would be lost during operations as a result of this action. Some individuals might survive, but marginal food sources and the lack of suitable habitat as the lake elevation rises appear to be the major limiting factors.

Two species of fish are present in Lower Slate Lake: three-spine stickleback (a forage fish) and Dolly Varden char (a sport fish). Estimates of mortality based on the survey completed in 2001 indicate approximately 1,000 Dolly Varden char could be lost because of the tailings disposal in Lower Slate Lake (Kline, 2003a). The Dolly Varden char in Lower Slate Lake appear to be small and exhibit slow growth, according to a comparison of the literature on other Dolly Varden char in Southeast Alaska lakes (Kline, 2003a). As discussed in Section 3.9.2, the number of three-spine sticklebacks in Lower Slate Lake has not been defined, although it is likely greater than the number of Dolly Varden char. The entire population of three-spine sticklebacks could be lost during operations.

Placement of tailings in Lower Slate Lake would raise the lake level to the point that most of both channels of Mid-Lake East Fork Slate Creek would become inundated. Kline (2003c) indicated that there is no evidence that Lower Slate Lake Dolly Varden char spawn in Mid-Lake East Fork Slate Creek. Dolly Varden char have been captured in this system in June, August, September, and October. In the accessible reaches of Mid-Lake East Fork Slate Creek, an average of seven Dolly Varden char were captured in each sampling effort. Of the fish captured in this system, 90 percent have measured less than 5.5 inches in total length. These fish represent the lower 50 percent of the Dolly Varden char in the Slate Creek system and are thus unlikely to include sexually mature fish. This lack of evidence of stream spawning is not sufficient to rule out the possibility that some stream spawning occurs; however, in this case, it appears very limited.

Mortality of macroinvertebrates and other aquatic organisms would also occur in close proximity to the deposited tailings. As the water level in the TSF rose, lakeshore vegetation would become inundated and provide new microhabitat and detritus for colonizing macroinvertebrates. Generally, macroinvertebrate species adapted to highly variable stream environments are better able to tolerate change than those in more stable lake and pond environments (Mackie, 1998). Impacts on species abundance and diversity resulting from catastrophic substrate loss or degradation are well documented. Reports of heavily disturbed streams indicate that macroinvertebrate recovery can occur within time frames ranging from months to a few years (Appendix C; Hill, 1975; Gore, 1985; Thomas, 1985), though responses can vary for individual species (Minshall, 1982).

Figures 2-16 and 2-17 provide overviews of Lower Slate Lake before operations and after closure. As discussed below under Sedimentation and in Appendix C, toxicity tests show that the tailings might not provide suitable habitat for macroinvertebrates. Over the long term, as natural materials redeposit throughout the lake, the larger shallow/productive areas should increase the available habitat (and corresponding fish and macroinvertebrate populations). In the proposed reclamation plan, after mine closure the lake would have at least an equivalent area of plant and shallow water macroinvertebrate habitat that is not covered by tailings. It is therefore assumed that post-closure habitat should be adequate to support a macroinvertebrate population at least comparable to the pre-mining population.

The work completed to date demonstrates that the TSF can be restored to at least equivalent habitat and fish populations after closure. The operational monitoring described in Section 2 would be used to further refine and optimize the reclamation plan. These data would be reviewed by the Forest Service and ADNR, which would approve and oversee implementation of the final reclamation plan. As required by the ADNR Title 41 permit, downstream fish passage would have to be provided at closure from Upper Slate Lake through Lower Slate Creek to East Fork Slate Creek below the lakes. Upstream fish passage would not be restored from East Fork Slate Creek below Lower Slate Lake to Lower Slate Lake.

The existing Jualin access road would be maintained as the primary access to the mine under Alternatives B, C, and D. The road would be upgraded as needed to suit construction and operational requirements and extended from Jualin to the proposed mine portal using appropriate Forest Service BMPs. This road has two stream crossings over Johnson Creek. Existing bridges would be upgraded. Construction would be consistent with Forest Service standards and guidelines (TRAN214), including the use of erosion control and stabilization measures. The installation or improvement of the bridges would also be done under ADNR Title 41 permits that would address impacts on fish habitat.

Water Withdrawal

Under Alternatives B, C, and D an infiltration gallery is proposed for installation in Johnson Creek near Jualin. The infiltration gallery would consist of a perforated pipe placed in gravel adjacent to the stream. Water would flow from a pipe into a sump and then be pumped into a 300,000-gallon freshwater tank. Water withdrawal would require approximately 0.3 cfs under Alternatives B and D and 0.52 cfs under Alternative C from Johnson Creek. These withdrawals would follow instream flow requirements developed by ADF&G and authorized under a water right issued by ADNR. Adherence to the requirements should minimize adverse effects associated with flow reductions. Withdrawals could be restricted during periods of critical flow.

Some short-term impacts on the stream channel would likely occur during installation of the infiltration gallery in Johnson Creek. BMPs should minimize these impacts, but the loss of macroinvertebrates and other aquatic insects would likely occur. As previously indicated, macroinvertebrate species would likely recolonize any areas affected by stream crossings. No studies are available on the presence of fish in this portion of Johnson Creek (Kline, 2003a). If fish are present, the installation of the infiltration gallery would likely have little direct impact on them, and downstream impacts from sediment deposition would probably not occur because sediment would be quickly flushed from the system.

Water Quality

Stream Discharges. Under Alternatives B, C, and D, surface water collected from the Kensington waste rock disposal area would be diverted into the sediment ponds (Figure 2-4) and ultimately discharged to Sherman Creek. This discharge would need to meet water quality-based discharge limits established under the NPDES permit. Because these discharge limits are designed to protect aquatic life, adherence to these criteria should prevent impacts on aquatic organisms in the drainages.

As noted previously, it is assumed that all aquatic life in the TSF would be lost during operations under Alternatives B, C, and D. Test data show that the deposited tailings at closure would not be a source of metals and other pollutant releases to the water column in the lake. The minimum water depth of 9 feet over the tailings should minimize any potential for long-term releases of metals. As a result, post-closure water quality should be comparable to pre-operational water quality and support the restoration of fish and macroinvertebrate populations.

Accidental Spills. Tailings would move from the process area to the TSF through a slurry pipeline. The potential for a spill from the pipeline to reach the Johnson Creek, Slate Creek, or Spectacle Lake drainages would be limited in that the pipeline would be adjacent to a bermed haul road. The distance between the tailings pipeline and Johnson Creek would further reduce the potential for a tailings spill to affect Johnson Creek. Any spill in the Slate Creek drainage would occur within the drainage area contained by the TSF and thus would not produce impacts outside the TSF area. A spill from the small segment of pipeline that crosses the Spectacle Lake drainage basin could result in tailings reaching surface waters. If a spill of tailings were to reach surface waters, the potential impacts would be similar to those described under Alternative A.

Under Alternatives B, C, and D, the mine would be developed using the existing roads in the Sherman Creek drainage. Therefore, fuel and supplies would be temporarily transported over this route until the Johnson Creek road was improved. As identified under Alternative A, fuel and process chemicals would be transported by truck throughout the operation of the mine. Although spill containment equipment would be located at several sites and available for rapid deployment, chemicals or fuel could enter Sherman Creek (while facilities are being constructed), Slate Creek, Johnson Creek, or tributary drainages. Results of an event of this nature would be similar to those discussed under Alternative A.

The probability of a fuel truck accident and spill is 0.04 percent (1 in 2,500) per year or 0.4 percent (1 in 250) over the life of the project (estimated to be 10 years under these alternatives). The maximum consequences of a spill of this nature would be up to 6,500 gallons of diesel fuel spilled into Lower Sherman, Johnson, or Slate Creek. Under Alternatives B, C, and D, however, the relative spill volumes would be lower than those under Alternatives A and A1 due to use of isotainers. The probability of a tailings pipeline accident and spill is 0.3 percent per year (1 in 520) and 3 percent (1 in 32) over the project life. The maximum consequences of a spill would be 270,000 gallons (2.65 tons) of tailings slurry spilled into the drainages.

Sedimentation

Sediment resulting from road construction and improvement and, to a lesser extent, from mine operation could be carried into the Slate and Johnson creek drainages. Impacts on the stream systems from these relatively minor amounts of sediment from construction-related activities would be similar to those described under Alternative A.

Under Alternatives B, C, and D tailings would be deposited subaqueously into the TSF. AScI Corporation (2000a, 2000b) conducted habitability tests using several amphipods on shallow and deep Lower Slate Lake sediments, a control lake sediment, and sediment composed of Kensington Mine tailings. AScI Corporation (2000a, 2000b) conducted tests using *Hyalella azteca* and *Chironomus tentans* in the various sediments to determine effects on survival, growth, emergence, and egg production. Results of the habitability tests on *Hyalella azteca* indicated the control lake sediments and Lower Slate Lake sediments (both shallow and deep) supported acceptable growth as defined by weight and length. The tailings sediment sample caused a statistically significant reduction in the survival of *Hyalella azteca* when compared with the control lake sediments and Lower Slate Lake shallow and deep sediments. Specifically, the survival of *Hyalella azteca* was as follows:

- 83 ± 13 percent in control lake sediments
- 76 ± 22 percent in Lower Slate Lake deep sediments
- 62 ± 28 percent in Lower Slate Lake shallow sediments
- 5 ± 8 percent in tailings sediments

The suggested USEPA minimum survival rate of *Hyalella azteca* for a 28-day sediment exposure is 80 percent. The effect of the tailings sample on *Hyalella azteca* reproduction could not be determined because of low survival in the tailings sample after 28 days.

Results of the habitability tests on *Chironomus tentans* indicated that the control lake sediments, Lower Slate Lake sediments, and tailings supported acceptable 20-day growth. Samples from shallow Lower Slate Lake and deep Lower Slate Lake and tailings samples supported emergence rates of 85 percent, 53 percent, and 43 percent, respectively, showing a statistically significant reduced emergence rate of *Chironomus tentans* when compared with the control lake sample and shallow Lower Slate Lake sediments. USEPA recommends a minimum endpoint of 50 percent for emergence.

These results indicate that mortality of and reproductive effects on *Hyalella azteca* and *Chironomus tentans* that attempted to recolonize the deposited tailings would occur as a result of subaqueous tailings deposition in the TSF. It is likely that similar effects on other macroinvertebrates and aquatic insects would occur. Appendix C shows that the sediment is not toxic to fish populations. However, the reduced number of macroinvertebrate and aquatic insect forage species might indirectly affect post-deposition fisheries populations. As discussed previously, it is assumed that the majority of the fish and other aquatic life in Lower Slate Lake would be lost during operations as a result of tailings disposal. Some individuals might survive, but limited food sources and the lack of suitable habitat as the lake elevation rose appear to be the major limiting factors.

At closure, the shallow aquatic habitat that is not covered by tailings should support near-term restoration of the macroinvertebrate and fish populations in the lake. Modeling shows that the tailings would not generally resuspend and redeposit over the natural sediment areas (Appendix C).

Finally, some uncertainty is associated with these analyses, including the tailings toxicity test results. Reasonable "worst-case" assumptions, however, have been made here and in Appendix C in presuming that all aquatic life would be lost in the TSF during operations and that the tailings would not support macroinvertebrates after closure (Tetra Tech, 2003b). As additional test and operational data became available, the mine operator would modify tailing deposition procedures and the reclamation plan to maximize opportunities for improving aquatic resources in the lake.

4.9.4 Effects of Alternative B

The same indicators as described under Alternative A were used to evaluate potential impacts under this alternative. Potential impacts related to the integrity of freshwater habitat in the TSF, water withdrawal, accidental spills, and sedimentation are described in Sections 4.9.1 through 4.9.3. No impacts on Upper Slate Lake aquatic resources are predicted under Alternative B. Additional effects on freshwater habitat and water quality might occur as described below.

Integrity of Freshwater Habitat

Under Alternative B, ADNR would require continuous discharge from the TSF at flows sufficient to protect aquatic life. As discussed below and in Section 4.6.5, however, the TSF might not always meet NPDES permit limits for metal pollutants and solids. During such periods impacts on downstream Dolly Varden char populations could occur because of cessation of discharges.

Water Quality

As noted above, the TSF effluent might not always meet NPDES permit limits. As a result, additional treatment would likely be necessary to ensure protection of downstream aquatic life.

4.9.5 Effects of Alternative C

The same indicators as described under Alternative A were used to evaluate potential impacts under this alternative. Potential impacts related to water withdrawal, sedimentation, and accidental spills would be the same as those described in Sections 4.9.1 through 4.9.3. Additional effects on freshwater habitat and water quality might occur as discussed below.

Integrity of Freshwater Habitat

Under Alternative C, the gravity-fed diversion channel would ensure that minimum instream flow requirements established by ADNR to protect aquatic life were met. In addition, the channel would provide for fish passage around the TSF.

The construction of the dam would inundate approximately 8 additional acres around Upper Slate Lake during the 10-year mine life, including stream, riparian, and wetland habitat. This could specifically affect spawning habitat in Upper Slate Lake, although the exact nature and locations of Dolly Varden char spawning have not been determined. Habitat effects could then affect the 1,500 Dolly Varden char that have been found in the lake. Any impacts would be temporary because the dam would be removed during reclamation and the lake and the surrounding area are expected to return to their original physical and biological conditions.

Water Quality

As discussed in Section 4.6.6, the water quality in the TSF would not always meet applicable permit limits. Although the diversion would maintain continuous flow such that discharge would not be required at all times, there is not sufficient capacity to retain all the water in the TSF until permit limits are met. Ultimately, a treatment system for metals and solids would likely be required to protect downstream aquatic life.

4.9.6 Effects of Alternative D

The same indicators as described under Alternative A were used to evaluate potential impacts under Alternative D. Potential impacts related to water withdrawals, sedimentation, and accidental spills would be the same as those described in Sections 4.9.1 and 4.9.3. Additional effects on freshwater habitat and water quality are described below.

Integrity of Freshwater Habitat

Under Alternative D, the gravity-fed diversion pipeline would ensure that minimum instream flow requirements established by ADNR to protect aquatic life were met. As required by ADNR, fish passage around the TSF would occur either through the pipeline or by trapping fish at the diversion intake and transporting them to below the dam.

Because of some uncertainty in the tailings toxicity test results, Alternative D includes a native material cap over the tailings. The cap would further ensure adequate macroinvertebrate habitat after closure. It would have to be installed unless the operator can demonstrate to the Forest Service, ADNR, USACOE, and USEPA that the tailings will not cause post-closure toxicity throughout the lake.

Water Quality

As discussed in Section 4.6.7, the TSF discharge would always meet applicable permit limits that are protective of aquatic life and no downstream impacts are predicted.

4.9.7 Summary

Table 4-16 summarizes the impacts of each alternative on freshwater aquatic resources. The major difference between Alternatives A and A1 and Alternatives B, C, and D would be the loss of approximately 1,000 Dolly Varden char and an unspecified number of three-spine sticklebacks under the latter alternatives. It is anticipated that after closure Lower Slate Lake could be restored to at least equivalent aquatic habitat.

Table 4-16
Summary of Impacts on Freshwater Aquatic Resources For All Alternatives

Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Diversions	Four diversions totaling 2.3 miles. Only Ophir Creek diversion directly affects stream flow. All diversions except around DTF removed at closure. Potential impact on Ivanhoe Creek because of increased flows from Ophir Creek diversion.	Same as Alternative A with smaller diversion around the smaller DTF.	One 1,500-foot diversion above the waste rock disposal/850-foot adit area on the Kensington side and 2,500-foot diversion around the process area on the Jualin side. 0.75 mile total diversions.	Same as Alternative B plus two 2,550-foot diversions constructed around the northern and eastern portions of the TSF. 1.75 miles total diversions.	Same as Alternative, plus a 3,500 foot pipeline diversion constructed around TSF. 1.5 mile total diversions.

Table 4-16
Summary of Impacts on Freshwater Aquatic Resources For All Alternatives (continued)

Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Stream flow	Potential impact on instream flows during critical flow period in Sherman Creek between withdrawal and discharge point. Limited by state requirements for maintaining instream flows necessary to maintain fish habitat. Mine drainage would provide alternative water supply.	Same as Alternative A.	Potential impact on instream flows in Johnson Creek drainage from the infiltration gallery (water supply). Limited by state requirements for maintaining instream flows necessary to maintain fish habitat. Potential elimination of flow in lower East Fork Slate Creek if discharge not allowed under NPDES permit.	Same as Alternative B, except no TSF impacts because diversions maintain flow in lower East Fork Slate Creek.	Same as Alternative B, except no flow issues associated with TSF because treatment system ensures compliance with NPDES permit limits.
Habitat loss	2,450-foot temporary loss in Ophir Creek during operations; channel restored during closure.	Same as Alternative A.	Loss of all habitat (20 acres) in Lower Slate Lake during operations; loss of habitat in Mid-Lake East Fork (approximately 1,200 feet) due to inundation as TSF water levels rise and East Fork Slate Creek (200 feet) due to construction of dam.	Same as Alternative B plus inundation of additional habitat around Upper Slate Lake.	Same as Alternative B.
Stream crossings	Five crossings within Sherman Creek drainage. Potential channelization, erosion of bed material, and sedimentation; potential effects on fish passage.	Same as Alternative A.	Five crossings (three in Sherman Creek, two in Johnson Creek drainage). Upgrading of crossings would have minimal impact on habitat.	Same as Alternative B.	Same as Alternative B.
Fish mortality	Potential loss of 100 to 200 Dolly Varden char resulting from Ophir/Ivanhoe Creek diversions.	Same as Alternative A.	100 percent mortality (estimated at 996 individual Dolly Varden char) in Lower Slate Lake during operation of the TSF. Three-spine sticklebacks and benthic organisms also eliminated during operations. Restored to at least pre-mining conditions at closure.	Same as Alternative B, plus short-term impacts on Upper Slate Lakes due to potential spawning area inundation.	Same as Alternative B, except greater certainty of TSF restoration due to cap.
Water withdrawals	None, assuming minimum instream flow requirements are met.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

4.10 AQUATIC RESOURCES: MARINE

Implementation of any of the project alternatives would have the potential to affect the marine environment. The main sources of impacts would be construction, facilities operations, and spills (primarily hydrocarbon contamination). The following discussions evaluate these potential sources of impacts on water quality, nearshore marine organisms, and marine mammals and fish. Criteria for assessing potential impacts on marine biological resources are based on (1) the number or amount of the resource that would be affected relative to its occurrence near the project site, (2) the sensitivity of the resource to proposed activities, and (3) the duration of the impact.

4.10.1 Effects of Alternative A

Water Quality

Construction. Potential construction-related impacts on marine water quality would result from excavation for the construction of the barge landing site at Comet Beach. Dredging operations would produce sedimentation. Excavation would result in short-term increases in suspended sediments in the nearshore waters adjacent to the excavation site. In general, increased suspended sediment concentrations could reduce the water clarity and light transmission in surface waters. Because the nearshore sediments are primarily coarse materials and cobbles that would settle rapidly to the bottom, the magnitude and duration of this effect would be minor. Similarly, eroded soils and other materials generated by runoff from other portions of the project area could be transported to Lynn Canal. The potential impacts on nearshore water quality from runoff are also expected to be minor and comparable to the potential effects from discharges from adjacent creeks and streams.

Under this alternative, the Comet Beach sewage treatment plant would be used during construction of the process area. Sanitary wastewater from the Comet Beach camp would undergo secondary treatment prior to discharge to Lynn Canal. Once built, the process area would include a sewage treatment plant that would discharge to a leach field, lessening the demand on the Comet Beach facility. Sewage effluent can be a source of suspended solids, organic materials, nutrients, fecal bacteria, and viruses. Because the nearshore waters of Lynn Canal are well mixed, accumulation of solids and organic matter from the sewage effluent is not expected. Similarly, eutrophication and oxygen depletion of bottom waters due to increased oxygen demand are not expected. Bacteria and viruses associated with the sewage would experience natural die-off; therefore, accumulation of bacteria and pathogens in Lynn Canal is not expected.

Although the volume of the discharge would likely be greater until a leach field system could be built, the discharge would have to comply with NPDES permit limits and water quality standards. Discharges of treated sewage represent a potential source of nutrients that could stimulate phytoplankton production in a localized area of Lynn Canal. This effect would be relatively small and could be offset by related reductions in light transmission caused by elevated localized turbidity associated with the effluent plume.

Facility Operations. The effects on marine water quality from the outflow from Sherman Creek and Camp Creek are expected to be insignificant, assuming that the effluent discharges comply with NPDES permit limits. Day-to-day operations of the Comet Beach marine terminal are not expected to affect water quality.

Spills. Alternative A would use diesel fuel as the primary fuel for on-site operations. The highest probability of a diesel spill in Lynn Canal would occur during transfers, such as those between barges and the 300,000-gallon storage tank at Comet Beach. The maximum potential spill during diesel fuel transfer would be about 880 gallons, based on the capacity of the fuel transfer system that would be employed and the size of the hose used for the transfers. Vessel groundings, collisions, or other accidents causing a rupture in the vessel hull could release large volumes of diesel fuel, although the probability of these spills is considerably lower than that of a fuel transfer-related spill.

If a spill were to occur, the dispersion of diesel fuel in Lynn Canal would depend on a number of factors, such as the combined strength of tidal currents, wind and wave mixing, longer-period current patterns, and the extent of previous weathering (i.e., changes to the physical/chemical properties of the material). In addition to dispersion, the fate of petroleum hydrocarbons after a spill is affected by a number of other processes, including evaporation, emulsification, dissolution, reaction, and sedimentation (Irwin et al., 1997). Oil undergoes several physical, chemical, and biological processes of weathering following a spill. Studies have found that gentle aeration of the oil-in-water dispersions of various crude oils results in a loss of 80–90 percent of hydrocarbons in 24 hours (Irwin et al., 1997). Biodegradation rates of hydrocarbons depend on the type of bacteria present, presence of limiting nutrients, temperature, and types of hydrocarbons. Most biodegradation occurs from a week to several months after a spill, the breakdown being done by bacteria (Irwin et al., 1997). These factors, along with the speed and effectiveness of spill response actions, would largely determine the effects associated with a spill.

Diesel fuel consists primarily of low- to medium-molecular-weight hydrocarbon compounds that are more volatile and water-soluble than the higher-molecular-weight components of crude oils. Therefore, a greater proportion of a diesel spill is lost to evaporation and dissolution compared to a crude oil spill (NOAA, no date). Although diesel is more volatile than crude oils, some of the soluble components, such as the lower molecular weight aromatic compounds, can be acutely toxic to marine organisms (NOAA, no date).

The greatest longevity of diesel fuel residues in the environment occurs when the fuel becomes buried in intertidal muds or marshes, where the potential for evaporation and dissolution or dilution is minimized. Because intertidal muds and marshes do not occur in the immediate vicinity of Comet Beach, the long-term persistence of diesel fuel resulting from a spill would not be expected. In addition, it is unlikely that most of a diesel spill would sink to the bottom of Lynn Canal.

Nearshore Marine Organisms

Construction. The construction of the marine terminal would require dredging a portion of Comet Beach in the immediate vicinity of the barge landing area. The dredging would physically disturb 2.3 acres of the cobble beach and intertidal and subtidal habitats. This would subsequently disturb any algae, mussels, snails, sea stars, crabs, and associated organisms inhabiting the area. However, the potential for lasting impacts from construction on marine organisms is minimal. The use of precast concrete blocks for a landing ramp would change the intertidal beach area from the current cobble, modifying future habitat conditions and likely the species composition in the small shoreline area. Increases in suspended particle concentrations would be localized and of short duration. Disturbances to the substrate would be localized to the area of newly constructed facilities. Recolonization by intertidal species would begin almost immediately and would continue until the community had recovered, likely 3 to 5 years.

Operations. During operations, mine water and runoff and drainage from the DTF would be discharged to freshwater creeks and would be required to meet water quality limits. These discharges would not affect nearshore marine organisms where the creeks enter Lynn Canal.

Spills. As noted above, hazardous substances, including diesel fuel, would be routinely used at the project site during both construction and operation. As explained in the Transportation section (Section 4.18), the probability of a spill is low, although a fuel spill entering Lynn Canal could adversely affect nearshore marine organisms. Although diesel fuel can be acutely toxic, its residence time in the marine environment is relatively short. One of the more toxic and persistent groups of components of hydrocarbons spills is polycyclic aromatic hydrocarbons (PAHs). These compounds, though a small portion of diesel fuel, have been found to be toxic or cause adverse effects on common Alaskan marine planktonic invertebrates at low concentrations, especially when subjected to normal light levels (Duesterloh et al., 2002; Meador et al., 1995). When a diesel spill occurs in the immediate proximity of a beach, hydrocarbons can be trapped in the sediments and remain for several years (Gulliksen and Taasen, 1982). The material trapped in beach sediments can continue to be lethal to intertidal organisms in the immediate vicinity of the spill for months (Gulliksen and Taasen, 1982). The coarse nature of Comet Beach (cobbles) would limit the amount of hydrocarbon that could be trapped following a spill.

The tailings pipeline would be located within the footprint of the haul road, reducing the likelihood of a tailings spill reaching Sherman Creek and limiting the extent of a spill should one occur. Section 4.9.1 notes that the probability of a tailings spill is small. However, if a spill were to occur, the volume could be as high as the 270,000-gallon capacity of the entire pipeline. In the unlikely event that a slurry spill reached Sherman Creek, at least some of the material would be removed from the stream through cleanup actions before it could reach the creek mouth. Much of the slurry would be liquid and fines that would disperse as suspended matter into Lynn Canal, although the majority would initially be deposited near the creek mouth. The tailings are not expected to be toxic in character (see Section 4.9.1). Some burial and loss of marine nearshore (intertidal and subtidal) benthic marine resources would occur. This would cause a short-term reduction in food resources for nearshore-rearing organisms, including crab, fish such as juvenile salmon, and other fish and invertebrates. Pelagic and many epibenthic organisms could avoid the direct impact by leaving the deposition area. The areas covered by this sediment would be recolonized rapidly by most benthic organisms within a year and would likely be totally recovered in 3 to 5 years.

Marine Mammals

Construction. Because construction activities would be confined to land and the nearshore areas of Lynn Canal, no impacts on marine mammals are expected. Free-swimming animals, such as marine mammals, would not be expected to reside for extended periods within the very localized waters containing elevated concentrations of nutrients from sanitary effluent, near shipping operations. They would also be likely to avoid the area during active periods of construction. Therefore, the probability of marine mammals remaining in any impacted area long enough to suffer chronic effects is negligible.

Operations. Marine mammals might be present in the vicinity of Comet Beach but are not known to congregate in the area. The movement of barges in and out of the site could result in the temporary displacement of individuals that might be in the area at any given time. This effect would be limited to the immediate vicinity of the Comet Beach terminal and would be short in duration.

Spills. Spills would be unlikely to affect marine mammals given the limited size of any potential spill and the ability of these creatures to avoid a contaminated area.

Fish

Construction. The waters off Comet Beach support juvenile pink and coho salmon in the spring and early summer. Construction of the barge landing at Comet Beach could have short-term adverse effects on migrating juvenile salmon if it occurred during typical nearshore rearing periods (likely March 15–June 15). Increased turbidity from dredging and pile driving might cause some avoidance of the areas and short-term reduction in benthic food resources from the removed benthic areas. Installation of pilings for the mooring dolphins at Comet Beach could have short-term direct adverse effects on nearshore rearing fish (e.g. herring, juvenile salmon). Adverse effects on fish have been linked to the pressure waves created by pile driving, especially metal piles. Pressure wave effects include local behavior modification and, in worse cases, hemorrhage and rupture of internal organs resulting in direct mortality (Longmuir and Lively, 2001; Stotz and Colby, 2001 as cited in Tetra Tech FW, 2003; Feist et al., 1996). Methods available to reduce or eliminate these impacts include timing of installation when major fish resources are not present and the use of bubble curtains and low-noise methods of pile driving.

The small area affected (about 2.3 acres) and the ability of pink salmon to feed on both pelagic and benthic resources (Groot and Margolis, 1991) would reduce impacts on this stock. Benthic organisms would recolonize the dredged area following the completion of construction activities, although the precast concrete landing ramp would likely have reduced production of benthic food resources. Long-term impacts on juvenile salmon or essential fish habitat (EFH) are not expected.

Operations. The design of the Comet Beach marine facility would not inhibit fish migration through the area. Discharges to Sherman Creek and Camp Creek would be well mixed by the time the effluents reached marine waters, and sediment would be controlled using BMPs. As a result, the potential for impacts from operations on marine fish or EFH in Lynn Canal is negligible.

Spills. Hazardous substances, including diesel fuel, would be routinely used at the project site during both construction and operation. Fuel spills entering Lynn Canal could adversely affect marine fish, with the same implications as those discussed under Water Quality above. However, as discussed in detail under Alternatives B and D below, the chance of PAHs reaching this level from normal operations is very low.

Total petroleum hydrocarbons (TPHs) comprise a mixture of light and heavy PAHs. These compounds have different toxicity characteristics based on their water-solubility, volatility, vapor pressure, and molecular weight (Irwin et al., 1997). Lighter aromatic hydrocarbons, like those contained in diesel fuel, are generally more volatile and rapidly evaporate. PAHs, which are a small portion of diesel fuel, are more toxic and persistent, particularly in sediment. Reported effects of individual PAHs on fish include reduced growth and development, impairment of reproductive and immune systems, altered endocrine function, and egg mortality (Irwin et al., 1997; Carls et al., 1999; Barron et al., 2004a, 2004b). Levels less than 1 μg /L PAH have been found to cause adverse effects on certain life stages of herring and pink salmon (Carls et al., 1999; Rice et al., 2001).

High concentrations of aromatic compounds from spills could become mixed in the water column, where they could be acutely and chronically toxic to marine organisms. Toxicity to fish such as migrant salmon juveniles would be short-term (Bax, 1987) unless a spill occurred during the spring (March 15 to June 15) when pink and chum salmon fry are closely associated with the nearshore environment. A spill at this time in the nearshore environment could be highly detrimental to fish use of those sites. Impacts on larger fish would be reduced by their avoidance of the spill area.

If a spill occurred during a salmon fishery, tainting of some fish would be expected. Although the percentage of the total salmon run affected would be small, the stigma of potential tainting could have significant effects on the fishery as a whole (Baker et al., 1990). Tainting of other fish, such as sablefish and halibut, could also occur. The operator has proposed to limit scheduled deliveries during open fisheries, which would reduce the likelihood of a spill affecting salmon or groundfish fisheries.

Tailings spills entering the marine environment through Sherman Creek would ultimately reduce available nearshore fish food supply over a small area. Such a spill could affect juvenile salmonids present during spring and early summer, as well as other marine predators (e.g., flatfish, crabs, shrimp). The impact of such a spill would be slight and short-lived because of the small area potentially affected and rapid recolonization of covered areas. The probability of a tailings spill is also small (see Section 4.9.1), and efforts would be made to clean up any spill before it entered the marine system.

4.10.2 Effects of Alternative A1

The potential impacts on the marine environment under Alternative A1 would be the same as those described for Alternative A. However, the duration of operational impacts would be shorter by 2 years due to the shorter operating life.

4.10.3 Effects of Alternatives B, C, and D

The placement of the marine terminal at Cascade Point (Alternatives B and D) or Echo Cove (Alternative C) would have different impacts on some marine resources. The overall impacts are summarized below.

Water Quality

Construction. Potential impacts from Alternatives B, C, and D on marine water quality in Berners Bay associated with dredging and construction of the marine terminals at Slate Creek Cove and Cascade Point or Echo Cove would be similar to those discussed under Alternative A. Excavation would be expected to result in short-term increases in suspended sediments in the nearshore waters adjacent to the excavation site. In general, increased suspended sediment concentrations could reduce the clarity of and light transmission in surface waters. Because the nearshore sediments are primarily coarse materials and cobbles, these materials would settle rapidly to the bottom. Therefore, the magnitude and duration of this effect on water quality are expected to be minor. In Echo Cove, dredging would occur along approximately 4,300 feet of the entrance at a depth (mostly less than 6.5 feet below mean lower low water [MLLW]) that might include a greater concentration of fine material. Periodic dredging at the Echo Cove entrance would be required, causing occasional short-term increases in turbidity having slight effects on water quality. This maintenance dredging would occur as necessary, whenever the crew shuttle had difficulty entering the cove. Disposal of the dredged material would be subject to a USACE Section 404 permit.

Operations. The discharges of mine water to Sherman Creek and TSF effluent to Slate Creek would occur well upstream of marine waters. Therefore, with the exception of accidental spills, project operations would not be expected to have any impact on water quality in the marine environment.

Spills. The probability of a spill at any of the marine terminals would be very low as a result of design elements (e.g., isotainers) and mitigation measures required by existing permits. The character of spills would be different between Slate Creek Cove and Cascade Point/Echo Cove, and the effects would be somewhat different among the three. Fueling would occur at Cascade Point (Alternatives B and D) or Echo Cove (Alternative C). There would be a potential at these locations for spills during fueling operations and for leaking of fuel or oils from the crew shuttle boat. The volume of a potential fuel spill during fueling operations could range from drops to tens of gallons depending on the circumstances of the spill. BMPs, including automatic shutoff valves, a trained operator, the use of an absorbent pad during the operations, and a bucket to control drips from the nozzle, would minimize the likelihood of such a spill. A spill at Cascade Point would likely be difficult to contain due to the high energy of the tide and currents, but hydrocarbon concentrations would quickly dissipate for the same reasons. Conversely, a spill at Echo Cove would be easier to contain because of the relatively gentle currents and tide, although hydrocarbon concentrations could persist at higher levels because the energy input to dissipate the spill would be less than that at Cascade Point. In either case, the concentrations of hydrocarbons would increase in the water column at least over the short term. Leaks from the crew shuttle boat could result in slight increases in hydrocarbon concentrations as well, and again the extent of flushing could result in higher levels at Echo Cove versus Cascade Point, assuming a leak of similar size. BMPs including regularly inspecting the vessel and prohibiting the discharge of oily bilge water, should reduce the occurrence of leaks.

Spills at Slate Creek Cove could come in the form of leaks from vessels (crew shuttle or barges) and would have consequences on water quality similar to those of leaks at Cascade Point. Because fuel would be delivered to the site in isotainers specifically designed for transporting hazardous materials, a fuel spill involving unloading an isotainer is highly unlikely. Likewise, chemicals used in the mining process would be shipped in sealed containers, minimizing the possibility of spills. Refueling of the equipment (i.e., trucks, fork lifts) would be done at an upland location away from the beach and would therefore be unlikely to contaminate the marine environment. Leaks from the equipment would be limited to the size of the fluid reservoirs, typically less than 20 gallons for oil and less than 30 gallons for diesel. If these volumes were to spill, the concentrations of hydrocarbons in the water column would increase until the spill was cleaned up or dissipated. Because of the relatively small size of such a spill, cleanup before the spill dispersed would be difficult and there would likely be a localized increase in chronic levels of hydrocarbons in the water column surrounding the facility over the short term (hours, days, or weeks).

Nearshore Marine Organisms

Construction. The construction of the marine terminals at Slate Creek Cove and Cascade Point would result in disturbances to intertidal and subtidal organisms. Under Alternatives B and D, facilities at Slate Creek Cove (see Figure 2-7) would require the placement of approximately 28,900 cubic yards of fill affecting approximately 3.6 acres within the beach intertidal and subtidal zones. Under Alternative C, the fill area would be reduced by approximately 0.5 acre (see Figure 2-10). Construction at Cascade Point (see Figure 2-8) would require a combination of dredge and fill. Approximately 70,000 square feet (1.6 acres) of intertidal and subtidal habitat would need to be dredged at Cascade Point. The excavation would be conducted inside the breakwater to below the minus 10 MLLW mark and would involve the removal of approximately 23,000 cubic yards (affecting 1.6 acres) of material. Approximately 33,000 cubic yards of fill would be placed to form the breakwater, covering a total of 56,628 square feet (1.3 acres) of beach and intertidal and subtidal areas.

The dock facility at Echo Cove would not require any direct fill or dredging. However the entrance to Echo Cove would need to be dredged because of its shallow depth (-6.5 feet MLLW). Estimated dredging would include removal of about 150,000 cubic yards of mostly sandy bottom material. Current plans include a 150-foot by 4,300-foot channel, affecting an area of about 15 acres of subtidal habitat as illustrated in Figure 2-11 (maximum dredge depth of -16 feet MLLW). Some areas outside this channel would also be dredged to ensure slope stability. Because of the sandy bottom at the entrance to this area, maintenance dredging would also be needed. Maintenance dredging would not be required at the other marine terminals. To ensure marine organism protection, representative, dredged sediment would be tested for toxic chemical composition prior to disposal to ensure sediment quality at the selected disposal site(s). The testing methods and disposal sites would be approved by the USACE prior to dredging.

These activities would disturb and entrain any algae, mussels, snails, sea stars, crabs, and associated organisms inhabiting the areas of the Slate Creek Cove and Cascade Point marine terminals and the 4,300-foot-long dredged entrance channel to Echo Cove. A common concern during marine dredging is short-term direct loss (due to entrainment) of the commercially important Dungeness crab, which often occupies shallow nearshore tidal and subtidal areas (Nightingale and Simenstad, 2001). This is an important commercial and recreational species in Berners Bay. Habitat would be permanently lost for the above-water portions of the fills at Slate Creek Cove and Cascade Point. However, these species would recolonize the inundated portions of the fills, as well as the dredged area at Cascade Point and the Echo Cove entrance. The long-term impacts from construction on most of these organisms would be minimal. The effect of increases in suspended particle concentrations on nearshore organisms would be localized and of short duration. The reoccurring dredging required for the Echo Cove entrance would cause periodic loss of subtidal benthic resources, including such organisms as Dungeness crab that might be present in the dredged channel. The channel dredging in Echo Cove, however, might have more long-term effects on Dungeness crab within the cove if habitat is changed substantially by the dredging. Juvenile Dungeness crab abundance and survival in Washington State has been found to be highest in nearshore gravel-algae and eelgrass habitat, with significantly lower density and survival in open sand habitat (McMillan et al., 1995 as cited by Nightingale and Simenstad, 2001). Should the navigation channel result in a reduction of the area of this type of habitat, production might be reduced to some extent within Echo Cove, an area known to be important for harvest of Dungeness crab. Although the exact extent of substrate (thought to be mostly sand) and algae habitat conditions within the potential dredge area is unknown, the fact that the depth would be increased indicates that attached algae production would be reduced due to lower light levels reaching the increased depth.

Disposal of the dredging spoils from Echo Cove channel would likely be done in open water in Lynn Canal and would require a separate Section 404 permit from the USACE. The marine areas where this disposal occurred would have short-term burial of benthic organisms and displacement of epibenthic organisms, including fish, crabs, and shrimp. However, studies of many disposal sites have found rapid recolonization of these areas by both benthic and epibenthic organisms (Nightingale and Simenstad, 2001).

The effect of increases in suspended particle concentrations on nearshore organisms would be localized and of short duration. The transfer bridge and the floating docks at all facilities could slightly reduce the amount of sunlight penetrating the waters and might produce a corresponding drop in productivity in shaded areas. This impact would be very limited in area and would be negligible.

Operations. Impacts from day-to-day facility operations on nearshore organisms would be minimal. A very small area of exposed breakwater would be permanently lost to benthic organism production at the Cascade Point facility as intertidal organisms would colonize the portions of the breakwater subject to tidal inundation. No comparable loss would occur at Echo Cove because no breakwater would be constructed.

At any of the proposed marine terminals, the benthic region in the immediate vicinity of the dock would likely be disturbed daily due to propeller or jet activity (“prop wash”) from the crew shuttle

(Nightingale and Simenstad, 2001). The bottom of this small area would be disturbed, likely resulting in reduced primary (attached algae) and secondary (benthic organisms) production due to frequent suspension of fine bottom material.

Spills. Operations at the Slate Creek Cove marine terminal could result in spills of fuel, process chemicals, or concentrate. As discussed in Section 4.18 (Transportation), the probability of a spill is very low. Should one occur, the dispersion of a fuel or chemical spill in Slate Creek Cove or Berners Bay would be affected by factors that include spill size, tides, wind, and bathymetry. These factors, along with the speed and effectiveness of spill response actions, would largely determine the magnitude of the spill's effects. Short-term effects of a spill could be significant, including acute toxicity for exposed individuals, depending on the material spilled. For example, low concentrations of some PAHs have been found to be toxic to marine plankton common in Alaskan water at very low concentrations (2 µg/L) when organisms are exposed to normal surface light levels (Duesterloh et al., 2002). PAH compounds can be retained in sediment, where they can be taken up by some benthic macroinvertebrates. Some of these species, including some fish prey species, bioaccumulate PAH compounds (Varanasi et al., 1989; 1992; Meador et al., 1995); however, many invertebrate species rapidly pass PAH from their systems, and do not bioaccumulate these compounds (Meador et al., 1995).

Small spills would not generate concentrations high enough to cause concern. Larger spills could produce acute effects, although following cleanup operations a larger spill would not be expected to have long-term consequences for the nearshore marine community.

There are no plans for loading any types of materials or supplies at Cascade Point or Echo Cove. Fuel for the crew shuttle boat would not be stored at either Cascade Point or Echo Cove but would be delivered by truck for direct fueling as needed (RTR, 2004). Because fueling procedures have been developed, including the use of many BMPs recommended for use in Alaskan harbors (Neil Ross Consultants, 1995), the primary source of any fuel entering the water at these sites would be diesel leakage or pumped bilge water. The transportation management plan and BMPs developed by Coeur (RTR, 2004) consider the timing of critical fish life stages and include restrictions on the timing, locations, and methods of fueling, reducing risks of accidental spills during these critical life stage periods. A regular maintenance schedule for the crew shuttle boat would minimize the likelihood of leakage, and small hydrocarbon leaks would not be expected to produce acute or chronic effects on intertidal organisms in the vicinity of Slate Creek Cove, Cascade Point, or Echo Cove. Likewise, policies limiting the discharge of bilge water would be incorporated into the facility management plan. However, chronic leaks or spills could have a greater local effect on nearshore marine organisms in Echo Cove because of the relatively low flushing of water in the cove. Higher concentrations would likely exist for a greater length of time within the cove than if a leak or spill were to occur at Cascade Point or Slate Creek Cove. However, relative to the other sites, the confined nature of Echo Cove would improve opportunities to clean up any large spill before it could spread.

Marine Mammals

Construction. Acknowledging the importance of the spring eulachon and herring runs in Berners Bay to Steller sea lions and other marine mammals, construction of any of the marine facilities would be prohibited from approximately March 15 through June 15 through CBJ's Allowable Use Permit, although ADNR's tideland leases and the USACE's Section 404 permits could include additional restrictions. The prohibition eliminates the potential for construction-related impacts during the most critical time period in the project area for marine mammals.

The use of Berners Bay by humpback whales becomes more irregular after the eulachon and herring spawning season, and the use of the area by Steller sea lions drops significantly (USFWS, 2003; Womble, 2003, personal communication; Siegler et al., 2003). The potential for impacts on humpback whales and Steller sea lions as a result of construction activities outside the March 15 through June 15 window would be further reduced by a stipulation proposed in the USACE's Section 404 permit. The stipulation would require the operator to cease in-water activities such as dredging and pile driving when Steller sea lions or humpback whales were observed within 1,000 feet of the activity.

Harbor seals (including pups and molting seals) have been documented hauling out in large numbers within the bay later into the summer (ADF&G, 2004, unpublished data). Most of the seals documented at this time were observed near the mouths of the Antler and Lace rivers, although they are also noted to haul out off the rocky point adjacent to Slate Creek Cove and at Point Bridget on the east side of the Bay. Dock construction activities at Slate Creek Cove during August would likely affect seals using the rocky point near cove: however, it is unclear whether seals hauled out at the mouth of the Antler and Lace rivers would be affected during construction because they would be some distance from it.

Operations. During most of the year, regular operations would include three to five daily round trips by the crew shuttle boat between Cascade Point and Slate Creek Cove, plus four barges per week docking in Slate Creek Cove. To reduce potential impacts on marine mammals, the operator's transportation plan (Appendix E) calls for restricting the number of daily shuttle boat trips to two to three per day during the April–May spawning runs of eulachon and herring. The operator would also limit barge traffic to the extent possible. The operator has proposed to fund a NMFS-trained observer to ride on the crew shuttle during the April–May time frame to determine the best routing between the two terminals to further minimize impacts on marine mammals. The crew shuttle and barge operations would need to comply with NMFS guidelines for approaching marine mammals. Adherence to the proposed practices should minimize the disturbance to Steller sea lions, as well as humpback whales. The *Biological Assessment/Biological Evaluation (BA/BE) for Threatened, Endangered, and Sensitive Wildlife Species, Kensington Gold Project*, presented as Appendix J, is under review with NMFS and contains a detailed description of potential impacts on marine mammals from vessel noise and operations. The BA/BE also includes additional mitigation measures to reduce potential impacts.

The effects from vessel traffic and noise on wildlife vary in different species and situations. Pinnipeds as a group are known to startle at noises. Porter (1997) observed Steller sea lions in Southeast Alaska startling and fleeing for a wide variety of reasons, such as helicopter overflights, bird flybys, and the presence of humans. Sea lions fleeing haulouts have fairly predictable behaviors once they gain safety and often return within 2 hours (Porter, 1997). The potential impact of cruise ship noises on local humpback whale populations in nearby Glacier Bay continues to be a subject of research and concern. What is clear from the Glacier Bay research is that humpback whales often move away from approaching vessels and may respond to vessel noises with aerial or vocal threats (Baker et al., 1982; 1983; Baker and Herman, 1989).Steller sea lions and harbor seals may habituate to strong noise signals. The failure of acoustical harassment devices ("seal bombs" and pingers greater than 200 decibels [dB]) to keep seals and sea lions away from aquacultural facilities or fishing equipment is an indication of habituation (Mate and Harvey, 1987; Myrick et al., 1990). While research off Cape Cod has shown that in some cases, humpback whales have acclimated to vessel noise (Watkins, 1986) continuing research on the interaction between humpback whales and cruise ships in Glacier Bay has yet to show that humpback whales in Southeast Alaska inland waters are able to habituate to vessel noises. Noise and traffic associated with operations outside the eulachon and herring spawning period could affect the occasional humpback whale or Steller sea lion using the area but would be more likely to affect the harbor seals using the rocky point east of the proposed Slate Cove dock facility.

Potential collisions with whales and other marine mammals during crew shuttle and barge operations in Berners Bay are possible; however, mitigation measures that would reduce the speed of the crew shuttle boat have been proposed. A reduction in the speed of the crew shuttle would reduce the likelihood for collisions and lower the noise level coming from the vessel both above and below water. Barges hauling supplies to and concentrate from the mine regularly would not be likely to affect whale distribution in Berners Bay. These vessels would operate at low, constant speeds and at regular intervals (three or four times per week) and would be prohibited from approaching within 100 yards (50 CFR Part 224 Regulations governing the approach to humpback whales in Alaska). Steller sea lions are very mobile and alert animals. It is very unlikely that they would be susceptible to strikes from vessels, especially the slow-moving crew shuttle and barges.

In Summary the project operations could cause effects on individual marine mammals due to moise and/or physical disturbance. As documented in the BA/BE, the mitigation measures expected to be included in federal, state, and local permits will minimize these effects and no adverse impacts are predicted.

Spills. The fate of petroleum hydrocarbons after a spill was discussed previously in this section, along with the fact that the probability of a spill is very low. If a spill large enough to result in water column contamination were to occur, marine fish would take up petroleum hydrocarbons from water and food. However, within a few days after exposure, aromatic hydrocarbons are oxygenated into polar metabolites and excreted. For this reason, most fish do not accumulate and retain high concentrations of petroleum hydrocarbons, even in heavily oil-contaminated environments. They are, therefore, not likely to transfer them to predators (Neff, 1990). Furthermore, marine carnivores are generally inefficient assimilators of petroleum compounds in food. Because primary prey species are able to release hydrocarbons from their tissues (Neff and Anderson, 1981), biomagnification does not occur.

Infrequent leakage of hydrocarbons from normal crew shuttle use could be expected to occur at the marine terminals or en route between them. However, considering the likely low levels of hydrocarbons that would result from such minor leakage, adverse effects on marine mammals using Berners Bay are not expected to occur. The potential effects from a spill on humpback whales and Steller sea lions are discussed in greater detail in Appendix J.

Fish

Construction. Construction windows would be established in the USACE Section 404 permits and/or ADNR's tideland leases to prohibit in-water construction activities for marine facilities at Cascade Point or Echo Cove and Slate Creek Cove between approximately March 15 and June 15. Such a prohibition would prevent any adverse effects on migrating juvenile salmon and spawning of herring and eulachon.

Assuming construction occurred outside the March through June window, some loss of prey resources would occur during the construction and periodic maintenance dredging of the mouth of Echo Cove under Alternative C (see Figure 2-11). Because the area around Slate Creek is naturally turbid from glacial runoff much of the year (Stekoll, no date b), additional turbidity from construction of the Slate Creek marine terminal would likely have little effect on normal site conditions. Effects on other salmonids (e.g., chum salmon, coho salmon, sockeye salmon) are likely to be similar to or less than effects on pink salmon because the former are less dependent (with the possible exception of chum salmon) on the nearshore area where the greatest effects would occur.

Some avoidance of the construction area might occur during dredging because of turbidity. Using BMPs during dredging would reduce turbidity. Some short-term loss of site-specific herring food sources could occur due to benthic disruption from fill and dredging because juvenile herring often feed extensively on benthic copepods (Simenstad et al., 1979). However, pelagic food sources (zooplankton), which are also commonly eaten (Emmett et al., 1991), would not be disrupted, supplying an alternative food source.

Installation of pilings at all the proposed marine terminals could have short-term direct adverse effects on nearshore rearing fish (e.g., herring, juvenile salmon) as a result of pressure waves associated with pile driving. Metal piles in particular have been linked to adverse effects on fish. Impacts on fish include localized behavior modification and, in worse cases, hemorrhage and rupture of internal organs resulting in direct mortality (Longmuir and Lively, 2001; Stotz and Colby, 2001 as cited in Tetra Tech FW, 2003; and Feist et al., 1996). However, methods are available to reduce or eliminate these impacts, including timing installation when major fish resources are not present and using low-noise methods of pile driving. These mitigation measures would be incorporated into the USACE Section 404 permits and/or ADNR's tideland leases

Construction of the breakwater for the Cascade Point marine terminal could result in the permanent loss of approximately 350 feet of shoreline spawning habitat used by Pacific herring. Herring often spawn directly on marine macrophytes such as kelp and eelgrass, but they also use other substrates, including rocks (Robinson et al., 1996; Brown and Carls, 1998; ADF&G, 2003). The fill at the Cascade Point terminal could also indirectly affect spawning habitat by producing modified currents. Although prespawning herring schools have been observed in Echo Cove (ADF&G, annual spawning survey notes), no reported spawning habitat is present in Echo Cove (Moulton, 1999); therefore, herring spawning success would not likely be affected by construction at the Echo Cove site.

Operation. The breakwater at Cascade Point could interfere with tidal flushing and passage of fish during periods of low (and lower high) tides and consequently have a minor impact on EFH. This is most likely to affect juvenile salmonids, especially during the spring (April–June) when salmon fry are cruising near shore to feed and avoid predators. This impact would be temporary because the area between the shore and the breakwater would be inundated during high tides. No breakwater would be present at Echo Cove, so similar effects would not occur there under Alternative C. Traffic at the Cascade Point facility would not have adverse effects on fish because use of the dock would be reduced during the critical herring spawning period. Lack of fuel storage and the use of BMPs during fueling and maintenance operations would likewise minimize the potential for operation-related effects.

Eulachon gathering prior to spawning in the general vicinity of the Slate Creek Cove marine terminal prefer to congregate in deeper water before heading into fresh water to spawn. The reduced number of crew shuttle trips and barge deliveries during this period, combined with eulachon's preference for deeper water, would minimize the potential for impacts on this species from shoreline facilities. Operations at other times of the year would not affect fish in the vicinity of the terminal.

Noise. The noise of crew shuttle boat traffic could have short-term adverse effects on schooling fish within Berners Bay. The reaction of fish to in-water sound is dependent on both the frequency and amplitude because different species have different detection capabilities (Hawkins, 1981, as cited by Nestler et al., 1992; Schwartz and Greer, 1984). Herring are known to modify their location in the water column upon the approach and passing of motorized vessels (Vabo et al., 2002; Misund et al., 1996; Freon et al., 1993). Schwarz and Greer (1984) observed that herring response to the sounds of various boat types was short-lived when noise levels decreased (as in a boat departing from the region) or stopped and that herring typically returned to their previous behavior in less than 10 seconds. Vabo et al. (2002) found dispersal of fish relative to the path of a large vessel (200 feet) to be short-term (less than a minute prior to the vessel's passing directly over herring schools). Juvenile herring showed less response to vessels than adults, with no avoidance below a depth of 210 feet (Vabo et al., 2002). Misund et al. (1996) found that reaction of herring to a boat ranged from 75 to 3,300 feet directly in front of the boat path but was confined to those fish within a fairly narrow width, within about 20 degrees of the boat's path. Furthermore, only about 20 percent of the herring schools encountered reacted to vessel noise (Misund et al., 1996). Finally, attempts at using noise to cause herring species to avoid areas have often proved partly or totally ineffective (Nestler et al., 1992).

Similar information is not available for eulachon, but capelin, another marine smelt species, have also been observed to move when motorized vehicles approach. For capelin, avoidance of vessel noise was noted to a depth of 360 feet (Olsen et al., 1983). Eulachon adults are most abundant in the 90-to 240-foot depth range while they congregate in Berners Bay prior to their migration for spawning up the local rivers (Sigler et al., 2003; Sigler, 2004, personal communication). The majority of eulachon, based on acoustic density, occur near the river mouths (Berners River Gully) away from the crew shuttle route, although high densities have also been observed in Slate Creek Cove.

The crew shuttle boat schedule could result in some level of disturbance up to six times a day (assuming three round trips) between Slate Creek Cove and either Cascade Point or Echo Cove during the spawning runs of herring and eulachon. Considering a rapid crossing of Berners Bay, active avoidance by some individuals would likely occur for less than 2 minutes each trip. Assuming that an individual fish remained within the crew shuttle route all day, overall disturbance (that is, induced reaction) would occur for a maximum of about 12 minutes a day. During normal operations, the maximum period of disturbance would be approximately 20 minutes per day. Noise from the crew shuttle boat would be most likely to affect fish in the upper 300 feet of water. The actual dispersion would occur over a narrow width, based on the observations noted above. Adverse effects on populations of prey resources along the crew shuttle route would be none to slight considering that the size of the area affected is small, the duration is limited, and only some of the prey species would react. Furthermore, fish would naturally move in and out of the area where noise would be encountered and the area could be reoccupied following passage of the vessel. Finally, some acclimation to the noise could occur. The effects of noise on prey species might be slightly greater near the crew shuttle terminals.

The potential effects of boat and dock noise on herring spawning activity near Cascade Point are unknown. The limited trips during spawning would result in infrequent boat noise, and the breakwater would reduce noise transmission directly from the Cascade Point dock area to the potential spawning area to the north. As noted above, not all herring respond to noise, and herring have been observed to resume their normal behavior rapidly (within seconds or minutes) following cessation or diminishment of the noise. If, as is further expected, the state's tidelands lease requires no use of the Cascade Point marine terminal during herring spawning, no boat and dock noise effects on herring spawning are predicted.

Effects on Habitat. Juvenile pink salmon are more dependent on the shallow habitat in the vicinity of the proposed marine terminals for rearing habitat compared to other salmon species and would therefore be more likely to be affected. Although some nearshore bottom area would be filled by the breakwater (1.3 acres) at Cascade Point, the ultimate result would be an extension of shallow water habitat (typically less than 3 feet deep) along the entire edge of the breakwater. Juvenile pink salmon typically use water less than 3 feet deep. Although the dock at Echo Cove would not affect shallow habitats, the dredging necessary at the mouth of Echo Cove under Alternative C would reduce the amount of shallow habitat in dredged areas.

During operations, prop wash in the area in the immediate vicinity of the crew shuttle docks could disturb the bottom over a very limited area. Shading from the docks, especially the floating portions, at all piers would also reduce some nearshore food production of benthic and epibenthic organisms (Nightingale and Simenstad, 2001) over a very limited area.

The addition of the breakwater at Cascade Point might improve usable habitat conditions on the shoreline side by reducing high-energy waves and increasing current complexity. Juvenile pink salmon often congregate in irregular shoreline areas with complex eddies, which might have concentrated levels of zooplankton and provide shelter from wind-generated waves and currents from strong tides (Groot and Margolis, 1991). Juvenile pink salmon are also known to prefer quiescent shoreline waters and have an affinity for small embayments, including marinas (Nightingale and Simenstad, 2001). Therefore, habitat conditions in parts of the shoreline inside the breakwater might be desirable rearing habitat because of the increased protection from waves. No similar habitat changes would occur in Echo Cove if Alternative C were selected. Potential for the accumulation of low levels of hydrocarbons resulting from fueling or vessel maintenance are not expected to be of concern based on the BMPs required by the CBJ's Conditional Use Permit (see Appendix I).

Some spawning habitat for Pacific herring at Cascade Point might be permanently lost due to construction of the breakwater at Cascade Point under Alternatives B and D, as noted above. This would include 1.3 acres of fill and 1.6 acres of dredging. However, the breakwater could be designed to enhance establishment of kelp or vegetation to mitigate for the loss of kelp. Historically, herring spawning of this stock (Lynn Canal stock) included areas from (at least) Auke Bay to Point Sherman (north of Berners Bay) (Moulton, 1999; McGregor, 2003, personal communication). With a reduction in abundance, spawning of this stock has appeared to occur in fewer locations, including regions on the east side of Berners Bay, Point Bridget, and some areas north of Point St. Mary (Cantillon, 2003, personal communication). Herring spawn within Berners Bay has been observed over 2 to 10 miles of shoreline (McGregor, 2003, personal communication). Use of the bay for spawning has not been consistently documented, but during 7 of the past 30 years, including 3 of the past 20 years and 2 of the past 10 years, spawning has included Cascade Point (Juneau Area Herring Spawning Surveys and Activities and other summary memoranda; ADF&G, multiple years). It should be noted that the lack of documentation on spawning at a particular area does not mean that spawning did not occur. The frequency and location of surveys have varied over the years, and some spawning periods and locations might have been missed.

If the filled and dredged area at Cascade Point was entirely lost for spawning, approximately 350 feet of shoreline would be affected. Potential nearshore current changes from the addition of the breakwater could also affect the spawning habitat (Nightingale and Simenstad, 2001). The overall effect of this loss of herring spawning habitat has not been agreed upon within the scientific community. Some studies document fidelity to spawning sites by herring (Emmett et al., 1991), whereas others indicate movement among sites (NMFS, 2001). There is also a general homogeneity of herring stock genetics, indicating mixing among stocks during spawning. Emmett et al. (1991) noted that there is no correlation between the number of eggs spawned and the adult population size because other factors affecting egg and early larval survival appear to be major events influencing population sizes. However, ADF&G uses spawn abundance as part of an overall model to estimate herring production in Alaskan waters (Fogels, 2004, personal communication). Moulton (1999) noted varied correlations between shoreline development and herring stock status in Puget Sound. He found that some stocks decreased while others increased in areas with extensive shoreline development; in some areas with low shoreline development, stocks also decreased. Locally, the absence of herring spawning in Auke Bay has followed intensive shoreline development in the area (McGregor, 2003, personal communication)

The presence of a breakwater at Cascade Point might result in some increase in usable rearing habitat for herring. Like pink salmon, juvenile herring are found in protected areas, such as protected bays and marinas, in abundance (Nightingale and Simenstad, 2001). In marina studies conducted in the state of Washington, herring were found to be the most abundant species. The presence of the breakwater would increase some protected water habitat similar to that found in marinas. The environment would not change in a similar manner under Alternative C because no breakwater would be constructed in what is already a protected (low-wave-energy) environment. At Cascade Point, the floating docks would serve as a support for kelp that could be used by herring for spawning (Nightingale and Simenstad, 2001). Increased predation in marina areas with piers, floats, riprap, and pilings has not been documented, although it is considered an area of concern (Nightingale and Simenstad, 2001). The over-water structures (piers) lower light levels, reducing potential food production and possibly the feeding success of some fish (Nightingale and Simenstad, 2001). Galvanized steel pilings for the dock would eliminate concerns about creosote contamination from treated wooden pilings, and BMPs, as noted above, would be employed for fueling and maintenance operations at Cascade Point to minimize the potential for hydrocarbon contamination.

The operation of the dock facility at Slate Creek Cove is unlikely to affect the migration of adult eulachon returning to spawn because they are usually found schooling near the bottom in deeper water except at slack tide. Dock pilings might be present at depths eulachon pass through; however, they would not impede migration. Similarly, juvenile eulachon primarily use deep water habitats and would not be likely to be affected by the dock structures.

Effects on Migration. Migration patterns of juvenile pink salmon fry and, possibly to a lesser degree, other salmon fry could be affected by the changes in shoreline area at both Cascade Point and Slate Creek Cove, and to a lesser degree in Echo Cove. However, the areas involved are small compared with the overall surface area of Berners Bay. Marina studies indicate that juvenile salmonids, particularly small pink and chum salmon (less than 2 inches in length), typically remain along the shoreline when migrating. Larger juveniles begin to move away from shorelines. At some marinas in Washington, early emerged fry follow the shoreline breakwater edges but are absent along detached breakwaters on the offshore side of marinas (Weitkamp, 1981). The presence of shadows under piers may also inhibit migration. Generally the shorter the distance and lighter the area, the less inhibition there appears to be on movement under piers. Although there is some attraction to pilings and potential food sources, juvenile schools of pink and chum salmon have been found to delay migration or move out around the end of piers (Nightingale and Simenstad, 2001).

The gap between the breakwater and the shoreline included in the design of the Cascade Point breakwater would permit fish movement in 2 feet of water about 12 percent of the time. Passage would be possible at shallower depths up to 24 percent of the time (Kline, 2003). During other periods, fish migration would be delayed or could proceed along the perimeter of the breakwater. The typical delay would be less than a day. These limitations would not occur at Echo Cove because there would be no breakwater. The large spacing between pilings and relatively narrow nearshore piers at Cascade Point and Echo Cove would reduce the delay effects associated with the piers. No documentation exists as to the effect on fish survival of any delay caused by piers (Nightingale and Simenstad, 2001; Simenstad et al., 1999).

Effects on Predation. Increases in predation could occur if juvenile pink salmon migrate along the breakwater at Cascade Point. Fish migrating around the breakwater would be closer to deepwater habitat than those remaining on the shoreline, which could harbor predators. Because the breakwater structure would be similar to, although steeper than, the steep, rocky shoreline north of Cascade Point, the breakwater is not expected to increase the extent of predation.

The potential for increased predation exists at Cascade Point, Slate Creek Cove, and Echo Cove around piers because predators are often attracted to such structures. However, increases in predation or reduction in survival from fish movement around or under piers have not been documented (Nightingale and Simenstad, 2001; Simenstad et al., 1999).

Spills. The most likely source of potential impacts on fish would be accidental spills. As discussed previously, accidental spills would be more likely to occur at Slate Creek Cove than at Cascade Point or Echo Cove because of material loading and offloading. Although the risk is lower at Cascade Point and Echo Cove because of the lack of boat-to-shore material transfers, fueling activities at Cascade Point or Echo Cove would have a potential for spills. The implementation of fuel storage and fueling BMPs at these sites would greatly reduce any chance of accidental diesel fuel spills. However, if a spill were to occur, the consequences could be serious, depending on the size and timing. Based on the record of the Alaska Marine Highway System ferry operations in Lynn Canal, which has had no in-water fuel spills (URS, 2004a), chances of spills associated with crew shuttle operations would be low no matter which alternative is selected.

A spill occurring during the April–May eulachon spawning run would expose the greatest number of individuals. As discussed above, eulachon prefer deeper water and would not necessarily be adversely affected by a small spill in the Slate Creek Cove area. However, a spill of sufficient magnitude could prevent them from reaching spawning grounds in the Antler and Berners/Lace rivers. A large spill could also taint the flesh of the eulachon over the short term and subsequently have a negative impact on Steller sea lions. Spills at other times of the year could also taint the flesh of salmon or other fish species present and therefore have a negative impact on commercial and recreational fisheries in Berners Bay.

In other seasons spills would have fewer potential adverse effects on fish resources. Based on winter tow net sampling, some juvenile eulachon and capelin are known to be present in the bay during periods other than spring and summer (Sigler, 2004, personal communication). However, their abundance would be much lower than that during the spawning season, and most juvenile eulachon would be expected to disperse beyond the bay by the end of summer (Hay and McCarter, 2000). Also, as noted above, fish are less oriented near shore or near the surface, where any concentrations of petroleum products would be highest. The use of isotainers and implementation of BMPs would curtail chances of major spills and adequately protect against petroleum discharge levels that would cause adverse effects. A monitoring plan would be initiated to help ensure that adverse effects would not occur from petroleum leaks (see Mitigation and Monitoring, Section 2.5)

Pink salmon are sensitive to oil during both spawning and early rearing (Rice et al., 2001). Early stages, however, appear to be less sensitive than those of Pacific herring to oil in the environment. Considering the likely low levels and infrequent nature of minor leakage from the shuttle boat under normal usage, adverse effects on pink salmon would not result from normal operations at any facility.

Among local fish stocks, the Pacific herring stock is of greatest concern for effects of hydrocarbon releases. This stock has ecological significance, is already depressed, and would have several life stages present in Berners Bay at or near the Cascade Point marine facility, which would be close to spawning areas. Pacific herring are a major prey source for many marine species. Reductions in the already depressed Lynn Canal population could therefore affect other resources in the greater Lynn Canal region, including salmon and marine mammals. Potential effects on herring would be less at

Echo Cove because it does not contain herring spawning areas, and spills would be more likely to remain confined in the cove due to low flushing.

A large release of petroleum to the environment could result in concentrations of petroleum compounds at levels that would adversely affect Pacific herring. The greatest concern would be from spills at Cascade Point because of its proximity to herring spawning areas, although the CBJ Conditional Use Permit prohibits fueling at Cascade Point during herring spawning activity. If, as expected, the state tideland lease requires no fueling at Cascade Point from the beginning of spawning through egg hatching, effects would be further minimized. Under Alternative C, fueling would be of less concern because Echo Cove is not near a spawning area and a spill could be more easily contained. If a spill occurred during a salmon fishery in Berners Bay, tainting of some fish might occur. Direct commercial salmon fishing in Berners Bay is limited to a few days at a time with some years having no commercial fishing directly in the bay, reducing the potential for direct effects on this fishery. Although the percentage of the total salmon harvest affected would be small, the stigma of potential tainting could have significant effects on the fishery as a whole (Baker et al., 1990). Tainting of other fish or shellfish (e.g., Dungeness crabs) could also occur depending on the size and location of such a spill. The discussion of herring in the BA\BE (Appendix J) includes a detailed literature review of the effects of hydrocarbons on fish.

Essential Fish Habitat Assessment

The Forest Service consulted with NMFS regarding the Essential Fish Habitat (EFH) Assessment (Appendix B). The assessment concluded that the proposed actions near freshwater systems would not have adverse effects on EFH. However, the proposed marine actions could have short-term adverse effects on EFH for some groundfish and salmon. In addition, some long-term adverse effects on EFH, though not substantial, might occur from pier placement within Berners Bay, particularly from construction of the Cascade Point pier site and associated breakwater. In addition, potential hydrocarbon leaks increase the potential risk to EFH and species that depend on this region within Berners Bay.

4.10.4 Summary

Table 4-17 summarizes the impacts of each alternative on marine water aquatic resources.

Table 4-17
Summary of Impacts on Marine Aquatic Resources for All Alternatives

Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Water quality	***Construction:*** Temporary increases in sediment and turbidity resulting from dredging. The cobble beach limits the extent of fine materials that could be disturbed.	Same as Alternative A.	Temporary increases in sediment and turbidity at Slate Creek Cove and Cascade Point for fill (both locations and dredging (Cascade Point).	Temporary increases in sediment and turbidity at Slate Creek Cove and Echo Cove. Larger-scale dredging required at Echo Cove would produce more turbidity than at Slate Creek Cove or Cascade Point.	Same as Alternative B.
	Operations: No anticipated impact under normal operations.	Same as Alternative A.	Same as Alternative A.	Occasional maintenance dredging of Echo Cove would temporally increase turbidity.	Same as Alternative A.

Table 4-17
Summary of Impacts on Marine Aquatic Resources for All Alternatives (continued)

Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Water quality (continued)	***Spills:*** Maximum potential spill 880 gallons based on design of ship-to-shore transfers excluding catastrophic spill (e.g., vessel grounding). Spill would elevate concentrations of hydrocarbons in the water column on a localized basis.	Same as Alternative A.	Leaks from the crew shuttle boat and barges more likely at Slate Creek Cove than large-scale spills because of the use of isotainers. At Cascade Point, the possibility of fueling-related spills, plus leakage from the crew shuttle boat, exists. Could range from drops to tens of gallons. Potential increase in low levels of hydrocarbons in the water column at Slate Creek Cove and more so at Cascade Point.	Same as Alternative B for Slate Creek Cove. The possibility of fueling-related spills, plus leakage from the crew shuttle boat, exists. Potential increase in low levels of hydrocarbons in water column at Slate Creek Cove and more so at Echo Cove.	Same as Alternative B.
Nearshore marine organisms	***Construction:*** Some mortality or displacement of non-mobile organisms during dredging operations. Recolonization of dredged area within a few years.	Same as Alternative A.	Fill at Slate Creek Cove and Cascade Point permanently eliminates some intertidal and subtidal habitat. Dredging at Cascade Point would result in some mortality or displacement of non-mobile organisms. Recolonization of dredged area within a few years.	Less fill at Slate Creek Cove would reduce the loss of intertidal and subtidal habitat compared to Alternatives B and D. Some mortality or displacement of non-mobile organisms during dredging within Echo Cove. Recolonization of dredged area within a few years.	Same as Alternative B.
	Operations: Minimal effects.	Minimal effects.	Minimal effects.	Maintenance dredging at Echo Cove would cause occasional displacement of non-mobile organisms.	Minimal effects.
	Spills: Potential contamination of inter- and subtidal organisms depending on size and distribution of spill. Spilled material would be short-lived due to high-energy nature of Comet Beach.	Same as Alternative A.	Contaminants spilled at Cascade Point and, to a lesser extent, Slate Creek Cove would dissipate quickly due to wave action and flushing. Potential short-term impacts on nearshore organisms at Slate Creek Cove if materials were spilled during loading/ unloading operations.	Organisms in the vicinity of the Echo Cove dock could have a longer exposure to chronic levels of contaminants that persisted in the environment if the spill were not adequately cleaned up due to calm waters within Echo Cove. If a spill were to occur, it would be more easily contained. Slate Creek Cove same as Alternative B.	Same as Alternative B.

Table 4-17
Summary of Impacts on Marine Aquatic Resources for All Alternatives (continued)

Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Marine mammals	***Construction:*** Minimal effects.	Same as Alternative A.	Activities at Slate Creek Cove could affect marine mammals during construction, impacts minimized by prohibition on in-water construction activities from March 15 to June 15 and when marine mammals are within 1,000 feet.	Same as Alternative B.	Same as Alternative B.
	Operations: Minimal effects.	Same as Alternative A	Low potential for vessel strikes to humpback whales from crew shuttle boat and barges due to minimum distance requirements and low speeds. Presence of crew shuttle could affect behavior of Steller Sea lions and seals in vicinity of Slate Creek Cove. Overall, mitigation measures minimize potential for adverse impacts.	Same as Alternative B.	Same as Alternative B.
	Spills: Minimal effects due to the relatively infrequent use of the area by marine mammals.	Same as Alternative A.	Leaks from crew shuttle and/or barges unlikely to affect marine mammals. Catastrophic spill, although highly unlikely, could affect sea lions, seals, and whales, depending on timing.	Same as Alternative B except that a spill could occur in Echo Cove, where it could more easily be contained.	Same as Alternative B.
Fish	***Construction:*** Temporary displacement during dredging. Pile driving operations could affect individual fish in the immediate vicinity of the activity.	Same as Alternative A.	Permanent displacement in filled areas of Slate Creek Cove and Cascade Point. Temporary displacement during dredging at Cascade Point. Pile driving could affect individual fish in the immediate vicinity of the activity. Potential impacts on herring spawning habitat (Cascade Point).	Permanent displacement in filled areas of Slate Creek Cove. Temporary impacts during initial and maintenance dredging of Echo Cove. Pile driving could affect individual fish in the immediate vicinity of the activities at Slate Creek Cove and Echo Cove.	Same as Alternative B.
	Operations: Minimal impacts. Acute and chronic exposure of sensitive life stages to petroleum hydrocarbons from fuel transfers at Comet Beach.	Same as Alternative A.	Potential short-term displacement of schooling fish as crew shuttle passes over. Acute and chronic exposure of sensitive life stages to petroleum hydrocarbon from fuel storage and transfers at Cascade Point. Potential short-term noise effects on spawning herring at Cascade Point.	Same as Alternative B except potential exposures to hydrocarbons would occur at Echo Cove rather than at Cascade Point. Potential short-term displacement of schooling fish as crew shuttle passes over.	Same as Alternative B.

Table 4-17
Summary of Impacts on Marine Aquatic Resources for All Alternatives (continued)

Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Fish (continued)	***Spills:*** A spill of 880 gallons could expose fish to elevated hydrocarbon concentrations. Juvenile pink salmon present along the shoreline could suffer mortality depending on timing and size of spill.	Same as Alternative A.	Potential for chronic exposure to hydrocarbons from vessel leaks at Cascade Point and Slate Creek Cove. A fuel spill at Cascade Point could contaminate herring spawn at Cascade Point, minimized by prohibition on fueling during herring spawning period.	Potential for chronic exposure to hydrocarbons from vessel leaks at Echo Cove and Slate Creek Cove.	Same as Alternative B.
Commercial fisheries	***Construction:*** None if construction completed outside fishing openings.	Same as Alternative A.	None.	None.	None.
	Operations: Potential conflicts between fishing vessels and delivery barges during fishing openings.	Same as Alternative A.	Minimal effects.	Potential effects on Dungeness crab fishery in Echo Cove during maintenance dredging operations.	Minimal effects.
	Spills: A spill occurring during a fishing opening could result in at least the perception of a contaminated catch. Potential impacts on juvenile pink salmon near shoreline.	Same as Alternative A.	Indirect impacts based on effects on larval/juvenile commercial species or prey species (herring/eulachon). Petroleum spill could affect commercial troll, gill net, and other limited fisheries within Berners Bay in similar manner as Alternative A.	Same as Alternatives B and D, plus a fuel spill in Echo Cove could affect the commercial and recreational harvest of Dungeness crab.	Same as Alternative B.

4.11 WILDLIFE

Activities associated with construction and operation of the Proposed Action or alternatives could potentially affect wildlife species inhabiting the Sherman Creek, Slate Creek, and Johnson Creek watersheds, as well as marine species that occupy Berners Bay and Lynn Canal during all or parts of the year. Impacts would be associated primarily with disturbance from road and pipeline construction, facility construction, and operation of the proposed mine. Impacts associated with habitat modification or reduction for some species (primarily species dependent on old growth) could also occur to a limited extent.

This section describes potential impacts on wildlife resulting from implementing the Proposed Action and alternatives. The factors that are the basis of the impact discussion for the various wildlife species or groups of species are discussed in Section 3, Affected Environment. A summary is presented at the end of this discussion (4.11.3).

4.11.1 Effects of Alternatives A and A1

The 1997 FEIS referenced the 1992 FEIS analysis of impacts on wildlife species because no animal species in the project area had been added to the threatened and endangered animal species list since 1992. The 1992 FEIS had disclosed potential impacts on various species groups, primarily associated with minor habitat loss (Forest Service, 1992) and human disturbance. As discussed in Section 3, subsequent information relative to wildlife species in the area has been gathered, specifically with respect to goshawks and bald eagles (ABR, 2000b). In addition, in 1996 ADF&G produced a rough draft report titled *Effects of Kensington Mine Development on Black Bears and Mountain Goats* (ADF&G, 1996). The following discussion incorporates this new information and summarizes the potential impacts of Alternatives A and A1 on the wildlife species and habitats described in Section 3. Table 4-18 shows the amount of available wildlife habitat in acres (depicted in Figure 3-6) for the 13 management indicator species (MIS) and the potential impacts under Alternatives A and A1.

Table 4-18
Habitat Cover Types Delineated Within the Kensington Gold Project Area and Potential Effects Under Alternatives A and A1

Habitat Cover Types	Project Area[a]	Alternative A	Alternative A1
Low-Volume Old Growth (8-20 mbf)	1,356	94.7	73.4
Medium-Volume Old Growth (20-30 mbf)	5,196	36.6	28.2
High-Volume Old Growth (30-50+ mbf)	1,914	2.7	2.7
Total Productive Old Growth	**8,466**	**135.2**	**104.3**
Nonproductive/Low Site Index Forest (0–8 mbf)	5,338	126.9	75.6
Nonforest Brush	163	0	0
Alpine	376	1	1
Fresh Water	39	0	0
Rock Outcrop	387	0	0
Slide Zone	1,146	4	4
Muskeg	1,858	0	0
Total	**17,773**	**265**	**184.9**
Percentage	Project Area	Alt A	Alt A1
Low-Volume Old Growth	8%	0.5%	0.4%
Medium-Volume Old Growth	29%	0.2%	0.2%
High-Volume Old Growth	11%	0%	0%
Unproductive Forest	30%	0.7%	0.4%
Non-Forested	22%	0%	0%
Total	100%	1.4%	1.0%

[a]Acreages from GIS may vary slightly with tables due to rounding.
Mbf = 1,000 board feet.

Less than 1 percent of the productive old growth would be altered under Alternative A, 95 acres and 37 acres of low- and medium-volume old-growth forest, respectively. Less than 3 acres of high-volume old growth would be affected under Alternatives A and A1. The remaining 131 acres potentially altered would consist of non-forested land or unproductive forest. Alternative A1 would affect 73 acres and 28 acres of low- and medium-volume old growth, respectively, and 81 acres of non-forested lands.

An analysis of forest fragmentation in the project area was based on the total number of low-, medium-, and high-volume old-growth forest patches. Patch sizes from Table 3-26 were used to estimate the acreage of contiguous patches of low-, medium- and high-volume old growth within the study area.

An increased level of edge effect from fragmentation would occur under all alternatives. The number of patches of low-, medium- and high-volume old-growth forest between the 1- to 15-acre, 50.1- to 100-acre, and 100.1- to 250-acre patch size classes would increase (Table 4-19).

Table 4-19
Patch Size Analysis for All Low-, Medium-, and High-Volume Old Growth Combined Within the Kensington Gold Project Area, by Alternative

Number of Patches by Size Class in Acres	Existing Condition	Alternative A and A1	Alternative B, C, and D
1 to 15 (% increase from existing)	1	8 (87.5%)	8 (87.5%)
15.1 to 50 (% increase from existing)	12	12 (0.0%)	12 (0.0%)
50.1 to 100 (% increase from existing)	1	1 (0.0%)	2 (50.0%)
100.1 to 250 (% increase from existing)	1	3 (67.7%)	1 (0.0%)
250.1 to 1,000 (% increase from existing)	1	1 (0.0%)	3 (67.7%)
>1,000 (% increase from existing)	2	2 (0.0%)	3 (33.3%)
Total No. of Patches	18	27	29

Management Indicator Species

Black and Brown Bear (MIS)

Implementing Alternative A would likely result in black and brown bear avoidance of mine facilities and areas of human activity (e.g., power supply generators, on-site personnel camp, barge landing area at Comet Beach, sand and gravel quarries, and helicopter landing area). The potential for bears (especially black bears) to become habituated to human presence also exists, which could result in bear/human interactions and possibly bear mortality due to defensive kills. Mitigation measures to reduce or eliminate impacts include implementation of Forest Plan standards and guidelines for bear management, implementation of a garbage management plan, and an operator-directed prohibition against hunting. These measures have proven to be effective in reducing bear mortality in and around logging camps and Forest Service camps. The 268 acres of total surface disturbance associated with Alternative A, including 135 acres of productive old-growth, would constitute a slight reduction in bear habitat for the life of the mine (or until reclamation is completed). These direct effects would be small in the context of bear habitat availability in the mainland forests between Juneau and Haines (e.g., ADF&G Game Management Unit [GMU] 1). The disturbance of 104 acres of productive old growth under Alternative A1 would have a similar effect on bears. An increase in traffic levels under Alternatives A and A1 might limit the movement of wide-ranging carnivores through this area, although the speed limit would minimize the potential for vehicle collisions.

Sitka Black-tailed Deer (MIS)

Implementing Alternative A would result in a direct loss of 95 acres of low-volume and 36 acres of medium-volume productive Old-Growth Habitat (OGH) potentially used by Sitka black-tailed deer. The forest within this OGH is insufficient to provide winter habitat. Alternative A would have minimal indirect impact on the species' local distribution and use of habitat in the vicinity of the project during winter because of the lack of suitable low-elevation, high-volume old-growth forests. The slightly lower impacts on the acres of productive OGH under Alternative A1 would result in essentially the same impacts as Alternative A on Sitka black-tailed deer. Local deer habitat connectivity would be disrupted by roads and human activity associated with Alternatives A and A1. The remaining 131 acres potentially altered would consist of non-forested lands or unproductive forest.

The potential for deer mortality due to road kill would be minimal because of the relatively slow speed of vehicles using the roads. The operator would prohibit employees from hunting deer (as well as other species) within the project area. This measure, along with Forest Plan standards and guidelines, should reduce or eliminate the potential for deer mortality as a result of Alternative A or A1. The disturbance and habitat avoidance resulting from Alternatives A and A1 would not likely affect regional coastal population levels of deer (e.g., within GMU 1C).

Alexander Archipelago Wolf (Species of Concern and MIS)

Implementing Alternative A would likely result in minor changes in use of the area by wolves, primarily associated with distribution and habitat use by deer. As deer avoided areas of high human activity or redistributed themselves based on the availability of high-quality habitat, wolf use of the project area would likely change in response. Impacts under A1 would be essentially the same as those under Alternative A. Human-related impacts might also occur, though the likelihood of this is considered low because mine employees would be prohibited from trapping or hunting. Habitat loss and mine-related disturbance associated with Alternatives A and A1 are not expected to affect wolf distribution or numbers in ADF&G GMU 1C.

Bald Eagle (MIS)

No bald eagle nests would be directly affected by implementing Alternative A or A1. The U.S. Fish and Wildlife Service (USFWS) and the Forest Service have developed an Interagency Agreement (May 15, 1990), which establishes a 330-foot management zone around each eagle nest site. Disturbance activities within this zone are restricted during the nesting season (March 1 to May 31 and June 1 to August 31, if there is evidence of nesting activity). In addition to the 330-foot management zone, the agreement applies restrictions to blasting within 0.5 mile and to repeated helicopter flights within 0.25 mile of bald eagle nests (Forest Service, 1992).

Because activities associated with Alternatives A and A1 would comply with the Interagency Agreement, no impacts on bald eagles would be expected.

Mountain Goat (MIS)

Of concern relative to mountain goats is the availability and distribution of suitable winter range, which in Southeast Alaska typically consists of old-growth forest near steep slopes (Forest Service, 1992). Mine development and operation under Alternatives A and A1 could result in avoidance of suitable winter habitat (closed-canopy forest) by goats in the vicinity of the Kensington Mine (Sherman Creek drainage). Although the 1992 FEIS did not quantify any distances associated with goat avoidance of human activity, it did discuss several studies that indicated goats might be displaced up to 2 miles from mine exploration activities, but that due to topographic relief and dense forested vegetation in the area, the magnitude of goat displacement distances might be reduced. Goat use of winter habitat near upper Sweeny Creek and Johnson Creek, and along Lynn Canal and Berners Bay, would not be affected (see Figure 3-6).

Goat behavior and habitat use might also be influenced by disturbance associated with personnel transport helicopter flights. With Alternatives A and A1, two to three flights per day, 5 days per week, would result in avoidance by goats of the landing area near the Kensington Mine during most of the workweek. Due to flight elevation restrictions (2,000 feet during good weather) and alternative routing of the aircraft during periods of cloud cover, helicopter-related impacts on goats in areas other than the vicinity of the landing area(s) are not expected.

Displacement of goats in upper Sherman Creek and short-duration exposure to noise during personnel transport flights are not expected to appreciably affect goat populations in the Lynn Canal/Berners Bay area because their primary use areas are north and west of the Kensington Mine during summer, and in low-elevation old-growth habitats to the south of Sweeny Creek during winter (ABR, 2000b).

Red Squirrel and Marten (MIS)

Potential impacts from Alternatives A and A1 on red squirrel and marten would be associated with removal of approximately 135 and 104 acres of old-growth forest cover, respectively, in Sherman Creek. Local impacts on these species could result from road and facility construction that would fragment the habitat and possibly affect local dispersal patterns. High-volume productive old growth below 1,500 feet in elevation is considered suitable for marten. Very little high-volume habitat would be removed under either alternative. When analyzed in the context of distribution and stand size of old growth in the Sweeny, Sherman, Slate, and Johnson creek drainages (see Figure 3-6), Alternatives A and A1 would not likely affect habitat connectivity for either species or reduce availability of 30-acre or greater patches of habitat.

Vancouver Canada Goose (Species of Concern and MIS)

Potential impacts from Alternatives A and A1 on the Vancouver Canada goose would likely be minimal due to its primary use of Berners Bay (see Section 3, Affected Environment). Alternatives A and A1 would not result in any mine-related activities in Berners Bay, and therefore the potential for impacts on this species would be minimal.

Hairy Woodpecker (Species of Concern), Brown Creeper, Red-breasted Sapsucker (all MIS)

Potential impacts on hairy woodpeckers, brown creepers, and red-breasted sapsuckers from Alternatives A and A1 would include local habitat loss associated with mine and mine facility development. Approximately 135 and 104 acres of productive old growth would be removed in the Sherman and Sweeny creek drainages under these alternatives. Nearly all the productive old growth is low- and medium-volume forest. Local impacts on these species resulting from road and facility construction that would fragment their habitat and possibly affect local dispersal patterns could also occur; however, when analyzed in the context of distribution and stand size of old growth in the Sweeny, Sherman, Slate, and Johnson creek drainages (see Figure 3-6), it would not likely affect populations in the Lynn Canal/Berners Bay area. Minimum stands of 15 acres for brown creepers and 250 acres for red-breasted sapsuckers would be available and well dispersed.

River Otter (MIS)

Old-growth vegetation adjacent to Sherman Creek provides river otter habitat in the project area. Potential impacts on otters currently occupying habitats in the Sherman drainage would result from local removal of old growth along the stream for road and bridge construction. These effects would be limited due to the distance between the creek and the road for most of the length of the road.

Threatened, Endangered, and Sensitive Species

The Forest Service consulted the USFWS regarding the presence of threatened and endangered species within the project area. The USFWS indicated that there are no threatened or endangered species within its jurisdiction that occur within the Tongass National Forest (Reference Code 03-28). Alternatives A and A1 would have little or no impact on threatened or endangered marine mammals because activities would be confined to Lynn Canal.

Humpback Whale (Endangered)

Addressed in Section 4.10.

Steller Sea Lion (Threatened)

Addressed in Section 4.10.

Peale's Peregrine Falcon (Sensitive)

Because no nesting habitat (rock outcrops overlooking water) for Peale's peregrine falcon occurs in the project area or vicinity (see Section 3, Affected Environment), implementing Alternatives A and A1 would not likely affect the species.

Northern Goshawk (Sensitive Listed)

Although potential habitat for goshawks (old-growth forests) can be found in the Sherman and Sweeny creek drainages, no goshawk nests are known to occur there. As discussed in Section 3, Affected Environment, the nearest active goshawk nest (ABR, 2000a) was in the vicinity of the Jualin Mine, although that nest was not located during a 2004 survey. Alternatives A and A1 are not expected to directly or indirectly affect the distribution or population status of goshawks occupying the project area. Prior to project implementation, goshawk nest surveys would be conducted in areas with potential nesting habitat and avoidance/protection measures adopted if necessary.

Trumpeter Swan (Sensitive Listed)

Potential impacts of implementing Alternatives A and A1 on trumpeter swans would be associated with human activity (daily barge traffic, helicopter flights, noise from mine operations) during the fall, winter, and spring months when migrating or overwintering birds might be present in Lynn Canal. Because no known nesting by trumpeter swans occurs in the Jualin/Kensington region (see Section 3, Affected Environment), mine-related impacts to this species' population would not be likely to occur.

Osprey (Sensitive)

Potential impacts of implementing Alternatives A and A1 on ospreys would be associated with human activity (daily barge traffic, helicopter flights, noise from mine operations) during the fall, winter, and spring months, when migrating or overwintering birds might be present in Lynn Canal. Because no known nesting by ospreys occurs in the Jualin/Kensington region (see Section 3, Affected Environment), mine-related impacts on this species' population would not be likely to occur.

Marbled Murrelet (Species of Concern)

A coarse filter analysis of GIS data layers was conducted to quantify the extent of potential impact on suitable marbled murrelet habitat within the project area. Only a small amount (2.7 acres) of high-volume old growth would be removed under either of the alternatives. Under Alternatives A and A1, potential impacts on marbled murrelets would include human disturbance associated with mine-related activities near the mouths of Sherman and Sweeny creeks, as well as approximately 2.7 and 36.6 (28.2 under Alternative A1) acres, respectively, of high- and medium-volume productive old-growth forest habitat loss associated with mine facility construction. Given the distribution and abundance of coastal old-growth forest in the Lynn Canal/Berners Bay area (see Figure 3-6), the loss of the acres associated with Alternatives A and A1 is not expected to result in population impacts on the species. Individual marbled murrelets could be affected, however, by the habitat reduction and mine-related human activity.

Indirect effects would be associated with fragmentation and patch size reduction of suitable habitat for the marbled murrelet. Habitat removal would affect forest fragmentation and connectivity by potentially reducing the effectiveness of interior habitat and increasing the potential for nest site predation by avian predators that are associated with forest edges and fragmented landscapes.

Kittlitz's Murrelet (Species of Concern, Candidate Species under ESA)

The largest known populations of Kittlitz's murrelet occur in Southeast and Southcoastal Alaska. Unlike the marbled murrelet, Kittlitz's is sometimes referred to as the "glacier murrelet," foraging almost exclusively at the face of tidewater glaciers or near the outflow of glacier streams, and nesting in alpine areas in bare patches among the ice and snow. McBride Glacier is the tidewater glacier closest to the project area, and it is in Glacier Bay National Park, approximately 50 miles west of the project area. No foraging or nesting habitat would be disturbed under any of the proposed alternatives, and therefore no adverse effects on the Kittlitz's murrelet are anticipated.

Birds

Waterbirds

Regional waterbird distribution and abundance are not expected to be noticeably affected by implementing Alternatives A and A1 because mine-related activity would be limited to the vicinity of Sherman Creek, which drains into Lynn Canal. Most documented waterbird nesting and feeding activity in the area is associated with habitats within Berners Bay (see Section 3, Affected Environment).

Migratory Birds

Several migratory bird species are likely to nest in the vicinity of the proposed mine facilities. Different bird species make use of different habitats within the project area. The primary effect on migratory birds would be nest destruction or abandonment if the activities occur in suitable nesting habitat during the breeding/nesting period. The taking of migratory birds, though not defined as including habitat destruction, could occur if nests themselves are destroyed during construction. The magnitude of the direct effects relates to the extent of impact on habitats for a particular species and the season in which the disturbance occurs. Alternative A would affect 268 acres of wetlands, including 135 acres of old growth and 127 acres of "low sites," including stands of mixed conifers and muskeg. Alternative A1 would affect 104 acres of old growth and 76 acres of low site habitats.

Indirect effects would be associated with fragmentation and patch size reduction of suitable habitat. For species such as northern goshawks, marbled murrelets, and Townsend's warblers, habitat removal would contribute to forest fragmentation by potentially reducing the effectiveness of interior habitat. Disturbances could also increase the potential for nest site predation by avian predators associated with forest edges and fragmented landscapes. Species associated with forest edge, riparian, or more open habitats might experience negligible habitat impacts or improvements to habitat in response to disturbance. Appendix H provides additional detail on migratory birds and their habitats within the project area.

Surface Spill Impacts

Accidental spills of chemicals or fuel on roadways could affect surface water quality because the haul road and access road would parallel Sherman Creek and include several stream crossings. Fur-bearing mammals and birds could be affected by direct exposure to the spilled material or contaminated surface water, though the extent of the impact would be minimal and short-lived because spill response and cleanup actions would be required.

4.11.2 Effects Common to Alternatives B, C, and D

The following discussion describes the potential impacts from implementing Alternatives B, C, and D on wildlife resources in the project area.

Table 4-20 shows the potential effects under Alternatives B, C, and D. Approximately 4 percent of the project area could be altered under Alternative B, C, or D. Less than 1 percent of the existing productive old growth within the project area could be altered under any alternative.

Table 4-20
Habitat Cover Types Delineated Within the Kensington Gold Project Area and Potential Effects Under Alternatives B, C, and D

		Alternatives		
Habitat Cover Types	Project Area[a]	Alternative B	Alternative C	Alternative D
Low-Volume Old Growth (8–20 mbf)	1,356	7.5	7.5	7.8
Medium-Volume Old Growth (20–30 mbf)	5,196	75.0	82.5	75.1
High-Volume Old Growth (30–50+ mbf)	1,914	58.1	59.3	58.8
Total Productive Old Growth	**8,466**	**140.6**	**149.3**	**141.7**
Nonproductive/Low Site Index Forest (0–8 mbf)	5,338	11.5	11.4	12.3
Nonforest Brush	163	0	0	0
Alpine	376	1	1	1
Fresh Water	39	20	32	20
Rock Outcrop	387	0	0	0
Slide Zone	1,146	1	1	1
Muskeg	1,858	17.8	17.8	17.8
Total	17,569	191.9	211.5	193.8
Percentage				
Low-Volume Old Growth	8%	0%	0%	0%
Medium-Volume Old Growth	29%	0.4%	0.5%	0.4%
High-Volume Old Growth	11%	0.3%	0.3%	0.3%
Unproductive Forest	30%	0%	0%	0%
Non-Forested	22%	0.2%	0.3%	0.2%
Total	100%	0.9%	1.1%	0.9%

Note: Mbf = 1,000 board feet.
[a]Acreages from GIS may vary slightly with tables due to rounding.

Management Indicator Species

Black and Brown Bear (MIS)

Implementing Alternative B, C, or D would likely result in black and brown bear avoidance of mine facilities and areas of human activity (e.g., process area, marine terminal at Slate Creek Cove, and the TSF) within portions of the Johnson Creek and Slate Creek drainages. The potential for bears (especially black bears) to become habituated to human presence also exists, which could result in bear/human interactions, possibly resulting in bear mortality. Mitigation measures to reduce or eliminate impacts include implementation of Forest Plan standards and guidelines for bear management, implementation of a garbage management plan, and an operator-directed prohibition against hunting. These measures have proven to be effective in reducing bear mortality in and around logging camps and Forest Service camps. The 192 to 211 acres of total surface disturbance associated with Alternatives B, C, and D would constitute a local reduction in bear habitat in these drainages for the life of the mine (or until reclamation is completed). These direct effects would be small, however, in the context of bear habitat availability in ADF&G GMU 1.

Traffic levels would increase under Alternatives B, C, and D; however, the likelihood of vehicle collisions causing injury or death would be low because of the speed limit on the road. Within the project area, the beach fringe area is likely used as a travel corridor for many wildlife species, including bears; however, the existing road bisects the beach fringe area near Slate Creek Cove. Indirectly, the existing road at Slate Creek Cove could be limiting movement to wide-ranging carnivores moving through this area and foraging on salmon near the mouth of Slate Creek. Human presence, construction activities, operation of the dock facility, and increased traffic along the existing road would likely limit use of the beach fringe as a travel corridor in this area for the duration of the operation.

Sitka Black-tailed Deer (MIS)

Implementing Alternative B, C, or D would result in a direct loss of approximately 140 to 150 acres of potential Sitka black-tailed deer habitat, including approximately 60 acres of winter habitat. Indirect impacts on the species' local distribution and use of habitat could occur in developed portions of Slate and Johnson creeks, as well as along the 5-mile access road. Impact on the species' local distribution and use of habitat would occur primarily during winter when it uses low-elevation old-growth forests. Potential impacts related to road and vehicle use are expected to be minimal due to the anticipated slow vehicle speeds associated with road use. Only local deer habitat connectivity would be disrupted by these alternatives; populations inhabiting other regions of coastal Alaska (see Section 3) would not be affected. The operator would prohibit employees from hunting deer (as well as other species) within the project area. This measure, along with Forest Plan standards and guidelines, should reduce or eliminate the potential for deer mortality as a result of Alternative B, C, or D. The disturbance and habitat avoidance resulting from Alternative B, C, or D would not likely affect coastal population levels of deer (e.g., within ADF&G GMU 1).

Alexander Archipelago Wolf (Species of Concern and MIS)

Implementing Alternative B, C, or D would likely result in minor changes in wolf use of the area associated with distribution and habitat use by deer. As deer avoid areas of high human activity or redistribute themselves based on availability of high-quality habitat, wolf use of the project area would likely change in response. Human-related impacts might also occur, though the likelihood of this is considered rare. Habitat loss and approximately 200 acres of mine-related disturbance associated with these alternatives are not expected to affect wolf distribution or numbers in ADF&G GMU 1.

Bald Eagle (MIS)

No bald eagle nests would be directly affected by implementing Alternative B, C, or D. USFWS and the Forest Service have developed an Interagency Agreement (May 15, 1990). The agreement establishes a 330-foot management zone around each eagle nest site. Disturbance activities within this zone are restricted during the nesting season (March 1–May 31 and June 1–August 31, if there is evidence of nesting activity). In addition to the 330-foot management zone, the agreement applies restrictions to blasting within 0.5 mile and to repeated helicopter flights within 0.25 mile of bald eagle nests (Forest Service, 1997b).

Because activities associated with Alternative B, C, or D would comply with the Interagency Agreement, no impacts on bald eagles are expected.

Mountain Goat (MIS)

Of concern relative to mountain goats is the availability and distribution of suitable winter range, which as described in Section 3, Affected Environment, in Southeast Alaska typically consists of old-growth forest near steep slopes (Forest Service, 1992). Mine development and operation under Alternative B, C, or D could result in avoidance of suitable winter habitat (closed canopy forests) by goats in the vicinity of the Jualin Mine, the Slate Creek lakes, and the Johnson Creek access road. The 1992 FEIS discussed several studies that indicated goats might be displaced up to 2,500 yards from mine exploration activities, but that due to topographic relief and dense forested vegetation in the area, the magnitude of goat displacement distances might be reduced (Forest Service, 1992).

Displacement of goats in upper Johnson Creek and in the vicinity of the Slate Creek lakes, as well as exposure to noise during personnel and supply transport along the Johnson Creek Road, could occur. Because goat use of the area primarily occurs near upper Johnson Creek (summer) and along the Lynn Canal coastline (ABR, 2000b), and not typically near the Slate Creek lakes or lower Johnson Creek, implementing Alternative B, C, or D would not appreciably affect the Lions Head mountain goat population or other populations in ADF&G GMU 1.

Red Squirrel and Marten (MIS)

Potential impacts from Alternative B, C, or D on red squirrel and marten would be associated with removal of approximately 140 to 150 acres of old-growth forest cover in the Johnson Creek drainage and in the vicinity of the Slate lakes. High-volume productive old growth below 1,500 feet in elevation is suitable for marten. Approximately 60 acres of high-volume habitat would be removed under Alternatives B, C, and D. Local impacts on these species could result from road and facility construction, which would fragment the habitat and could possibly affect local dispersal patterns. However, when analyzed in the context of distribution and stand size of old growth in the entire study area (Slate and Johnson creek drainages [see Figure 3-6]), implementing any of these alternatives would not likely affect habitat connectivity for either species or reduce the availability of 30-acre or greater patches of habitat.

Vancouver Canada Goose (Species of Concern and MIS)

Potential impacts from Alternative B, C, or D on Vancouver Canada goose would be associated primarily with construction and operation of the Slate Creek Cove marine terminal and with disturbance associated with daily crew shuttle traffic and periodic barge traffic in Berners Bay and Slate Creek Cove. The potential use (nesting, feeding, and molting) by this species of the Slate lakes and vicinity would not be precluded under any of these alternatives after construction of the TSF and diversion structures was completed. Approximately 33 acres of upland habitat adjacent to Lower Slate Lake would be inundated, effectively removing these acres from potential goose nesting habitat.

Additional habitat would likely be created, however, along the edges of the post-inundation shoreline for goose and other bird and terrestrial species, the Ecological Risk Assessment in Appendix C shows there will be toxicity-related effects associated with the TSF. Although short-term impacts on Vancouver Canada geese could occur associated with initial construction and avoidance of human activity areas, as well as loss of potential nesting habitat in old growth and forested wetlands, long-term impacts on populations are not expected under any of these alternatives.

Hairy Woodpecker (Species of Concern), Brown Creeper, Red-breasted Sapsucker (all MIS)

Potential impacts on hairy woodpeckers, brown creepers, and red-breasted sapsuckers from Alternatives B, C, and D would include local habitat loss in the Johnson and Slate creek drainages associated with mine and facility development. Approximately 140 to 150 acres of productive old growth would be removed in the Johnson and Slate creek drainages, respectively. Local impacts on these species resulting from road and facility construction that would fragment their habitat and possibly affect local dispersal patterns could also occur; when analyzed in the context of distribution and stand size of old growth in these drainages (see Figure 3-7), however, construction would not likely affect populations of these species in the Lynn Canal/Berners Bay area. Minimum stands of 15 acres for brown creepers and 250 acres for red-breasted sapsuckers would remain available and well dispersed (Table 4-15).

River Otter (MIS)

Old-growth vegetation adjacent to water within the Slate and Johnson creek drainages provides river otter habitat in the project area. Potential impacts on otters currently occupying habitats in the Johnson and Slate creek drainages would result from local removal of old growth along the streams for road and bridge construction and from disturbance associated with subsequent operation-related activities (e.g., road use, mine operations, pipeline maintenance). Impacts would be generally limited because of the distance between the road and the creeks, although there would be two crossings of Johnson Creek.

Threatened, Endangered, and Sensitive Species

The Forest Service consulted the USFWS regarding the presence of threatened and endangered species within the project area. The USFWS indicated that there are no threatened or endangered species within its jurisdiction that occur within the Tongass National Forest (Reference Code 03-28). The Forest Service also initiated a formal consultation with NMFS regarding the Steller sea lion and humpback whale (Forest Service, 2003). The BA/BE (Appendix J) assesses potential impacts from the project on threatened and endangered and forest sensitive species focusing on the impacts associated with Alternatives B, C, and D.

The BA/BE found the operations of the marine facilities *is-Not Likely to Adversely Affect* the Steller sea lions and humpback whales. The BA/BE found that the project would *Not Affect* any salmonids. Because the project might result in the harassment of individual Steller sea lions at some point during the life of the project, NMFS has indicated that formal consultation might result in the need for an Incidental Take Statement to be issued to the Forest Service for the project to be permitted. If an Incidental Take Statement were required, the mine operator would also need to apply for a Letter of Authorization for small takes that could occur during construction or operation. Critical habitat for the humpback whale has not been designated, and no critical habitat for the Steller sea lion would be affected.

The BA/BE also found that the project *May Impact Individuals, But is Not Likely to cause a Trend to Federal Listing or Loss of Viability* for the northern goshawk and would have *No Impacts* on the osprey and peregrine falcon. The BA/BE also found the project would have *No Impact* on trumpeter swans but suggested monitoring swans wintering in proximity to the crew shuttle and barge traffic and implementing potential mitigation measures should monitoring show disturbance.

Humpback Whale (Endangered)

Addressed in Section 4.10.

Steller Sea Lion (Threatened)

Addressed in Section 4.10.

Peale's Peregrine Falcon (Sensitive)

Because no nesting habitat (rock outcrops overlooking water) for Peale's peregrine falcon occurs in the project area or vicinity (see Section 3*)*, implementing Alternative B, C, or D would not be likely to affect the species.

Northern Goshawk (Sensitive)

Potential habitat for goshawks (old-growth forests) can be found throughout the Johnson and Slate creek drainages. Based on the 2004 survey, however, there are no active nest sites and no impacts are predicted. The operator will be required to conduct early season goshawk surveys prior to road construction or reconstruction and use, and for a minimum of 2 years after operations begin, to further document any nesting in the vicinity of the existing road or other suitable habitat in the vicinity of mining operations. If a new nest were located, Forest Plan Standards and Guidelines would apply. These guidelines include maintaining an area of not less than 100 acres of productive old growth (if it exists) centered around the nest tree and allowing no continuous disturbance likely to result in nest abandonment within the surrounding 600 feet from March 15 through August 15.

Trumpeter Swan (Sensitive)

Impacts of implementing Alternative B, C, or D on trumpeter swans would likely be associated with human activity (barge traffic, crew shuttle traffic, noise from mine operations) during the fall, winter, and spring months when overwintering birds could be present in Berners Bay (see Section 3, Affected Environment). The inundation of approximately 33 acres of upland area adjacent to Lower Slate Lake would reduce trumpeter swan nesting habitat, although additional habitat would likely be created along the edges of the new shoreline. Because no known nesting by trumpeter swans occurs in the Jualin/Kensington region, mine-related impacts on this species' population would not be likely to occur. Impacts from crew shuttle and barge traffic on wintering swans in Berners Bay could be mitigated by restricting or reducing barge traffic during periods of high swan use (as indicated by monitoring).

Impacts from crew shuttle and barge traffic on swans wintering near the mouths of the Antler, Lace, and Berners rivers should not occur due to distance; however, potential disturbance to swans in Berners Bay would be mitigated by the restriction on boat traffic during the gulachon run, which corresponds to a period of high swan use.

Osprey (Sensitive)

Potential impacts of implementing Alternative B, C, or D on ospreys would be associated with human activity (daily boat traffic, noise from mine operations) during the fall, winter, and spring months, when migrating or overwintering birds might be present in Berners Bay. Because no known nesting by ospreys occurs in the Jualin/Kensington region (see Section 3, Affected Environment), mine-related impacts on this species' population would not be likely to occur.

Marbled Murrelet (Species of Concern)

Marbled murrelets generally select old-growth stands and large-diameter trees as nest sites (Ralph and Miller, 1995; DeGange, 1996; Kuletz et al., 1995). A small percentage (less than 10 percent) of birds might nest on the ground (DeGange, 1996). Large limbs of old-growth trees are the preferred area for nest placement. Kuletz et al. (1995) stated that the best predictor of marbled murrelet activity and occupied behaviors was location relative to heads of bays, tree size, epiphyte cover on trees, and number of platforms in south-central Alaska. A coarse filter analysis of GIS data layers was conducted to quantify the amount of suitable marbled murrelet habitat in the project area. Suitable marbled murrelet habitat was defined as medium- and high-volume forest regardless of elevation; however, higher-volume, lower-elevation stands are more likely to be used than higher-elevation stands based on previous studies and known occupied stands in Washington and Oregon. Approximately 5,196 acres of medium- and 1,914 acres of high-volume old-growth forest occur within the project area. Removal of suitable marbled murrelet habitat would occur under each of the three alternatives, ranging from approximately 134 acres under Alternatives B and D to 142 acres under Alternative C (Table 4-20). No areas identified as volume class 6 or 7 (coarse canopy structure) would be removed under any of the above alternatives.

Indirect effects would be associated with fragmentation and patch size reduction of suitable habitat for the marbled murrelet. Habitat removal would affect forest fragmentation and connectivity by potentially reducing the effectiveness of interior habitat and increasing the potential for nest site predation by avian predators associated with forest edges and fragmented landscapes.

Kittlitz's Murrelet (Species of Concern and Candidate Species under ESA)

The largest known populations of Kittlitz's murrelet occur in Southeast and Southcoastal Alaska. Unlike the marbled murrelet, Kittlitz's is sometimes referred to as the "glacier murrelet," foraging almost exclusively at the face of tidewater glaciers or near the outflow of glacier streams, and nesting in alpine areas in bare patches among the ice and snow. McBride Glacier is the tidewater glacier closest to the project area, and it is in Glacier Bay National Park, approximately 50 miles west of the project area. No foraging or nesting habitat would be disturbed under any of the proposed alternatives, and therefore no adverse effects on Kittlitz's murrelet are expected.

Birds

Waterbirds

Regional waterbird distribution and abundance are not expected to be noticeably affected by implementing Alternative B, C, or D because mine-related activity would be limited to the vicinity of Slate and Johnson creeks, both of which drain into Berners Bay. Although most waterbird nesting activity in the area appears to be associated with habitats within Berners Bay, the primary use areas for these concentrations are in the shallows at the head of the bay, away from project activity. Barge and crew shuttle traffic could disrupt flocks of waterbirds congregating in Slate Creek Cove (e.g., during the spring eulachon runs). Because of the operator's commitment to reduce the potential for disturbance of waterbird concentrations by reducing boat transport trips during high-bird-use periods, implementing any of these alternatives would not be likely to affect waterbird populations in the Lynn Canal/Berners Bay area.

Migratory Birds

Several migratory bird species are likely to nest in the vicinity of the proposed mine facilities (see Appendix H). The primary effect on migratory birds would be nest destruction or abandonment if the activities occurred in suitable nesting habitat during the breeding/nesting period. The taking of migratory birds, although not defined as including habitat destruction, could occur if nests were destroyed during construction. The magnitude of the direct effects would be related to the extent of impact on habitats for a particular species and the season in which the disturbance occurred. Alternative B, C, or D would affect between 95 and 114 acres of wetlands, including muskeg and forested types. Alternatives B and D would affect about 140 acres of old-growth habitat, while Alternative C would affect 150 acres of old growth.

Indirect effects would be associated with fragmentation and patch size reduction of suitable habitat. For species such as northern goshawks, marbled murrelets, and Townsend's warblers, habitat removal would contribute to forest fragmentation by potentially reducing the effectiveness of interior habitat. Disturbances might also increase the potential for nest site predation by avian predators associated with forest edges and fragmented landscapes. Species associated with forest edge, riparian, or more open habitats might experience negligible habitat impacts or improvements to habitat in response to disturbance.

Surface Spill Impacts

As discussed in the Surface Water Quality section, accidental spills of chemicals and fuel on roadways could cause effects on surface water quality in Johnson or Slate creeks. Mammals and birds in these drainages could be affected directly by exposure to the spilled material or indirectly by drinking contaminated surface water. The extent of impacts would be limited because of the spill response and cleanup that would be required.

Noise

Direct impacts on wildlife from construction- and operation-generated noise (exclusive of those discussed under marine mammals) are expected to be slight because of their infrequent occurrence, low magnitude, or location (see Section 4.18 for discussion of noise). Noise would be generated by blasting during construction and mine development, helicopters during construction, offloading at Slate Creek Cove, shuttle boat transport in Berners Bay, and vehicle activities on site roads. Although noise levels can be measured and predicted, the impacts of noise on wildlife are largely unknown and assessment of impacts remains subjective. Wildlife are receptive to different sound frequency spectrums, many of which might be inaudible to humans. Furthermore, different species of wildlife or individuals within the same species might respond in dissimilar ways to increases in sound pressure level or changes in the nature of sound. The potential effect depends on the nature of the noise, (continuous or impulse), the sound pressure level increase above background, the behavior of the species (related to season and time of day), the level of wildlife use of the area, and the tolerance of the species or individual.

Drilling and blasting near Slate Creek Cove during the 14- to 18-month construction period would occur once a day at most. Though loud, it should cause no sustained impacts on any mammal or bird in the vicinity. Quarry blasting would occur in the Jualin mine site area, again about once a day and away from marine areas. The areas where blasting would occur are topographically isolated from the marine areas by a combination of ridges, peaks, and conifer forests, and therefore blasting should not affect marine wildlife species. Local disturbance from either of these activities would be brief and is not expected to result in modification in behavior because of the short duration.

Helicopter activity would occur only 12 to 14 times per month during construction and would include flights from Juneau to the site. This is not a large increase in helicopter activity over what currently occurs (up to 200 flights daily in the summer in Lynn Canal) in the region, so wildlife disturbance would be slight relative to background conditions. Offloading of supplies at Slate Creek Cove would occur about four times per week and would include some sharp noise (metal on metal). This noise might cause some brief startle reactions in wildlife (mammals, birds) near the pier, but the noise would dissipate generally to normal voice level less than 1 mile from the site (see Section 4.18), causing limited potential for disturbance.

Shuttle boat traffic would occur three to five times daily between Slate Creek Cove and Cascade Point or Echo Cove. Noise levels equal to normal voice level would not be exceeded within a mile of the route. The relatively low noise levels of the shuttle and brief periods of shuttle passing are likely to cause slight disturbance of birds that are very near the boat. Vehicle traffic on the road from the terminal at Slate Creek Cove to the mine might increase, to some unknown extent, avoidance of this region by brown bear. However, the presence of the road might have a greater effect than noise on such avoidance.

Increased noise levels expected during the Kensington Gold Project construction, operation, and reclamation would result in direct, short-term impacts on wildlife in proximity to the project's footprints. Wildlife avoidance due to noise would result in the displacement of individuals into areas where noise levels are lower. Because operation of the project would occur year-around, noise disturbance could affect both resident species (e.g., northern goshawk, black bear, bald eagle) and those occupying the area seasonally (e.g., various neotropical migrant birds). The predicted extent of noise impacts on wildlife, as described above, is based on the implementation of Alternative B, C, or D. Noise levels are expected to exceed ambient levels and adversely affect wildlife over approximately one-half of the project area (based on blasting during construction) (see Section 4.18, Noise). The noise levels would range from 125 dBA for blasting near the borrow pits attenuating to 84.2 dBA near Cove Point, to 72 dBA at the milling process building, and to below ambient levels at Cove Point (see Section 4.18, Noise). Noise from underground blasting would be quieter than that for any surface blasting, and therefore the potential for disturbance to wildlife would be less or none.

4.11.3 Summary

The potential direct effects of the Kensington Gold Project on wildlife vary substantially between species groups and alternatives. Species groups discussed include marine mammals, marine birds, terrestrial mammals, and terrestrial birds. Direct and indirect effects, which vary by alternative, include loss of habitat, disturbance during construction activities and mine operations, mortality from vehicle or vessel collisions, habitat fragmentation, interior forest patch size reductions, nest predation, and increased human disturbance.

Alternatives A and A1 would not involve the construction of marine facilities or associated boat service within Berners Bay, and therefore no impacts on marine mammals and marine birds that use the bay would occur. Marine mammals might be present in the vicinity of Comet Beach, but they are not known to congregate in the area. Minor habitat impacts are expected for management indicator species and other species of concern. For species associated with higher-volume, coarse-canopy forests, such as northern goshawk, marbled murrelet, and Townsend's warbler, impacts on their habitat are expected to be small. Less than 3 acres of high-volume old-growth forest would be affected under Alternatives A and A1, and less than 1 percent of the total productive old-growth forest would be removed (Table 4-14). A total of 135 acres and 104 acres of productive forest would be affected under Alternatives A and A1, respectively. Helicopter flights (up to three flights per day, 5 days per week) to transport personnel might displace goats in the upper Sherman Creek watershed;

however, it would be for a short duration and would not be expected to appreciably affect the goat population in the area.

Alternatives B, C, and D include the development and operation of the Jualin mine site, two marine terminals within Berners Bay, transport of personnel by crew shuttle boat, and transport of supplies by barge. Impacts on marine mammals are discussed in Section 4.10. Thousands of marine birds use the bay during the April–May eulachon run. Waterfowl concentrations also occur during late fall to early winter within the bay.

Impacts on terrestrial wildlife habitat vary slightly between Alternatives B, C, and D, ranging from approximately 192 acres of total surface disturbance under Alternative B to 211 acres under Alternative C (Table 4-16). Approximately 1 percent of the project area would be disturbed under any of the alternatives. Approximately 1,914 acres of high-volume and 5,196 acres of medium-volume old-growth forest occur within the project area. Under the worst case, the dam on Upper Slate Lake and diversion ditches included under Alternative C would remove approximately 60 acres of high-volume and 83 acres of medium-volume old-growth habitat (Table 4-16). Overall, habitat impacts on management indicator species and other species of concern are not expected to be substantial under Alternative B, C, or D.

4.12 SOILS, VEGETATION, AND WETLANDS

4.12.1 Soils

Impacts Common to All Alternatives

The main source of impacts on soils in the project area is the physical disturbance associated with construction of the various facilities. The most immediate impact on the soil resource is the loss of productivity that comes with removal of the vegetation. To the extent possible, soils stripped from disturbed areas would be placed in topsoil stockpiles for later use in reclamation. The loss of soil particles to erosion from disturbed areas and stockpiles could cause a loss of the soil as a resource and affect water quality as soil particles were carried into surface waters. Soils on slopes would be of the greatest concern from a soil erosion standpoint, and the greatest potential for erosion would occur during the construction activities and stripping operations.

The operator would be required to implement BMPs to reduce the potential for erosion. The BMPs would include seeding the stockpiles to stabilize them and using diversions, check dams, silt fences, and sediment ponds. These BMPs would reduce the amount of disturbance exposed to surface water flow and minimize the movement of materials entrained in runoff. The most basic indicator of impacts on the soil resource is the extent to which soils are disturbed. Table 4-21 presents the amount of disturbance, in acres, to the various soil types by alternative. (Characteristics of these soils are presented in Table 3-28.)

Effects of Alternatives A and A1

Construction of the DTF under Alternative A would result in the placement of waste rock and tailings over more than 100 acres of shallow to deep organic soils. Fill would need to be placed in the Sherman Creek drainage to build the process area and associated facilities. This would require the salvaging of highly productive humic cryorthods soils prior to construction. Soils would also be stripped from the till, sand, and gravel borrow areas and access roads prior to their development. In

Table 4-21
Acres of Affected Soil Type by Alternative

Soil Type	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Cryosaprists and Histic Cryaquepts	109.20	73.8	-	-	-
Cryohemists Typic Cryaquod Association	50.60	50.60	20.30	25.58	21.24
Humic Cryorthods	58.10	12.00	47.79	61.68	47.79
Lithic Cryosaprist and Lithic Cryaquod Soils	21.80	21.80	11.54	11.79	11.75
Entic Cryumbrept McGilvery and Rock Outcrop Soils	21.30	21.30	10.03	10.16	10.03
Cryaquepts	4.40	4.40	1.76	1.76	1.76
Cryorthods Cryofluvents Complex	3.20	3.20	0.93	0.93	0.93
Typic Cryaquods Humic Cryorthods Association	-	-	21.29	21.29	22.01
Total	268.60	187.0	113.64	133.19	115.52

all cases, the stockpiled topsoil (or growth media) would be redistributed to a depth of at least 1 foot over disturbed areas as part of the reclamation process (Forest Service, 1997a [Appendix C]). Under Alternative A1 the reduction in size of the DTF and till borrow area would result in a smaller effect on soils as shown in Table 4-21.

Effects of Alternatives B, C, and D

Alternatives B, C, and D would result in fewer acres of impacts on soils compared to Alternatives A and A1. The principal source of impacts would be the same as that under Alternatives A and A1—construction of the process area, sand and gravel borrow areas, and access roads. Soils would be stripped prior to construction of the TSF dam. Soils might also be salvaged from areas that would be inundated as the TSF filled.

Reclamation

The process of restoring soil productivity would begin with the redistribution of soil from the stockpiles once mining operations ceased. The degree to which productivity could be restored depends on a number of factors, such as the nutrient status, depth of application, and degree to which the soil structure was preserved. The nutrient status could be improved as necessary through the addition of fertilizers. The depth of application could be varied to suit the reclamation objective for a particular area, while soil structure is a natural feature that develops over time. Once vegetation became established, soil-building processes would continue and support the natural development of soil and vegetation.

4.12.2 Vegetation

Vegetation within the project area would be affected under any of the alternatives. Impacts related to mining are different from those of typical timber harvesting in that soils would be removed from disturbed areas and stockpiled after the vegetation is removed. Without soil being redistributed as would be done during reclamation, the reestablishment of vegetation would be dependent on the development of soils on these stripped areas. Under any of the alternatives, the largest areas of disturbance would be concentrated in a few places (i.e., tailings disposal, processing areas) while other, smaller sites would be scattered throughout the project area (road widening, borrow areas, pipelines). Sensitive plant surveys of the project area failed to identify any sensitive species (ENSR, 2003; Icy Strait Environmental, 2002). The results of the surveys are documented in the biological evaluation for sensitive plant species (Tetra Tech, 2003a).

Impacts on vegetation can be expressed in terms of timber resources and land cover categories. Table 4-22 presents the number of acres of timber resources affected for each species, age, and volume class. These numbers do not add up to the total number of disturbed acres because the table addresses only areas supporting timber. These numbers do not directly coincide with the numbers presented in Table 4-23 because different data sets were used to develop each analysis.

Table 4-22
Impacts on Timber Classes by Alternative (in acres)[a]

Species	Age and Productivity Class	Alternative A	Alternative B	Alternative C	Alternative D
Hemlock	Young-growth sawtimber; low-volume	40	12	12	12
Hemlock	Old-growth sawtimber; low-volume	26.5	33	40	34.5
Hemlock	Old-growth sawtimber; medium-volume	0.0	29.3	29.6	29.5
Hemlock-Spruce	Young-growth sawtimber; low-volume	20	0	0	0
Hemlock-Spruce	Old-growth sawtimber; low-volume	48.5	6	6	6
Hemlock-Spruce	Old-growth sawtimber; medium-volume	3.5	12.3	12.6	12.5
Total		**137.5**	**92.6**	**100.2**	**94.5**

[a] This analysis was not conducted for Alternative A1.

Table 4-23
Impacts on Land Cover Classes by Alternative (in acres)

Vegetation Type	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
High-Volume Old-Growth	2.7	2.7	58.1	59.3	58.8
Medium-Volume Old-Growth	36.6	28.2	75.0	82.5	75.1
Low-Volume Old-Growth	94.7	73.4	7.5	7.5	7.8
Nonproductive Forest (mixed conifer, muskeg, and forb/grass/sedge)	126.9	75.6	10.2	11.4	11.0
Muskeg Forest	0	0	17.8	17.7	17.8
Slide Area	4	4	1	1	1
Alpine	1	1	1	1	1
Open Water (fresh)	0	0	20	32	20
Open Water (marine)	2.1	2.1	4.9	3.1	4.9
Total	268	187.0	195.5	215.5	197.4

Table 4-23 presents impacts on vegetation resources considering all vegetation types in the project area. A small amount (9.0 acres) of the low site index vegetation unit has been affected by previous activities at the site, including the wastewater treatment plant, the personnel camp at Comet Beach, and the portal and existing development rock storage area. Low site index in this case refers to vegetation communities where productivity (in terms of timber) is limited. Limitations might result from high water tables, shallow soils, or a combination of the two. Forested areas mapped within the low site index category would typically be considered forested wetlands. Other low-index sites would include muskegs and bogs, reflecting increasing soil moisture levels.

Two potential concerns when vegetative cover is removed from an area are the potential for the invasion of disturbed areas by noxious weeds or other invasive species and the increased possibility of erosion (see discussion above). Weedy species are primarily a threat to newly cleared soils because the competition from the existing vegetation is removed. In Southeast Alaska, alders and fireweed are the native invaders and are often the first to become reestablished in an area. Although these species are indicators of disturbance, their presence is not detrimental to the successional process. However, the introduction of nonnative species might negatively affect the long-term species diversity and success of reclamation. Invasive species have not been a significant problem in Southeast Alaska, although species like Canada thistle (*Circium arvense*), Japanese knotweed (*Polygonum cuspidatum*), and foxtail barley (*Hordeum jubatum*) are becoming more widespread (Shephard, 2002; ADF&G, 2002).

The invasion of weedy species can produce an obvious change in species diversity; however, changes in hydrologic or drainage patterns can also influence the species composition on a local scale. These types of changes are typically reflected in increases or decreases in the populations of the species already present. These types of impacts are not expected to be long-term or widespread. The installation of diversion ditches, for example, might actually lead to an increase in productivity depending on the species composition and the degree of change. These types of effects can be more pronounced in wetlands and are described further in that section.

Reclamation

The resiliency of the vegetation in the region is evidenced by the reestablishment of timber and muskeg communities following the logging and other impacts associated with mining in the late 1800s and early 1900s. These older disturbances did not include removal of the soil resource. For the Kensington Gold Project, soil would be spread over areas that had been stripped as part of reclamation. The soils redistributed from stockpiles during the reclamation process would not necessarily resemble the original soils in terms of nutrient content, texture, and structure. It is expected, however, that vegetation would be successfully reestablished on the site. Reclamation would be conducted under a reclamation plan approved by the Forest Service; see Appendix D for the preliminary Reclamation Plan. Native species are available for reclamation purposes. The relatively small size of the disturbances means that plants from adjacent, undisturbed areas would serve as seed sources in addition to species planted as part of the reclamation process. Under Alternatives A and A1, the topography of the reclaimed DTF would likely support an upland forest in place of the wet forest and muskeg that currently occupy the site. Under Alternatives B, C, and D, reclamation of the TSF would result in an increase of wetland habitat along the margins of the enlarged Lower Slate Lake in areas that are currently a mixture of upland forest, forested wetland, and scrub bog. Reclamation of the remaining areas under all alternatives would result in a mixture of uplands and wetlands.

4.12.3 Wetlands

Wetlands throughout the project area would be affected by construction and operations. Projects affecting wetlands are subject to federal, state, and local requirements. Executive Order (EO) 11990, for example, calls for no net loss of wetlands; however, the no net loss is a goal and the USACE, as the permitting authority, retains flexibility in its permitting process. Section 404 of the Clean Water

Act requires the USACE to issue permits for activities that would result in the placement of dredge or fill material in wetlands subject to the Act. Wetlands subject to the Act are considered jurisdictional and must meet hydrologic, soil, and vegetation criteria described in the *1987 Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory, 1987). Before a permit may be issued, Section 404(b)(1) Guidelines require that projects avoid impacts to the extent possible, minimize impacts that cannot be avoided, and provide compensatory mitigation for impacts that occur. The 404(b)(1) Guidelines also require the selection of the least environmentally damaging practicable alternative. The operator has received a Section 404 permit for Alternative A and has applied for a permit that would cover activities proposed for Alternative B, C, or D. The CBJ has its own wetland policies, one component of which is mitigation banking. Under the concept of mitigation banking, wetland impacts in one project area may be offset by the contribution of land or resources to a mitigation bank that can be used to preserve or restore wetlands off-site (CBJ, 1991). The USACE would consider these aspects in reviewing the proponent's application for a permit.

Table 4-24 presents a summary of the acres of impacts from each alternative on each wetland type during mining operations. Reclamation activities (discussed below) under each alternative would restore some of the lost wetland habitat.

Table 4-24
Acres of Wetlands Affected Under Each Alternative from Construction Through Operations

Wetland Type	Alternative A	Alternative A1	Alternative B[a]	Alternative C[a]	Alternative D
Estuarine Rocky Intertidal Shoreline	-	-	3.0	1.3	2.5
Estuarine Unconsolidated Intertidal Shoreline	1.6	1.6	-	1.8	-
Estuarine Subtidal	0.7	0.7	3.3	3.3	3.3
Lacustrine (open water)	-	-	20.0	20.0	20.0
Palustrine Aquatic Plant Bed	-	-	0.1	0.1	0.1
Palustrine Unconsolidated Bottom	-	-	-	12	-
Palustrine Emergent	-	-	9.6	15.0	9.8
Palustrine Scrub-Shrub	56.4	24.4	0.1	0.1	0.1
Palustrine Forest	150.0	107.6	19.0	23.6	20.7
Upland Forest (upland/wetland mix)	38.0	31.3	2.9	5.3	2.9
Disturbed (upland/wetland mix)	21.4	21.4	39.2	39.2	39.2
Total	268.1	187	97.2	118.4	98.6

[a] Includes 2.7 acres of estuarine wetland impacts at Cascade Point.

Effects of Alternative A and A1

Alternative A would affect 268 acres of wetlands during operations. The DTF would be constructed in the terrace area, which consists of palustrine forest and palustrine scrub-shrub wetlands. There would be a permanent loss of these wetlands because the design of the DTF would preclude their reestablishment. The process area, till borrow area, and sand and gravel borrow areas would be built in areas consisting of a mix of upland forest (with wetland inclusions) and palustrine forested wetlands. Alternative A1 would affect 187 acres of wetlands and would differ from Alternative A in that less fill would be placed in terrace area wetlands.

The reclamation plan approved for Alternative A would restore approximately 98 acres of wetlands. Emergent wetlands would be established within the DTF diversions, the till borrow area, and sand and gravel borrow pits. To the extent possible, the haul roads, process area, laydown areas, and areas used for stockpiles would also be reclaimed as wetlands. Due to the topography of these areas, wetlands developing in these areas would likely be of the forested or scrub-shrub type. A similar number of wetland acres would be restored under Alternative A1.

Functional Losses. The construction of the DTF in the terrace area would result in the permanent loss of over 100 acres of palustrine forest and palustrine scrub-shrub wetlands. Functional values for these wetlands are medium for wildlife habitat, production export, and flood flow alteration. The production export function is limited in the terrace area because intermittent streams drain the area. For the same reason, wetlands in this area possess low functional value for riparian support. Their position in the landscape results in lower values for groundwater recharge than similar wetland types higher in the watershed would demonstrate. The DTF would be reclaimed as an upland at closure. Because wetlands in the terrace area are primarily forested (as opposed to emergent), some of the lost functions, such as wildlife habitat, might be replaced, assuming a viable forest was successfully established following reclamation of the DTF. However, the establishment of a forest on the DTF that would provide a wildlife habitat of similar quality to that which currently exists would take tens of years. The establishment of emergent wetlands in the diversions around the DTF would provide diversity in the structure of the reclaimed ecosystem. Because emergent wetlands could be established much more quickly than forested types, these wetlands could provide high values for nutrient cycling and sediment/toxicant retention in the post-reclamation environment, particularly in the early years following reclamation of the DTF.

The functions and values provided by wetlands in the vicinity of the process area and borrow areas would be lost during construction and operations. Functions of the emergent wetlands (e.g., sediment retention, nutrient export, and wildlife habitat) would be restored relatively quickly in the areas used as borrow areas following reclamation because the structure of the vegetation in these wetlands is simple and the plants would grow quickly. Functions associated with the remaining forested wetlands (e.g., wildlife habitat and production export) would recover more slowly, reflecting the time it would take for trees and shrubs to become reestablished in the reclaimed areas. Some of the nutrient inputs to Sherman Creek provided by wetlands disturbed by construction and operation of the project would be lost until wetlands were reestablished; however, long-term effects on the riparian wetlands along Sherman Creek would not be expected because large areas within the drainage would remain undisturbed. The Sherman Creek riparian wetlands would not be expected to suffer a noticeable loss in function because a buffer strip would be maintained, except in the immediate vicinity of crossings and the wastewater treatment ponds.

Effects Common to Alternatives B, C, and D

Construction of the process area, TSF, tailings pipeline access road, and marine terminals would affect wetlands under each alternative. Impacts would include excavation and burial. Approximately 38 acres of wetlands would be filled during construction of the process area within areas identified as disturbed upland. However, because this area contains wetland inclusions, it is considered wetlands for purposes of this discussion. Construction of the TSF dam would require the placement of fill in approximately 4 acres of evergreen forested wetlands and 2 acres of emergent wetlands near the outlet of Lower Slate Lake. Operation of the TSF would also fill and inundate an additional 10 acres of forested wetlands and 4 acres of emergent wetlands surrounding Lower Slate Lake. These losses would be permanent, although the areas covered with tailings and inundated would become open water and have the potential to support benthic organisms and provide fish habitat following reclamation. The tailings pipeline and access road would directly affect 2.5 acres of emergent wetlands, primarily in the vicinity of Spectacle Lake and Upper Slate Lake. Combined, the main road upgrade, the tailings pipeline access, and the cutoff spur between the main road and the pipeline access would affect 4 acres of forested wetlands, slightly more than 1 acre of emergent wetlands, and less than 0.2 acre of scrub-shrub wetlands. The direct impacts resulting from the fill for the tailings pipeline access road would persist during the duration of operations, but wetlands would be reestablished after reclamation of the road and pipeline. Direct and indirect impacts resulting from upgrading the main access road might be permanent or temporary depending on whether the state and landowners choose to retain possession of the road or remove it.

The roads could produce indirect impacts on wetland hydrology by altering flows of surface water and shallow groundwater. The extent to which these impacts would occur is difficult to determine and depends to a large extent on the type of fill material and on the effectiveness of the drainage controls along the disturbance. However, studies on roads in peat wetlands in Southeast Alaska indicate that impacts are generally limited to the immediate vicinity of the road and that the hydrologic regime recovers relatively quickly within 30 feet downgradient of the road (Forest Service, 1999; Glaser, 1999; McGee, 2000). The area most sensitive to alterations in hydrology would be where the road crossed scrub-shrub and emergent wetlands in the area between Spectacle Lake and Upper Slate Lake. These changes might not result in the transition of wetland to upland, although subtle changes in species composition could occur as the vegetation component adapts to the new hydrological conditions. The extent of any such impacts would be very limited.

Construction of the Slate Creek Cove marine terminal would affect a small amount of rocky intertidal shoreline. Most of the disturbance in this wetland type has already occurred from the construction of the existing fill structure at the beach. The Cascade Point marine terminal would require placement of fill over 1.3 acres of intertidal and subtidal habitats. The intertidal areas consist of a rocky beach with bedrock outcrops. Subtidal portions were vegetated by red coralline algae (*Lithothamnion* sp.) and green algae (*Ulva* sp.) (Stekoll, no date a). The fill would result in the permanent loss of a small amount of this habitat, although the fill would be colonized over time. Additional discussions of impacts on the marine environment are presented in Section 4.9.

Functional Losses. The predominant wetland types that would be affected by Alternatives B, C, and D are forested and emergent wetlands. Forested wetlands at the outlet of Lower Slate Lake received high functional ratings for wildlife habitat, carbon/detrital export, and fish habitat. They received moderate ratings for sediment/shoreline stabilization and nutrient cycling. Emergent wetlands within the vicinity of the proposed process area received moderate ratings for all functions except groundwater interchange (low). Wetlands in the vicinity of the Slate lakes and Spectacle Lake form a large forest and emergent wetland system. This area would experience approximately 23 acres of impacts under Alternative B, almost 35 acres under Alternative C, and 25 acres under Alternative D. The forested/emergent system provides high levels of wildlife habitat and moderate values for fish habitat, nutrient cycling, carbon/detrital export and sediment/toxicant retention. Of the additional affected acres under Alternative C, the inundation of 11 acres around Upper Slate Lake would occur only during the life of the project. These wetlands would be expected to reestablish once the water levels receded. Construction and operation of the TSF would result in the permanent loss of 23 acres (13.5 acres of forested wetlands and 9 acres of emergent wetlands).

The direct loss of function would result from the placement of fill, burial by tailings, or inundation. With the exception of the areas inundated by the TSF or buried by the dam, impacts on forested wetlands would remain in place through the duration of operations and would begin recovery with reclamation. The loss of the habitat function would not occur simply as result of construction and operation of the project because the presence of humans and equipment would likely affect the habitat values well beyond the direct impacts on forested wetlands. The loss of hydrologic functions would to some extent be replaced by the TSF, which would provide surface hydrologic control and sediment/toxicant retention.

As noted under Alternative A, the replacement of wetland function depends to a large extent on how quickly vegetation can be reestablished. Therefore, the replacement of the functions provided by forested wetlands would take much longer than those provided by emergent types. The operator has not provided specific information on the extent of wetlands to be restored on a project-wide basis. The details provided in the proposed reclamation plan for Lower Slate Lake focus on restoring fish habitat rather than on wetland restoration. However, it is likely that emergent wetlands would reestablish over time along the margins of the shoreline as the hydrologic system returned to a new equilibrium following reclamation. The period of time for wetland species to become established would depend to some extent on the substrate available for the reestablishment of vegetation. The placement of stockpiled organic material in strategic areas would provide a foundation for the immediate reestablishment of wetland vegetation. It is likely that organic material from surrounding areas would accumulate relatively quickly within the lake, facilitating the spread of aquatic and wetland species. Assuming successful implementation of the reclamation plan, wetland functions provided by Lower Slate Lake, including carbon/detrital export, nutrient retention/export, fish habitat, and sediment/ toxicant retention, should be improved over the long term.

Effects of Alternative B and D

Alternatives B and D would affect approximately 94.5 and 96.4 acres of wetlands for facilities and structures, including the process area, pipeline access road, and TSF. Wetland types affected range from emergent bogs to forested. The landing craft ramp portion of the Slate Creek Cove marine terminal would affect an additional 3.6 acres of rocky intertidal and estuarine subtidal wetlands. An additional 20 acres of open water in Lower Slate Lake would also be affected. The littoral zone (maximum extent of emergent vegetation) within the lake encompasses approximately 6 acres.

Effects of Alternative C

Alternative C would result in impacts on 114.4 acres of wetlands, with the increase due to the disturbances associated with the diversion ditches and the inundation that would result from damming Upper Slate Lake. The types of wetlands inundated under Alternative C would be split almost equally between forested and emergent types. Construction of the diversion structures would result in the physical disturbance of 8 acres of wetlands, primarily forested. The diversions would also affect the hydrology of wetland areas downgradient because by design they would intercept overland flow. The acreage of wetlands that could be affected by the altered drainage patterns was not determined; however, most would ultimately be buried by tailings or inundated as the water levels rose within the TSF. Construction of the dam on Upper Slate Lake would also result in inundation of 12 acres of emergent and forested wetlands surrounding the lake. These wetlands would be flooded for only the duration of operations; however, the reestablishment of forested wetlands on the site would require a period of tens of years. Emergent wetlands would be expected to develop relatively quickly assuming the pre-flooding hydrological regime was restored.

The elimination of the barge loading ramp would result in a slightly smaller disturbance to the sandy intertidal shoreline wetlands that occur along Slate Creek Cove. The total reduction in impacts is estimated to be approximately 0.5 acre of the 3.6 acres that would be affected under Alternatives B and D.

4.12.4 Summary

Soils

Table 4-21 presents a side-by-side comparison of impacts by alternative across soil types. In considering impacts on the most productive soils (Humic Cryorthods, Cryorthods Cryofluvents Complex, and Typic Cryaquods Humic Cryorthods Association) on an acreage basis, Alternative C would affect approximately 84 acres; Alternatives B and D, approximately 70 acres; and Alternative A, 61 acres. Alternative A1 would affect only 15.2 acres of the most productive soils on the site. Although these soils would be affected during construction and operation, they would also serve as growth media in the reclamation phase of the project. Because the soils would be reapplied as part of reclamation, their productivity would not be permanently lost. However, the characteristics of the soils following reclamation would depend to a great extent on the depth, moisture regime, slope, and aspect of the areas where they were applied.

Vegetation

Alternatives B, C, and D would have a greater impact on high- and medium-volume old-growth forests compared to Alternatives A and A1 during construction and operations. Conversely, Alternatives A and A1 would have a greater impact on low-volume and nonproductive forests, including the forested wetlands and muskegs where the DTF would be constructed. The low productivity in the terrace area currently results from saturated soils, a condition that would be eliminated if the DTF were constructed. Following reclamation, the DTF would have the potential to support a higher level of productivity because the soils would not be saturated. The extent to which a productive forest could be reestablished would depend on the quality and characteristics of the growth media placed during reclamation and the extent to which the growth media could retain adequate moisture for tree growth. Reclamation of the disturbances under Alternatives B, C, and D would ultimately result in productivity levels similar to those existing in the pre-mining condition because the hydrology would not be altered to the extent of that in the terrace area. However, it could take 100 years or more for timber volume and forest characteristics similar to the pre-mining condition to develop following reclamation.

The other primary difference between Alternatives A and A1 and Alternatives B, C, and D is the size of the largest disturbances. Large disturbances (e.g., the DTF and borrow areas) take longer to recover than smaller ones because of the influence of adjacent vegetation. The close proximity of seed source material and the establishment by root sprouting species such as Sitka alder means vegetation could become reestablished relatively quickly in disturbances such as road cuts. Seeds and root growth require a greater period of time to establish within and move across more sizable disturbances, as do the microorganisms that improve the interaction between plant roots and soil. Therefore, the reestablishment of vegetation cover in smaller disturbances, such as the roads, would occur much more quickly than that in areas like the DTF, process area, waste rock disposal, and borrow areas. A reclamation plan that included seeding with native species would help to ameliorate the effect to some extent.

Wetlands

The principal difference between Alternatives A and A1 and Alternatives B, C, and D is the types of wetlands that would be affected and the value associated with those wetlands. Alternative A would have the greatest effect on palustrine forested and scrub-shrub wetlands, with approximately 110 acres lost permanently due to construction of the DTF. Palustrine forested and scrub-shrub wetlands are among the most common wetland types in Southeast Alaska and provide a moderate to high level of wildlife habitat within the terrace area. These values would be lost permanently once construction of the DTF began. Under Alternative A, some of the palustrine forested and scrub-shrub wetlands in other portions of the project area would become emergent or aquatic bed wetlands (borrow areas), while others would be encouraged to return to their pre-mining form following reclamation. Alternative A1 would have proportionally fewer impacts on wetlands in the terrace area because of the reduced footprint of the DTF.

By comparison, Alternatives B, C, and D would affect substantially fewer acres of wetlands but would affect a greater number of wetland types, including palustrine emergent, palustrine aquatic bed (Upper Slate Lake), and lacustrine (Lower Slate Lake). Lower Slate Lake provides high values for fish habitat, high values for wildlife habitat, and moderate values for nutrient cycling and carbon export. Upper and Lower Slate lakes provide aquatic habitat for the Dolly Varden char, three-spine sticklebacks, and benthic organisms that inhabit the lake. In addition, the lake margins support the wide variety of wildlife in the area, including moose and Vancouver Canada geese. Not all functions provided by the lakes would be lost during construction and operations; however, the value for fish habitat is assumed to be lost for the duration of operations and the value in terms of wildlife habitat would be reduced at a minimum. Nutrient cycling and production export values would also be lost during operations. The diversity in form provided by the palustrine emergent wetlands provides moderate wildlife habitat values and sediment retention, as well as high values for flood flow alteration. The forested wetlands would provide values similar to those associated with Alternatives A and A1. Impacts on the emergent, forested, and shrub-scrub wetlands would remain at least through the duration of operations; the extent of recovery following reclamation would depend to a great extent on the extent of fill removal and reestablishment of wetland hydrology.

Alternative C would also affect Upper Slate Lake (palustrine aquatic bed) during operations. The effect of losing or reducing the functions of both lakes simultaneously during operations would be substantially greater than the effects on Lower Slate Lake alone under Alternatives B and D, including the loss of nutrient cycling, and production export and loss/reduction in value of habitat for fish (see Section 4.10) and wildlife (see Section 4.11). Upper Slate Lake and the wetlands surrounding it would recover from the impacts from inundation after reclamation; however, the recovery of emergent and submergent wetland vegetation along the margins of the lake would take years, with herbaceous vegetation recovering first, followed by shrubs and trees.

4.13 LAND USE AND RECREATION

The following discussion of land use focuses on the National Forest System lands within the project area. Although similar uses might occur on adjacent private lands, Forest Service jurisdiction, including designations, standards, and guidelines, does not extend to private lands. Figure 2-1 provides an overview of land ownership in the project area.

4.13.1 Effects of Alternative A

Land Use

Since publication of the 1992 FEIS, the study area’s land use designation in the Tongass Land and Resource Management Plan (Forest Plan) has been changed from Land Use Designation (LUD) II to Modified Landscape (ML) with a minerals overlay. The goal of the ML designation is to provide a mix of resource activities while minimizing the visibility of developments in the foreground distance zone and providing a spectrum of recreation and tourism opportunities consistent with resource activities such as mining. Goals of the minerals designation include “To encourage the prospecting, exploration, development, mining, and processing of locatable minerals in areas with the highest potential for minerals development” and “To insure that minerals are developed in an environmentally sensitive manner, and that other high-valued resources are considered when minerals developments occur" (Forest Service, 1997b). A detailed discussion of the visibility of components of Alternative A and their compatibility with these goals is included in the following sections.

Long-term impacts of Alternative A on land use would be minimal. This alternative would result in the disturbance of 268 acres. Interim and final reclamation would be designed to be consistent with Forest Service land use objectives. Structures would be removed, and the area would be regraded and revegetated. The DTF and the diversion above it would remain in place.

A short-term impact on land use would be the displacement, during project construction and operation, of the relatively few hunters who currently use the project site. Expansion of the mine facilities at Comet Beach would constitute a change in land use. Noticeable impacts on commercial fishing in Lynn Canal are not expected. When possible, barge deliveries would be scheduled to avoid interference with commercial fishing.

As discussed in Section 3.13.2, the project is located within a portion of roadless area 301, which includes both the historic Kensington and Jualin mining properties, including access roads. Except for some minor realignment, no new road construction would occur under Alternative A.

Recreation

The mining activities associated with Alternative A would occur in an area classified as Semi-Primitive Non-Motorized (SPNM) and Semi-Primitive Motorized (SPM). However, the Forest Plan allows for these recreational settings to be altered to Roaded Modified due to the LUD of ML. In Roaded Modified areas, recreation opportunities are provided in a substantially modified environment, where roads and other human alterations might be strongly dominant but remain visually subordinate when viewed from distant sensitive roads.

Lynn Canal is the only Visual Priority Travel Route (VPTR) with a view into the project area. The DTF would be highly visible to the cruise ship and ferry passengers passing by the site during project operation, but it would be less apparent after closure and reclamation. The mine portal area would also be visible from Lynn Canal but would be more visually subordinate than the DTF (see Section 4.14, Visual Resources). Project-related lighting would be visible from Lynn Canal but would be minimized by downward-directed lights. Alternative A would thus be consistent with the Forest Service's management prescriptions for recreation after closure, but it might not be compatible during operation.

Because the mine site can be accessed only by boat or air, Alternative A would not cause significant displacement of recreational users simply because current use of this site is limited. There has been some hunting for goat and black bear documented near the Kensington Mine site. Hunters would likely follow the movement of wildlife to adjacent areas as the mine becomes operational. Existing recreational use of the Comet Beach area would also be displaced as a result of the presence of supply barges and its proximity to the heliport. Direct effects on the recreational fishery are not expected as a result of implementing Alternative A.

The noise and activity from Alternative A would result in some impacts on recreation. Cruise ship and ferry passengers would not be likely to be affected by the noise generated by barges and helicopters. However, the proposed two to three helicopter flights per day could affect boaters within the flight path adjacent to Lynn Canal. Helicopter flights could be heard in Berners Bay, depending on the flight path and schedule. Those hunting in the vicinity of any of the mine-related facilities would also be affected by project noise and activity.

Projected population increases due to Alternative A could create an indirect impact by increasing hunting and fishing pressure in the region. Any increase in hunting and fishing pressure would be distributed throughout the Juneau region. Hunting and trapping from project facilities would be prohibited by employees, as would the on-site use of firearms. The public would not be subject to the prohibition applicable to mine employees.

4.13.2 Effects of Alternative A1

Land Use

Alternative A1 would have land use impacts similar to those under Alternative A, except that the DTF would be approximately one-third the size of the DTF under Alternative A. Material would be stockpiled in the area adjacent to the reduced DTF, resulting in a disturbance during operation. Because the DTF would remain in place after project completion and reclamation, a smaller DTF would allow more of the area to be restored to its original condition than under Alternative A.

Recreation

The reduced production option would have effects on recreation similar to those under Alternative A, except that the smaller DTF would reduce the visual impact on ferry and cruise ship passengers in Lynn Canal. Visual impacts are discussed in more detail in Section 4.14. The duration of impacts under Alternative A1 would be shorter (10 years) than that under Alternative A (12 years).

4.13.3 Effects of Alternatives B and D

Land Use

Land use management guidelines for the Alternative B and D study area would be similar to those for Alternative A, except that the Slate Creek Cove marine facility and the southern 2.5 miles of access road are currently within an OGH LUD. This designation seeks to maintain old-growth forests and their associated ecological processes, including associated fish and wildlife species and flora/fauna biodiversity. Objectives include "To the extent feasible, limit roads, facilities, and permitted uses to those compatible with old-growth characteristics" (Forest Service, 1997b). Because the access road and much of the laydown area already exist and would be upgraded only where necessary, the mine facilities within this LUD should be compatible with the OGH designation. If the OGH boundaries are modified as described in Appendix F, this area will revert to the ML LUD discussed above under Alternative A.

The long-term effects of Alternatives B and D on land use would be similar to those of Alternative A. Alternatives B and D would result in less total disturbance than Alternative A, and reclamation undertaken at the end of mining would restore the site to its previous uses. The TSF would remain in place, but it would be reclaimed to restore fish habitat. The resulting lake would have a larger surface area than the existing Lower Slate Lake. The pipeline access road, recycling system, and pipeline would be removed.

Short-term impacts on existing commercial and recreational fishing activities would be limited, although impacts on hunting uses would be similar to those under Alternative A. Construction and operation of the Slate Creek Cove marine terminal would change the land use to a more developed use, but recreational access to shorelines immediately adjacent to the facility would still be allowed.

Alternatives B, C, and D include the construction of approximately 4.5 miles of new road. Assuming a corridor of influence extending 1,200 feet on either side of these new roads, the total additional area of "roading effect" within roadless area 301 would be about 1,300 acres. This represents about 0.1 percent of the roadless area. Because the additional road construction would be within a recognized historical mining district, the actual effect on the roadless character would be negligible. The new roads associated with the project would not be visible from either Berners Bay or a VPTR.

Recreation

The extent of impacts on recreation uses would be different between the areas where active mining activities were occurring and Berners Bay. The Jualin and Kensington mine areas and the site of the proposed TSF are designated as SPNM but are allowed to be altered to a Roaded Modified recreational setting because of their location within the ML LUD. Proposed facilities in these areas would be consistent with the Roaded Modified designation because they would be visually subordinate from VPTRs and use areas (UAs). The Slate Creek Cove marine terminal and the southern 2.5 miles of access road are the only project features outside the ML designation. These facilities currently lie within the OGH LUD, which encourages maintenance of the existing recreational setting. More developed settings are allowed because of authorized activities or activities in adjacent LUDs. Topographic and vegetative screening would be used when locating roads and the marine transfer facilities. The marine facility and the 1-mile stretch of road lying within 0.25 to 0.5 of a mile of shoreline are designated as SPM, with the remaining 1.5 miles of road classified as SPNM. Project traffic along the 1.5 miles of access road designated as SPNM might conflict with the nonmotorized character of the area. There would be an estimated 34–37 round trips per day on the road, most of which (25 per day) would be tractor-trailer trucks carrying concentrate. If the OGH boundaries were modified as proposed in Appendix F, the Recreational Opportunity Spectrum (ROS) in the vicinity of the marine facility and access road would be allowed to be altered to a Roaded Modified setting, which would be more compatible with mining-related traffic.

Alternatives B and D would displace relatively few recreational users because the immediate project site is not highly used for recreation. The mine site is accessible only to the few boaters who anchor their boats and then hike or drive an off-road vehicle (ORV) or snowmobile the 5 miles up the existing access road. There is no existing road access to the TSF. The limited amount of hunting that occurs in the project area might be displaced as wildlife moves to adjacent areas. Development of the marine facilities at Slate Creek Cove would displace any boaters who might otherwise land or camp at the marine terminal site. Public use of the marine terminal would not be allowed, but boaters would still be allowed to pull up on the adjacent beach.

The project features most likely to affect recreation would be the transportation of personnel, supplies, and concentrate to and from the project. Noise, wakes, lights, safety issues, and visual impacts are all concerns resulting from the proposed crew shuttle boat, barge, and helicopter traffic. Such traffic would create an ongoing commercial presence in the vicinity of Berners Bay, which differs from the existing recreational boat traffic, which is more transient in nature. Approximately three to five shuttle boat trips (round trips) per weekday would be required to transport project personnel, and an estimated two trips per day would take place on weekends. The shuttle would remain at the Cascade Point marine terminal when not in use. Crew shuttle crossings are currently scheduled to depart Cascade Point at 5:00 a.m., 3:00 p.m., 6:00 p.m., and 1:00 a.m. on weekdays and 5:00 a.m. and 6:00 p.m. on weekends. Depending on weather conditions, the crew shuttle crossings would take approximately 15 minutes. Under the proposed schedule, the shuttle would be en route for approximately 2 hours per day on weekdays and 1 hour per day on weekends; half of that time would be early morning hours.

Approximately four barges per week would transport supplies, fuel, and concentrate to and from the project. The barges would typically be 286 feet by 75 feet. They would take approximately 30 to 45 minutes to cross the bay from Lynn Canal and would remain at Slate Creek Cove for several hours—long enough to load or unload. Project-related helicopter traffic would be limited to occasional trips to transport emergency supplies or personnel.

The noise and activities from the crew shuttle and barge would affect recreational boaters and land-based recreation in the vicinity of Cascade Point and Slate Creek Cove. The shuttle would generate an estimated 80 A-weighted decibels (dBA) at the middle of the bow at full speed. As a comparison, the Forest Service uses an assumed background noise of 45 dBA for shoreline environments with calm sea and surf (Hart Crowser, 1997). Section 4.17 discusses the extent of noise impacts from the crew shuttle and other aspects of mining operations. Generally, people on motorboats that are underway would be unlikely to hear the shuttle even in close proximity. However, kayakers, beachcombers, and people in moored boats would be able to hear the crew shuttle boat, depending on their location, the location of the crew shuttle, and ambient conditions at the time (e.g., wind, waves, other boats). The crew shuttle crossings would generate less noise than the airboats that currently ply the bay. The general noise and activity generated as barges are unloaded or employees embark and disembark the crew shuttle at Slate Creek Cove would also affect boaters who moor or camp in the cove. The crew shuttle would slow down as it approaches the marine terminals, which would reduce the level of noise coming from it. Noise generated by the mine/mill site and vehicles using the access road is not expected to affect recreation, except for the few hunters and trappers who might travel through the project area.

The crew shuttle boat would travel at a maximum of 18 mph and the wakes from the crew shuttle would be larger than those generated by the skiffs that currently frequent the bay. A study of boat wake effects in the Upper Mississippi River showed recreational boats as having wakes of 3.2 inches, 6.3 inches, 9.5 inches, and 19.7 inches for pontoons, fishing boats, medium power boats, and large cruisers, respectively (Wilcox, no date). The barges would travel at slower speeds and have smaller wakes than the shuttle and thus would have less wake impact. Compared with the waves that regular users encounter in Berners Bay, the wakes are not expected to affect recreational users in the vicinity of the project area.

Visual impacts caused by the project could also affect the quality of the recreation experience. The only project features visible from Berners Bay would be the Slate Creek Cove marine terminal and a small portion of the pipeline access road, visible from the northern third of the bay. The area from which the access road could be seen consists mostly of the shallow waters near the mouth of the Berners and Antler rivers, but it also includes the Berners Bay Cabin. The road would be 6 miles away from the cabin and partially screened by trees and thus relatively difficult to detect. It might also be possible, depending on the weather and extent of tree cover, to see a very small part of the process area from the Berners Bay Cabin, limited to portions of the topsoil stockpile, waste rock storage area, and possibly the top of the mill building. See Section 4.14,Visual Resources, for a detailed discussion of visual impacts.

In addition, boaters could see the crew shuttle or an occasional barge cross the bay, depending on the time of day. These vessels would contrast with the smaller boats now used on the bay. The 3:00 p.m. and 6:00 p.m. shuttles on weekdays and the 6:00 p.m. shuttle on the weekend would be more likely to be seen by boaters, each trip lasting roughly 30 minutes. The 5:00 a.m. and 1:00 a.m. crew shuttle crossings might also affect boaters who moor or camp overnight on Berners Bay, particularly in Slate Creek Cove. The marine facility would be lighted only while boats are being loaded or unloaded. Marine facility lighting would affect mostly campers, overnight boaters, and those viewing the night sky; however, effects would be limited due to the long daylight hours during the recreation season. Lighting at the mine process area and TSF would not be visible to recreationists (see Section 4.14).

The only project features visible from Lynn Canal would be the Kensington Mine portal (primarily the development rock storage) and Comet Beach facilities, which would be visually subordinate to the overall landscape. Although the waste rock stockpiles outside the Kensington portal would be visible to cruise ship and ferry passengers, mine activities would often be pointed out to ferry passengers as part of the shipboard interpretive program (Forest Service, 1997a).

The primary impacts on land-based activities, such as hiking, camping, staying in cabins, and beachcombing, would be the sight of several crew shuttle crossings a day, and possibly a barge crossing the bay. The Slate Creek Cove marine terminal would be visible from Point Bridget and the Echo Cove facilities, but they would be approximately 7 miles away. The marine facility would be most visible on a clear day when a barge is moored. The only features visible from the Berners Bay Cabin would be a small stretch of the pipeline access road and possibly the topsoil and development rock storage, which would be over 6 miles away and thus difficult to distinguish. Those hunting in the project area might have views of the project, depending on their location.

The project would be most visible from flightseeing planes or helicopters that fly over the project area. The Kensington and Jualin Mine sites would be visible from the air, as would the TSF, the access road, and the Slate Creek Cove marine terminal. The project area is not located on the more popular flightseeing routes, however, and many helicopter pilots who cross the bay often point out the Jualin Mine as an item of interest (Wilson, 2003, personal communication).

An indirect impact on recreation would be the potential impact on wildlife viewing if Steller sea lion or humpback whale populations are disturbed by crew shuttle traffic. Wildlife viewing is popular during the spring, when marine mammals enter the bay for the eulachon runs. Impacts on the recreational fishery are not expected as a result of Alternative B or D.

Projected population increases due to Alternative B or D (and the other alternatives) would create an indirect impact by increasing hunting and fishing pressure in the region. Since hunting by project employees would not be allowed on mine properties and employees would be transported from Juneau, any increase in hunting/fishing pressure would be distributed throughout the Juneau region. Furthermore, ADF&G regulates hunting and fishing and can adjust the number of permits based on demand within a particular management unit. Hunting permits for moose are allotted by drawing, with thousands of hunters competing for the 14 permits allowed in the study area; thus the additional population resulting from the project would cause only a minor increase in competition for moose permits. Increased hunting pressure on other species, such as goat or bear, would be addressed as necessary by ADF&G.

Construction impacts during the 14- to 18-month construction period would be similar in nature to the operation impacts, except for the use of the temporary personnel camp at Comet Beach. The noise, dust, and activity generated by construction of the Slate Creek Cove marine terminal and possibly the access road improvements would affect boaters using Slate Creek Cove. Periodic blasting (maximum once per day) would be audible in Berners Bay during construction. The blasting noise is expected to be 84.2 decibels at Cove Point and 75.5 decibels at the Berners Bay Cabin, compared to the assumed background noise of 45 decibels. The noise from helicopter traffic, estimated at 12–14 trips per month, is projected to be 62 decibels at Cove Point and would affect recreation. Construction-related boat traffic across the bay would affect recreational boaters. During the heaviest construction period, there would be one barge trip and several crew shuttle trips per day.

4.13.4 Effects of Alternative C

Land Use

The effects of Alternative C on land use are similar to those for Alternatives B and D, except that the marine terminal would be constructed in Echo Cove instead of at Cascade Point. The Echo Cove marine terminal would be located approximately 0.75 mile north of the existing boat ramp at the head of the cove. The Echo Cove marine terminal would be smaller than the proposed Slate Creek terminal because it would not need to accommodate barges. This alternative would alter the land use by introducing a second boat facility to Echo Cove, along with the associated parking facilities. Like the Cascade Point site, the Echo Cove site is owned by the Goldbelt Corporation; construction of the terminal would therefore not conflict with Forest Service land use policies.

Recreation

As with land use, the primary difference between Alternatives B and C in terms of recreation impacts is the construction of the marine terminal in Echo Cove. The terminal structure would affect recreation by introducing another human alteration to the cove, thus creating a visual impact on those boating in the cove or engaged in shoreline activities like picnicking and beachcombing. A boat facility at this location, however, would be less visible from Berners Bay than the Cascade Point facility and would not require a breakwater. It would therefore have a lesser visual impact from the bay (see Section 4.14, Visual Resources).

The terminal would be used for an estimated three to five round trips per weekday and an estimated two round trips per day on the weekends. The shuttle would remain at the Echo Cove terminal when not in use. The shuttle is currently scheduled to depart at 5:00 a.m., 3:00 p.m., 6:00 p.m., and 1:00 a.m. on weekdays and 5:00 a.m. and 6:00 p.m. on weekends. The shuttle trips with the greatest potential for affecting recreation would be the 3:00 p.m. and 6:00 p.m. weekday trips and the 6:00 p.m. weekend trip.

Crew shuttle boat traffic within the cove would have a greater impact on recreation than that at the Cascade Point terminal because it would introduce wake and noise impacts into the relatively sheltered Echo Cove. The cove is regularly used by small boats, particularly kayaks and skiffs. Recreational activities along the shoreline include camping, hiking, picnicking, beachcombing, and shore fishing. Much of the existing kayak traffic stays within the protected waters of Echo Cove, and thus a marine terminal in the cove would have a greater impact on kayaking than Alternative B or D would have.

When operating at full speed in Berners Bay, the crew shuttle would generate an estimated 80 dBA, compared with the assumed background noise of 45 dBA for shoreline environments with calm sea and surf. When entering the cove, however, the shuttle's speed would be reduced, thereby reducing noise impacts. Those using motorboats would be unlikely to hear the shuttle noise in Echo Cove. The shuttle would generate less noise than the airboats that currently put in at Echo Cove.

The wakes generated by the crew shuttle would affect kayaks and other small boats. Because there is generally less natural wave action in Echo Cove than in Berners Bay, the shuttle-generated wakes would be more noticeable. Wake wash along the shorelines would also affect land-based recreation, such as hiking and picnicking. Construction of the Echo Cove marine terminal would require excavation near the terminal site and intermittent maintenance dredging. These would affect recreation activities, creating a visual impact on those using the cove and its shoreline. The crew shuttle boat entering Echo Cove could also conflict with the numerous crabpots that tend to be concentrated just inside the mouth of the cove.

4.13.5 Summary

Alternatives A and A1 would have greater impacts on land use than Alternatives B, C, and D because they would disturb more land and the DTF would remain in place after project completion. The primary impact of Alternatives A and A1 on recreation would be the views of the DTF and mine process area from Lynn Canal during operation and the DTF after reclamation. Facilities associated with Alternatives A and A1 would be located within the ML LUD with a Minerals Overlay. This LUD allows resource activities to alter the ROS to Roaded Modified, which requires facilities to be visually subordinate from VPTRs. The facilities proposed for Alternative A would be compatible with this LUD, except the DTF, which would not be visually subordinate as seen from Lynn Canal. Alternatives A and A1 would thus not meet the ML LUD during operation but would meet it after reclamation.

Under Alternatives B, C, and D, the construction of the Slate Creek marine terminal would affect land use by interrupting recreational use of that portion of the shoreline. After project completion, mining facilities and the marine terminal would be removed and the area reclaimed, except the TSF, which would remain in place after project completion. The mine process facilities and TSF would be compatible with the Modified Landscape LUD and Minerals Overlay.

The impacts of Alternatives B, C, and D on recreation would be greater within the vicinity of Berners Bay and Slate Creek Cove than at the immediate mine site because of the larger number of people using the bay. Impacts on Berners Bay would result from the presence of regularly scheduled shuttle and barge traffic, which would alter the remote, pristine character of the bay. Recreationists would be able to see the Slate Creek and Cascade Point marine terminals, as well as several 30-minute crew shuttle trips per day and an estimated four barge trips per week.

Noise generated by the crew shuttles would be similar to that from the existing large power boats that use the bay but would be audible to people in smaller boats in close proximity to the shuttle boat. The shuttle would slow down when reaching the terminals, reducing noise impacts on those using Echo and Slate Creek coves. Lighting and noise during crew shuttle or barge offloading could also affect campers or boaters moored overnight. Crew shuttle wakes would be an estimated 18 inches, compared with 9.5 inches for a medium power boat, which would affect kayakers near the shuttle but would be similar in size to the wave heights that can occur naturally. Because much of the existing kayaking occurs in Echo Cove, Alternative C would have a greater impact on the kayakers that use the cove in terms of noise, wakes, and visual impacts.

The recreation impacts of the mine process area and TSF under Alternatives B, C, and D would be minimal relative to the Berners Bay impacts because much of the area is private property with relatively difficult access and thus is not used extensively for recreation. In addition, the Mining Overlay that applies to the mine process area and TSF site allows for changes to the recreational setting to a Roaded Modified ROS, allowing for more developed facilities and motorized uses than the existing Semi-primitive Non-motorized ROS. An approximate 1.5-mile stretch of the project access road is within the OGH LUD and is designated an SPNM ROS. The project-related truck and bus traffic along the road might conflict with this ROS. If the OGH boundaries were changed as proposed in Appendix F, the LUD would revert to ML, which would reduce this conflict because it would allow the ROS to be altered to Roaded Modified.

4.14 VISUAL RESOURCES

4.14.1 Effects of Alternative A

The 1997 SEIS provides a detailed description of the visual impacts of Alternative A. In summary, the primary visual impact of Alternative A would be the DTF, which would be visible to passengers on ferries and cruise ships on Lynn Canal (Figure 4-1). Other facilities visible from Lynn Canal would be the Comet Beach facilities, process area facilities, two of the four borrow pits, and stretches of the access road. The Comet Beach facilities visible from the canal would include the helicopter landing area and hangar, the fuel transfer facility, and the temporary personnel camp, which would become a storage area for concentrate containers during project operation.

According to the Forest Plan (Forest Service, 1997b), the Comet Beach marine terminal and DTF facilities would lie within the ML LUD. Therefore, these facilities would need to conform to the Modification Visual Quality Objective (VQO) because they lie within the middleground view from the Lynn Canal ferry and cruise ship routes. Under the Modification VQO, activities may visually dominate the landscape, but they must have visual characteristics similar to the adjacent landscape. During project operation, the Modification VQO would not be met, primarily because of the DTF, which would contrast with the surrounding landscape in terms of line, form, color, and texture. After project completion and reclamation, the Modification VQO would be met. Reclamation efforts would include revegetation and slope stabilization of the borrow pits and revegetation and recontouring of the DTF, roads, and process area, where possible. The DTF would be graded and seeded concurrently with construction, and trees and shrubs would be planted after closure. Reducing the color and texture contrast of the DTF by revegetation would make it more difficult to distinguish the contrasts in line and form that would remain after reclamation, allowing the Modification VQO to be met. Establishing enough vegetative cover to reduce color and texture contrasts and thus meet the VQO could take 5 to 10 years after project completion.

The process area at the Kensington Mine portal would also be very evident from Lynn Canal, contrasting with the surrounding landscape because of its light color and horizontal lines. Lighting of the process area would also be visible from Lynn Canal, but only during hours of darkness, which are limited to the very late evening and early morning hours during the summer season. Because the process area lies within the ML LUD, with a Minerals Overlay, it would need to conform to the Maximum Modification VQO during project operation and the Modification VQO after completion. The Maximum Modification VQO allows mining activities to dominate the landscape when viewed as middleground, but landscape design techniques should be used to reduce adverse visual impacts where these are visible from VPTRs and UAs such as Lynn Canal (Figure 3-11). After project completion, the Modification VQO would be met once reclamation reduces the contrast in color and line.

The visual condition resulting from this alternative would be Type VI during operation because the DTF would appear as a major disturbance contrasting with the natural appearance of the landscape. The visual condition after reclamation would be Type III because the DTF would be noticeable but the natural appearance of the landscape would be dominant.

Source: SCWA, 1996.

FIGURE 4-1. SIMULATION OF ALTERNATIVE A, LOOKING EAST. DRY TAILINGS FACILITY (RIGHT) AND PROCESS AREA (LEFT)

4.14.2 Effects of Alternative A1

Reducing the production levels under Alternative A1 would lessen visual impacts by reducing the size of the DTF to approximately one-third the size of the DTF under Alternative A. Figure 4-2 presents a representation of the DTF at the end of mining under Alternative A1. The disturbed area on the immediate right of the DTF depicted in Figure 4-2 would be used for stockpiling material during operation. Because this area would be used until the final stages of building the DTF, it would be the last area to be reclaimed. The Alternative A1 scenario substantially reduces the visual impact relative to Alternative A. However, the smaller DTF would still not meet the Modification VQO during project operation because it would contrast with the surrounding landscape in terms of line, form, color, and texture. After project completion and reclamation, the Modification VQO would most likely be met because contrasts in color and texture would be reduced. Reduced production levels would also shorten the life of the mine to 10 years of operation, plus 2 years of construction, compared to 12 years of operation and 2 years of construction under Alternative A. Alternative A1 would thus shorten the amount of time that the VQO would not be met.

Visual impacts resulting from the Comet Beach development, process area, borrow areas, and access road would be the same as those for Alternative A. As with Alternative A, the visual condition resulting from Alternative A1 would be Type VI during operation because the DTF would appear as a major disturbance contrasting with the natural appearance of the landscape. The visual condition after reclamation would be Type III because the DTF would be noticeable but the natural appearance of the landscape would be dominant.

4.14.3 Effects of Alternatives B and D

The effects of Alternatives B and D on visual resources were evaluated by selecting a key viewpoint of the proposed action and developing a photo simulation from that viewpoint. The view of the proposed Slate Creek Cove marine terminal and southern terminus of the main access road, as seen from across Slate Creek Cove, was selected as a critical viewpoint because the cove is used for boating, camping, and fishing and is listed as a Visual Priority Use Area in the Forest Plan (Forest Service, 1997b). The disturbance expected at the Kensington Mine portal under Alternatives B and D was not simulated because the disturbance in the portal area would be similar to that shown for Alternative A. The Cascade Point marine terminal would also be visible from Berners Bay, but it was not simulated because it would be located on private property. A visual simulation of the Cascade Point marine terminal is provided in the Cascade Point Access Road Environmental Impact Statement (Forest Service, 1998a). The remaining project features for Alternatives B and D, such as the mine process area, TSF, and access roads, either would not be seen from the VPTRs or would be visible but visually subordinate to the surrounding landscape given the distance from viewers and vegetative screening; therefore, they were not included in the simulations.

Source: Modified from SCWA, 1996.

FIGURE 4-2. SIMULATION OF ALTERNATIVE A1, LOOKING EAST. DRY TAILINGS FACILITY (RIGHT) AND PROCESS AREA (LEFT)

The photo simulation of the Slate Creek Cove marine terminal is shown in Figure 4-3. The simulation shows an approximation of what the facility would look like from a boat approximately two-thirds of a mile south of the facility, near the mouth of Slate Creek Cove. The photo was taken during an ebb tide of approximately 7.7 feet above sea level. The marine facility would be within the foreground view from Slate Creek Cove, the middleground view from the western part of Berners Bay, and the background view from the eastern shores of the bay. On a clear day the facility might be visible in the background from the southern shore of Berners Bay, particularly when the crew shuttle or barge is docked. The size and number of boats that would use the facility are discussed in more detail later in this section. Alternatives B and D also include a laydown area near the marine terminal but behind the treeline. It would be visible only from the access road and from the air. The laydown area would be approximately 150 feet by 150 feet and used to store equipment, supplies, and transport containers for the flotation concentrate.

The Slate Creek Cove marine terminal and the southern portion of the main access road are currently located within the OGH LUD, which requires that activities conform to the Retention VQO at all distance zones. Activities are to be designed so as not to be visually evident to the casual observer. Exceptions for small areas of nonconforming developments, such as transportation and mining developments, may be considered on a case-by-case basis (Forest Service, 1997b). The Forest Plan requires the use of designs and materials that are compatible with the forms, colors, and textures found in the characteristic landscape.

The terminal would be evident to the casual observer but might be considered an exception because it would be small in scale when viewed from much of Slate Creek Cove relative to the forested ridge behind it. The simulation indicates that the color of the docks and gravel fill would contrast with the surrounding landscape. This contrast would diminish over time as the portion of gravel below tide level became weathered and covered with mussels. Color contrasts would be reduced by painting the facility a neutral, nonreflective color approved by the Forest Service. The facility’s line and form would be more compatible with the landscape than its color, given the strong horizontals of the shoreline and the vertical tree pattern. The marine facilities would be removed and the beach area reclaimed after project completion, which would allow the Retention VQO to be met in the long term.

If the OGH boundaries were modified as proposed in Appendix F, the LUD would revert to ML, which would alter the VQO at the marine terminal site to Partial Retention because it is in the foreground view from Slate Creek Cove. The terminal should meet the Partial Retention VQO because it would be subordinate to the landscape character of the area during and after project completion. Clearing of vegetation would be kept to a minimum and materials and colors that blend with the natural surroundings would need to be used to meet the Partial Retention VQO.

The Cascade Point marine terminal would be more visible than the Slate Creek Cove terminal from the southern portions of Berners Bay, including Echo Cove, Echo Cove Bible Camp, and Point Bridget (Forest Service, 1998a). The facility would not need to meet a Forest Service VQO because it would be located on private property. The facility would create a strong contrast with the surrounding shoreline, particularly in terms of color and texture. The fill required for the breakwater would create a large, rectilinear form, which would contrast with the adjacent shoreline. The shuttle boat used to transport personnel would remain at Cascade Point when not in use, and thus it would also be visible from Echo Cove and the bay.

FIGURE 4-3. SIMULATION OF THE SLATE CREEK COVE MARINE TERMINAL, LOOKING NORTH

The 1992 FEIS and 1997 SEIS describe the visual impacts of the road and mining activities at the Kensington portal. Under Alternatives B and D, there would not be any process facilities at the Kensington portal or the DTF, but the access road and some of the mine area disturbance would remain as part of these alternatives and would be visible from Lynn Canal. Under Alternatives B and D, waste rock would be stored at the Kensington portal, in the same area proposed for processing facilities under Alternative A, but the disturbance would be slightly smaller (by approximately 8 percent) than the process area disturbance shown for Alternative A (Figure 4-1). The southernmost part of the disturbed area shown for Alternative A (the DTF) would not be disturbed under Alternatives B and D. As with Alternative A, the disturbance would be within the middleground view from Lynn Canal, and thus it would need to comply with the Maximum Modification VQO during project operation and the Modification VQO after completion. The waste rock piles would be the most visible feature from Lynn Canal, contrasting in color with the adjacent forested mountainside. The horizontal line created by the rock pile would contrast with the natural openings in the forest and avalanche chutes that are predominantly vertical or near vertical. The Maximum Modification VQO allows mining activities to dominate the landscape when viewed as middleground, but landscape design techniques should be used to reduce adverse visual impacts. Reclamation of the area after project completion would reduce the contrast in color and line, allowing the Modification VQO to be met.

The only other VPTRs and UAs with views of project facilities would be the northern third of Berners Bay, much of which is extremely shallow, and the Berners Bay Cabin. These areas would have a view of approximately 2/3 mile of the pipeline route and access road, as well as 0.5 mile of the road between Johnson Creek and the pipeline route. Much of the road would be screened by the existing conifer trees, but the low, deciduous tree cover in the vicinity of Snowslide Gulch would make it difficult to completely screen the pipeline route. The pipeline might be discernible as a horizontal, light-colored line on the mountainside, depending on the amount of cut and fill required and the amount of screening provided by trees. Mitigation measures would be used to reduce the visibility of the road, such as minimizing clearing, cuts, and fills by using full bench cuts and end-hauling materials on steep slopes.

In addition, the Berners Bay Cabin might have a view of the top of the mill building and adjacent development rock and topsoil stockpiles. Because the cabin is over 6 miles from the site, the facilities would be difficult to detect, depending on weather conditions. When visible, the facilities would be perceptible only as a change in color. Painting the mill building a nonreflective, earth-tone color would mitigate this view.

The pipeline access road and mine/mill site would lie within the ML LUD with a Minerals Overlay and would be within the background view from the Berners Bay Cabin and the middleground from the mouth of the Berners and Lace rivers. The pipeline access road and mine/mill site would thus need to conform to the Maximum Modification VQO during project operation and the Modification VQO after project completion. They would meet these VQOs because they would not dominate the characteristic landscape during operation and would not be visible from the bay after reclamation.

The existing Jualin access road would be maintained as the primary site access, but it would be upgraded as needed to support operations. The specific details of the design improvements have not been developed but are expected to be minimal. Topsoil would be salvaged where possible, and in some areas crushed rock would be used to widen the road surface. In other areas the road subgrade would be formed by cut-and-fill methods. The main access road in its current configuration is not visible from Berners Bay. Although it is possible that stretches of the road would be visible once it is improved, the surrounding coniferous forest would screen most of the road. Mitigation measures discussed above for the pipeline route would be used to minimize the visibility of the road. Truck and other vehicle traffic might generate some fugitive dust, but it would be limited by the use of gravel surfacing, and any dust generated would not be likely to rise above the height of the trees.

The other mine facilities are not expected to be visible from VPTRs and UAs, and thus they would be visible only to the relatively few people who enter the area for hunting or other activities. These facilities include the TSF, borrow sites, and topsoil stockpiles. Facilities that are not visible from VPTRs and UAs would need to meet only the Maximum Modification VQO and thus might visually dominate the landscape. These facilities would be reclaimed and returned to their previous state after the completion of mining, except for the TSF, which would remain in place, resulting in a larger surface area of the lake. The TSF dam would remain, and the face would be revegetated over time.

The use of a crew shuttle boat and barges to transport personnel and supplies to the Slate Creek marine facility would also have a visual impact on boaters on Berners Bay and those using the recreational facilities at Echo Cove and Point Bridget State Park. The 75-foot crew shuttle and 286-foot barge would contrast with the predominantly smaller (18- to 20-foot) skiffs that frequent the bay. The shuttle would make an estimated three to five round trips per day, while the barge would make approximately four round trips per week to the marine terminal. Wakes from the crew shuttle would likely be larger than those produced by most of the skiffs that currently use the bay. See Section 4.13, Land Use and Recreation, for details on the timing of the boat traffic and its impact on recreation.

Project-related lighting could also be visible to campers and other people viewing the night sky. When operating during times of darkness or reduced visibility, the shuttle boat would use the lights required by Coast Guard regulations. The lights are intended to be seen by other boats, not to light up the surroundings (which would hinder visibility), and thus they are not extremely bright or large (Bishop, 2003, personal communication). During the summer season, lights would be seen only on the 1:00 a.m. shuttle trip and possibly on the 5:00 a.m. trip because of extended daylight hours. The marine facilities would be lighted only while boats are approaching or being loaded or unloaded. Lighting from the mine site, process area, and tailings facility would not be visible from Berners Bay due to the topography. Lighting at the Kensington Mine portal would likely be visible from Lynn Canal, but the effects would be mitigated by the use of downward-directed lights and limited to the relatively short hours of darkness during the summer season.

The primary impact during construction would result from the construction of the Slate Creek marine terminal, which would be visible from Berners Bay. This is expected to occur during the first quarter of construction, which would likely occur in early summer, after the peak period for recreationists visiting the bay to view wildlife. In addition, the construction camp at Comet Beach would be visible from Lynn Canal. Fugitive dust might also create a visual impact during construction. There would be more barges entering the bay during construction, estimated at one per day, and they would be visible from Point Bridget State Park and some of the Echo Cove facilities. There would also be additional helicopter flights during construction, approximately 12 to 14 per month, and several shuttle boat crossings a day from Cascade Point once the Slate Creek marine terminal was constructed.

In summary, the construction of the Slate Creek and Cascade Point marine terminals would change the visual condition of Berners Bay from a Type III condition in which human alterations are noticeable, but not dominant, to a Type IV, in which changes are easily noticed but do not stand out as a dominating impression of the landscape. After project completion and reclamation, the bay's visual condition would return to Type III. The visual condition of the Johnson Creek drainage, as seen from Berners Bay, would change from a Type I to a Type III during operation, reverting back to Type I after reclamation. The visual condition on the Kensington side of the project would remain a Type V during project operation because the only visible change would be an increase in the size of the existing disturbance at the portal. After project reclamation the visual condition on the Kensington side would be considered a Type II because the reclaimed mine area would be difficult for the casual observer to notice. The VQO of Retention at Slate Creek Cove would be met during and after operation due to the exceptions allowed to the VQO in the Forest Plan. If the LUD of this area changed to ML due to changes in the OGH boundaries, the VQO would be Partial Retention, which would be met if natural colors were used and clearing was minimized. The Maximum Modification VQO at the Jualin Mine site would also be met during and after project operation. The Maximum Modification VQO at the Kensington Mine site would be met during operation, and the Modification VQO would be met after project completion.

4.14.4 Effects of Alternative C

The effects of Alternative C on visual resources would be similar to those for Alternatives B and D, except that the Cascade Point marine terminal would be relocated to the eastern shore of Echo Cove. Alternative C would also reduce the disturbance at Slate Creek Cove by eliminating the landing ramp. This would reduce the amount of gravel fill visible from the cove during low tides. After project completion, reclamation would be similar to reclamation under Alternatives B and D, except that the TSF diversion structures would also be removed and reclaimed.

The Echo Cove marine terminal would be smaller than the Slate Creek Cove terminal because it would not require a breakwater. The terminal would be within the viewshed of the portion of the bay extending from Cascade Point to Point St. Mary and Slate Creek Cove, but it would be difficult to detect from the open waters of the bay because of its relatively small size. The marine terminal would not be visible from the southern shore of Berners Bay, including Point Bridget. The shuttle boat used to transport personnel would be more visible from the bay than the terminal structures. The shuttle would remain at Echo Cove when not in use, and thus it would be visible from Echo Cove and portions of the bay during most of the daylight hours. Locating the terminal at Echo Cove would also require the use of red and green navigation lights at the mouth of the cove, and possibly along the cove’s shoreline.

All the project facilities under Alternative C would have the same effect on VQOs as Alternatives B and D. The Echo Cove marine terminal would not need to meet a Forest Service VQO because it would be located on private property. The steel dock and support structures at the Echo Cove terminal, as well as the lighting, would create a contrast with the surrounding shoreline, primarily in terms of color. The structures could be painted a neutral color to reduce color contrasts. Access to the Echo Cove marine terminal would require periodic maintenance to support the crew shuttle operations. This maintenance would consist of occasional dredging of portions of the channel, as needed. The dredging during construction and maintenance would cause a visual impact on those using the cove and its shorelines.

4.14.5 Summary

The mining facilities proposed under Alternatives A and A1 would be much more visible to the public than those proposed under Alternatives B, C, and D. The DTF would be highly visible from Lynn Canal, as would the mine process area. The DTF would not meet the Modification VQO during operation because it would contrast with the surrounding landscape, but it would most likely meet that VQO after reclamation.

The primary visual impact of Alternatives B, C, and D would be the view of several crew shuttle boats per day and approximately four barges per week crossing Berners Bay, as well as the Slate Creek and Cascade Point marine terminals. The Slate Creek marine terminal would likely meet the

Retention VQO because exceptions are allowed for small areas of nonconforming transportation or mining developments. The Cascade Point marine terminal would be located on private property and thus would not need to meet a VQO. Alternative C would slightly reduce visual impacts at Slate Creek Cove by eliminating the landing ramp. Moving the Cascade Point marine terminal to Echo Cove would reduce visual impacts from Berners Bay, but it would increase visual impacts on those using the cove.

4.15 SOCIOECONOMICS

This section describes the socioeconomic impacts of Alternatives A, A1, B, C, and D. As discussed in Section 3, socioeconomic impacts are evaluated for the region of influence (ROI) encompassing the City and Borough of Juneau (CBJ). Because the current No Action Alternative (Alternative A) is identical to the Proposed Action Alternative evaluated in the 1997 SEIS and in the Socioeconomic Impact Assessment Report prepared by Hansen and Associates (1997), this document summarizes the results of those efforts in the Alternative A impacts section. (The monetary impacts presented in the 1997 reports have been updated to 2002 dollars to allow for a better comparison between Alternative A and the other four alternatives.) Alternatives A1, B, C, and D are newly proposed alternatives, although they contain many of the elements of Alternative A. This report incorporates, to the extent possible, the same methodologies and assumptions used in the previous studies to ensure consistency in the way the alternatives are evaluated. Nonetheless, not every assumption used in the earlier studies remained appropriate or applicable for this analysis for various reasons, including changes in the state of the regional economy between 1997 and 2003 and the configurations of the new proposed alternatives. Such differences are explicitly noted in the text where appropriate.

Methodology

Economic Input-Output Analysis. Projections of economic impacts on the ROI from implementation of the Proposed Action have been developed using the Impact Analysis for Planning Model (IMPLAN). IMPLAN is an economic input-output model, originally developed by the Forest Service for natural resource planning but later updated and adapted by many other government agencies and private sector analysts for use in economic impact analysis. The IMPLAN system has been in use since 1979 and has evolved from a mainframe non-interactive application to a menu-driven microcomputer program that is completely interactive.

The IMPLAN model is a regional input-output model that is derived by using local data combined with national input-output accounts. The model uses the most currently available data obtained from the Department of Commerce, Bureau of Labor Statistics, and other federal and state agencies. The model uses trade flow characteristics to trace economic changes in a regional economy arising from changes in the level of activity in one or more identified sectors. It uses county-level data to adjust the national income accounts to fit the trade flow characteristics of the subnational ROI for the study. The analyst develops an ROI based on various factors, including residential distribution of the directly affected workforce, and trading and commuting patterns. An ROI is typically an aggregation of one or more counties because the county is the smallest jurisdiction for which most economic data are collected. IMPLAN estimates economic changes for the defined ROI and quantifies changes to the following economic indicators:

- Sector output
- Employment
- Personal income
- Total value added
- Employee compensation
- Proprietors income

- Other property income
- Indirect business taxes

Changes in these indicators provide a detailed picture of how a change in a specific sector affects businesses, households, and the public sector in the whole region. It should be noted, however, that because there has been no recent mine construction activity in the CBJ region, the latest version of IMPLAN's database (year 2000) does not provide the inputs to run the model for this sector. Instead, the analysis uses the same employment and income impact multipliers used in the 1997 study to estimate the socioeconomic impacts of the construction phase. Although this approach allows for consistency with the previous study, it might not capture some of the changes in the regional economy that have since taken place and that might result in somewhat different multipliers. Conversely, the IMPLAN model was used to estimate regional employment and earnings impacts from the operation of the mine. The 1997 analysis used a derivative model called IPASS. The differences in these models could lead to differences in impact estimates using similar input data (e.g., number of direct workers). For example, the IMPLAN model used for this study has a higher employment impact multiplier than the impact multiplier used in the 1997 study and therefore would predict larger changes for the same project assessed. Hence, this difference should be taken into account when comparing Alternative A with Alternatives A1, B, C, and D.

Major Assumptions Used in the Economic Impact Analysis. The predicted economic impacts of all alternatives were estimated using the methodologies described above. The analytical results of the modeling efforts, however, are affected by several factors including the quality of the data used and the types of assumptions made. As noted above, because Alternative A is a variation of the Proposed Action alternative that was evaluated in Reed Hansen and Associates' 1997 Socioeconomic Impact Assessment, to the extent possible this analysis uses the same assumptions as the previous analyses to facilitate comparison between the projected impacts of the five alternatives. For example, this analysis uses the same assumptions regarding expenditure patterns during the construction period and the demographics of the mine workforce, including percentage of in-migrating workers bringing families to the CBJ. (The full set of assumptions used regarding in-migration rates, demography, and multiplier adjustments for the construction workforce is described in the Draft Socioeconomic Impact Assessment, Kensington Gold Project [Reed Hansen and Associates, 1997].)

Some changes in assumptions from the previous analyses were necessary because of data availability issues and changes in economic conditions since 1997. For example, unemployment levels are higher and the overall CBJ economy is weaker in 2004 than in 1997. Accordingly, the labor force available to fill construction and mining operation jobs is somewhat larger than that a decade ago. The primary limitation to filling these jobs with local workers is that many of the construction and operation jobs require specialized skills. The previous studies, including the Draft SEIS, assumed that up to 80 percent of the jobs would be filled by in-migrating workers. Given the higher unemployment rates and the planned training and outreach programs by the mining operators, it is reasonable to assume that more of the project-generated jobs would be filled by local workers. Hence, the Final SEIS also evaluates the impacts under a Low-Migration Scenario, which assumes that local workers would fill 50 percent of the construction and mining operation jobs. It should be noted that the current operating mine in the CBJ area, Greens Creek Mine, operates using primarily local workers. The assumption used in the original 1997 economic analysis and in the Draft SEIS that 80 percent of the construction and mine workforce would relocate from outside the ROI is still used in the current analysis as the High-Migration Scenario.

Similarly, because the CBJ labor market is weaker now than in 1997 and because indirect jobs are less specialized than the mining jobs, the Final SEIS assumes that under the Low-Migration Scenario only about 25 percent of those jobs would be filled by in-migrating workers. Under the High-Migration Scenario, 50 percent of the indirect workers are assumed to in-migrate.

4.15.1 Effects of Alternative A

Under Alternative A, the 1997 Kensington Gold Mine Plan would be implemented. The economic impacts of this action were thoroughly assessed in the 1997 Socioeconomic Impact Assessment prepared by Hansen and Associates. The following subsections summarize the results of that effort. It should be noted that dollar values presented in the 1997 Socioeconomic Impact Assessment have been updated from 1996 dollars to 2002 dollars.

Employment Impacts. Short-term and long-term minor beneficial direct and indirect effects on regional employment would be expected. The proposed development would take place in three phases (construction, operation, and reclamation) over a period of about 17 years. Construction of surface and underground facilities would occur in the first 2 years, resulting in short-term beneficial impacts on ROI employment. The average workforce would be 164 workers during the first year of construction and 338 workers during the second year of construction. The peak construction workforce, estimated at 345 workers, would occur during the second year of construction. Indirect jobs created by the construction of the mining facilities would total 35 during the first year and 128 during the second year.

The operational phase would last 10 years, followed by a 1- to 2-year inactive period, and finally a 2-year reclamation period. The operational and reclamation phases would result in long-term beneficial impacts on ROI employment. The direct operations workforce would comprise 253 employees. The employment level would drop to 30 workers during the 1- to 2-year inactive period, then increase to 100 workers during the final 2-year reclamation phase of the mining project. Long-term indirect employment would be about 187 workers over the steady-state operating life of the mine.

Earnings Impacts. Short-term and long-term minor beneficial direct effects on regional income would be expected. The Kensington Mine would increase employment, and therefore the total income of the ROI. In the short term, during the 2-year construction phase, impacts would be small because it is expected that most of the construction workers would live at the work camp and return to their permanent residences outside the ROI when off work. During the operational phase, more workers would be expected to move to the CBJ and establish residence, resulting in a long-term beneficial impact on regional income. Total annual wage payments during the operations phase would range from $15 million to $18 million.

Population Impacts. Short-term and long-term minor direct effects on population would be expected. The presence of the Kensington Mine would be expected to attract workers from outside the ROI, some of which would choose to establish residence in the ROI. However, the operator's proposed plan to build a 250-person camp to accommodate workers at the mine during the construction and operations phases, in addition to the company's plans to provide transportation to the mine for workers residing in Haines, would substantially reduce the number of construction workers and dependents relocating to the community during the first 2 years of the development. Most construction workers, especially single or unaccompanied workers, would choose to reside at the work camp, returning to their permanent residences when they were not working. A higher proportion of preproduction workers during the construction phase would be accompanied by family members and, because they would have the opportunity for long-term employment during the operational phase, would choose to establish residence in Juneau. Also, all of the operator's management staff would be expected to reside in the ROI. Therefore, in the short term, the ROI population would be expected to experience some increase because of job seekers looking for work directly or indirectly related to mine construction. In the first year of the construction phase, the CBJ population would increase by 242, including 37 children of school age and 120 mine campsite residents. During the second year, the CBJ total population would increase by 618, including 109 school-age children and 190 mine campsite residents.

In the long term, the Kensington Mine Project would be expected to increase the CBJ's population by about 665 persons when the mine is in full production. Of this total, 133 persons would be of school age. The 1997 economic analysis assumed that most mineworkers would not be local, with many coming from outside Alaska. It is also assumed that, because the operator would provide transportation from Haines to the mine, up to 40 production workers would be employed from that area. Applying a 50 percent in-migration rate, instead of a 80 percent in-migration rate, would reduce the size of the population increase by more than 20 percent.

Housing Impacts. Short-term and long-term minor adverse direct effects would be expected. In the short term, pressure would be greatest on multifamily rental housing, which, along with other housing, is in relatively short supply. Construction workers tend to use more transient, mobile, and multifamily housing. The construction phase of the Kensington Mine would generate demand for 45 units or about 2 percent of the CBJ's current multifamily rental housing stock. Assuming a smaller migration rate would reduce the increase in demand for housing but could still result in higher rental rates.

In the longer term, some housing used by construction workers would be occupied by operations workers after the construction phase was complete. It is possible that some of the construction workers would be retained for the operational phase or find alternative employment within the ROI. Operation of the mine would generate demand for 127 housing units in the CBJ. The housing market would be expected to remain tight, with high demand for housing but short supply. The increase in demand would likely result in increased housing prices and rental rates. The sales price and rental increases could have a negative impact on low- and moderate-income households, especially those who currently do not own housing. However, the operator's provision for 102 housing units through an agreement with Goldbelt, Inc., would substantially mitigate the adverse effects of increased housing demand associated with the Kensington Gold Project.

Tax Base Impacts. Short-term and long-term minor beneficial direct effects would be expected. In the short term, the total property valuation increases associated with the construction phase of the mine would be $18.6 million by year 2. This includes the preexisting valuation of the land component of residential housing, as well as the value of residential property associated with existing housing occupied by project-related households. The mine property was estimated to add property value based on a straight-line depreciation methodology.

In the long term, the increase in residential property valuation associated with the operations phase is estimated at $33.4 million. As in the case of the construction phase impacts, this includes the pre-existing valuation of the land component of residential housing as well as the value of residential property associated with existing housing occupied by project-related households. Total taxable property associated with mine operations (excluding the mine project, which is treated in the construction impact analysis) is estimated at $43 million.

4.15.2 Effects of Alternative A1

As described in Section 2, Alternative A1 is a variant of Alternative A, with a slightly smaller construction cost structure and operational workforce. For example, the total construction cost for Alternative A1 is estimated to be about $20 million less than that for Alternative A, although the length of the construction period (20 to 22 months) and the number of construction workers would be the same for both alternatives. Therefore, for the construction phase of the project, the magnitude and duration of the socioeconomic impacts of Alternative A1 would be almost identical to the socioeconomic impacts resulting from implementation of Alternative A.

The primary difference between the two alternatives is that under Alternative A1, the operational workforce would total 237 employees versus 253 employees under Alternative A. Consequently, the economic stimulus generated under Alternative A1 would be slightly smaller than the economic gains attained under Alternative A. For example, with 16 fewer direct employees, the proposed mine would generate a slightly smaller payroll and about 10 fewer indirect jobs would be created in the CBJ economy. Nonetheless, the mine would still generate economic benefits in terms of income, tax impacts, and business volume, albeit at a slightly lower level than under Alternative A.

The operation of the mine would also create additional demand for housing, schools, and other public services. However, because the projected operational workforce and associated changes in population under Alternative A1 are only slightly smaller than under Alternative A, the impacts would be almost the same in magnitude, albeit more short-lived because of the reduced project life cycle (i.e., 10 years versus 12 years under Alternative A).

4.15.3 Effects of Alternatives B, C, and D

The following section presents the analysis for Alternatives B, C, and D, focusing on the details of Alternative B. The only differences between Alternative B versus Alternatives C and D, from an economic perspective, are the higher capital costs that would be incurred by the operator during construction under Alternatives C and D and the slightly higher operations and maintenance costs that would be incurred under Alternative D. However, because the workforce levels and duration of operations would be the same for all three alternatives, the socioeconomic impacts on the CBJ would be identical.

Summary of Impacts

Short-term and long-term direct and indirect economic benefits would be expected from implementation of Alternatives B, C, and D. During operation of the mine, short-term negative impacts could result from the increased demand for housing and public services.

Construction of the mining facility would lead to an increase in employment for the duration of the construction phase. A small number of additional jobs would also be generated as a result of the increase in economic activity. The economic stimulus from mine construction would end upon opening of the mine and commencement of facility operations. Operation of the mine facility would generate more long-term economic benefits than the construction phase because direct and indirect jobs would be generated for the 10-year life cycle of the facility. The in-migration of direct and indirect workers to support the facility, however, would be large enough to adversely affect the housing market and impose cost burdens on the public service sector, especially education. Impacts could include short-term increases in rental and owner-occupied housing prices and some crowding in individual schools depending on where employees would locate within the Juneau School District. The projected increase in population, however, is within historical annual variations, and the additional revenues generated by the increased economic activity in the CBJ would likely be sufficient to cover the additional costs needed to provide public services to the additional residents.

Construction Requirements and Impacts

Under Alternatives B through D, the mining facility would be constructed during a 16-month period compared to the 22-month construction period under Alternatives A and A1. In addition to the mining facility, some on-site temporary housing would be built to accommodate the construction workforce. As described in Section 2, up to 160 workers (80 at a time) would be housed at the camp. Furthermore, in support of the proposed Slate Creek Cove marine terminal, construction workers would reside on a self-contained barge during the course of the 90-day construction period for that facility.

Because Alternatives B through D would have an accelerated construction schedule (16 months versus 22 months) compared to Alternatives A and A1, more expenditures and labor would be directed to the project in the first year than in the second year. For purposes of this analysis, it is assumed that approximately 70 percent of the total construction expenditures and labor hours would occur in the first year while the remaining 30 percent of these resources would be spent in the first 4 months of the second year of the construction phase. It is also assumed that the size of the construction workforce would peak at 325 at the end of the first year of the construction period and decrease to zero by the end of the 16th month (Earthworks, 2004). The size of the construction workforce would be expected to average 228 workers during the first year and 98 workers during the final 4 months of the build-out. Using an annual wage of $66,905, total labor costs for the mining facility are estimated at $17.3 million (based on an hourly wage of $28.47 [ADLWD, 2003a] and 47 hours per week for 50 weeks[1]). Based on the facility's estimated cost of $100 million, approximately $83 million of the total cost would be allocated to non-labor costs (e.g., materials, energy, transportation inputs).

Employment Impacts. The construction workforce would comprise a diverse group of occupations ranging from truck drivers and heavy equipment operators to electricians and plumbers. As noted above, the construction project would employ on average 228 direct workers during the first year and 98 direct workers the second year. Direct workers are those employed to perform tasks directly associated with the construction of the mining facility (e.g., excavating, paving). Typically, increases in direct employment generate a second round of job creation, or indirect employment, as overall economic activity increases. This is commonly referred to as the "ripple" or "multiplier" effect. The number of indirect jobs that would be created is estimated using an employment multiplier generated by a model such as IMPLAN. However, because such a high percentage of the construction workers are expected to come from outside the ROI and would spend a large portion of the construction period at on-site housing, using the standard multiplier would likely overstate the multiplier effect. Therefore, consistent with the previous analyses, the regional employment multiplier for the CBJ (1.75) has been reduced by 80 percent to obtain an adjusted estimate of the total employment impact. Using the smaller multiplier gives the total employment impact estimates shown in Table 4-25.

As shown in Table 4-25, the construction phase would generate on average 262 jobs during the first year and 113 jobs during the second year. Because of the nature of construction activity, these jobs would be temporary and would likely end after the facility is completed. It should also be noted that during peak construction activity, when it is estimated that 325 workers would be employed, some additional indirect jobs might also be created. However, given the extreme short-term nature of many

[1] The analysis assumes that during the second year the construction employees would work for 16 weeks.

Table 4-25
Direct and Indirect Employment Associated With Construction[a]

Employment	Year 1	Year 2
Direct construction work	228	98
Indirect jobs	34	15
Total employment	262	113

[a] Average size of workforce during each year of construction. Peak workforce size reaches 325 employees during the first year.

of these "peak employment" jobs, the economic stimulus would be similarly brief and the number of indirect jobs generated extremely small.

Earnings Impacts. The estimated payroll for the construction project is $17.3 million using the average-size workforce of 228 during the first year of construction and 98 during the second year. This translates into $15.2 million in wages during the first year and $2.1 million in the second year. The drastic decrease in direct earnings during the second year is attributable to the fact that construction would be completed by the end of the fourth month of that year. Using an average monthly wage of approximately $2,800 for all industries in the CBJ, earnings of indirect workers would total $1.14 million in year 1 and $168,000 in year 2. Short-term workers employed during the peak construction employment period would generate additional earnings. (Average monthly wage data for all industries in the CBJ were obtained from the Alaska Economic Information System, Department of Community and Economic Development.)

Population Impacts. The construction of the mining facility would result in a minor increase in the ROI's population. To estimate the size of the increase, the current analysis evaluates two scenarios: a high-migration scenario that closely follows the previous analyses and a low-migration scenario that takes into account a less robust economy than that in 1997 and implementation of an outreach and training program. Under the high-migration scenario, it was assumed that 80 percent of the construction workers would in-migrate, while 20 percent of the construction workforce would be drawn from the local CBJ labor force. Under the low-migration scenario, it was assumed that only 50 percent of the construction workers would in-migrate. For both scenarios, and consistent with previous analyses, it was assumed that only 20 percent of the incoming construction workforce would bring family members along. Family size for married construction workers is estimated at 3.28, which is the average family size for the state of Alaska (USDOC, 2003a). Fifty percent and 25 percent in-migration rates (high- and low-migration scenarios, respectively) are assumed for indirect workers versus the 85 percent rate used in the 1997 analysis. These jobs are more diverse than the direct jobs, and given the current state of the CJB economy, it is likely that the local labor force could fill more of these jobs. Table 4-26 shows estimated population changes based on these assumptions.

As shown in Table 4-26, the construction-induced population changes are quite small. During the first year of the construction period, the projected increase in the CBJ population would be about 0.9 percent under the high-migration scenario and 0.6 percent under the low-migration scenario. A large proportion of these workers would be expected to out-migrate before the end of the construction period, as labor requirements diminish. Some workers might be retained for the operational phase of the mine.

Table 4-26
Estimated CBJ Population Changes Associated With Mine Construction

High-Migration Scenario	**Year 1**	**Year 2**
Direct construction worker-related population	266	114
Indirect worker-related population	25	10
Total population change	290	124
Low-Migration Scenario	**Year 1**	**Year 2**
Direct construction worker-related population	166	72
Indirect worker-related population	12	5
Total population change	178	77

Housing Impacts. The construction phase of the project would likely have minor impacts on the housing market. As noted in Section 3, the CBJ housing market is not nearly so tight as it was in 1996. Vacancy rates have risen dramatically. Single-family rental vacancy rates in the CBJ, for example, increased from 4.4 percent during 2002 to 9.1 percent in 2003.[2] Apartment rental vacancy rates were estimated at 6.2 percent (AHFC, 2003). Impacts on housing would also be somewhat mitigated by the construction of an on-site camp that would accommodate 160 workers rotating on 2-week shifts. It is likely that some of these workers would share housing units in the CBJ. It is also likely that the vast majority of in-migrating construction workers would rent rather than buy housing (or neither, because some workers might live at the camp during work periods and return to their homes [e.g., in Haines] on their days off work). Therefore, the primary increase in demand would be for rental housing. Table 4-27 presents the estimated increase in demand for housing during the construction phase.

Table 4-27
Projected Increase in Demand for Rental Housing During Mine Construction

Housing Demand	**Year 1**	**Year 2**
High-Migration Scenario		
Single direct workers*	70	30
Single indirect workers	14	6
Direct workers with family	36	16
Indirect workers with family	4	2
Total Housing Demand	124	54
Low-Migration Scenario		
Single direct workers*	45	20
Single indirect workers	7	3
Direct workers with family	25	11
Indirect workers with family	2	1
Total Housing Demand	79	35

*The analysis assumes many single direct workers would share housing, which would reduce demand by about 50 percent.

[2] As described in Section 3, the estimated vacancy rate for single-family rental residences is based on a limited survey conducted for the Alaska Housing Finance Corporation (AHFC).

Assuming that the single in-migrating direct construction workers rotate between on-site housing at the mine camp and some type of accommodation in Juneau, up to 146 rental housing units would be required during the first year of the project although the number would decrease to 63 during the second year under the high-migration scenario. Under the low-migration scenario, demand for rental units would reach 91 in the first year and 39 in the second year. In reality, the number of required housing units would likely be much lower because many of the unmarried construction workers would share housing units to save costs, while other workers would return to their home city on their days off, especially if their permanent residence was in Haines or another Alaskan community such as Skagway, Gustavus, or Hoonah. It is conservatively estimated that these factors would likely reduce rental demand to about 70 and 30 rental units during the first and second year, respectively, under the high-migration scenario, and 45 and 20 units under the low-migration scenario. Single in-migrating indirect workers are assumed to require rental housing in the CBJ because they are not directly associated with the mine construction and would not use the temporary camp housing. It is also assumed that all direct and indirect workers bringing families would require rental housing. Based on these assumptions, it is estimated that the total increase in demand for rental housing would be 124 units during the first year, decreasing to 54 units during the second year. Under the low-migration scenario, total demand for rental housing would reach 79 units in year 1 and 35 units in year 2. As discussed in detail in the Operation Impacts sections, the current supply of housing would be sufficient to meet this temporary increase in demand. It is possible that this additional demand would result in short-term rental price increases.

School Impacts. The projected impacts on the Juneau School District would be minor. During the first year, it is estimated that the total population impact on the CBJ would be 290, which would decrease to 125 in the second year. Using demographic data from the 2000 Census for Alaska (age distribution), it is estimated that under the high-migration scenario, 40 additional school-age children (children between 5 and 19 years old) would require educational services during the first year of construction. That number would decrease to 22 during the second year as construction reached completion. Under the low-migration scenario, in-migrating families would include 24 school-age children during the first year, but by the end of the second year only about 10 additional students would remain. Using age distribution tables from the same census, it is estimated that during the first year, the approximately 40 additional students under the high-migration scenario would be equally distributed among the CBJ's elementary schools, middle schools, and the one high school (not including the alternative schools). During the second year, enrollment would decrease by about six students at each school level. The impacts on the elementary schools would be particularly small because the Juneau School District operates seven elementary schools with a total enrollment exceeding 2,500 students. The low-migration scenario would have minimal impact given the small number of students that would be added compared to the current student enrollment levels.

Other Public Service Impacts. The projected change in population would cause a minor temporary increase in demand for other public services, including police and fire protection. During the first year under the high-migration scenario, it is estimated that the total population impact on the CBJ would be an increase of 290 people, which would decrease to 124 people in the second year. To maintain the CBJ's current ratio of 1 police officer per every 591 people under the high-migration scenario, the CBJ would need to increase the police force by only one-half of a full-time equivalent police officer (i.e., a part-time employee); by the second year, that need would decrease to only one-third of a full-time equivalent. Under the low-migration scenario, the CBJ would need to increase its police force by only one-third of a full-time equivalent in the first year and by a negligible one-tenth of a full-time equivalent by the second year. For the fire department, under the high-migration scenario, the CBJ would need to hire 1 more full-time equivalent firefighter in year 1 to maintain the current ratio of 1 firefighter for every 307 people, and that would decrease to one-half of a full-time equivalent in year 2. Under the low-migration scenario, the necessary personnel increase for the fire department would be less than one full-time equivalent for both year 1 and year 2.

Similar increases in demand for health care, emergency services, and public utility services would also be expected. However, because of the relatively small size of the construction workforce and the fact that much of their time would be spent at the worksite, the change in demand for these services would be easily accommodated by the current service infrastructure.

Mine Operations Impacts

Under Alternatives B, C, and D, the Kensington Mine would operate for approximately 10 years and require a total workforce of 225, including 62 employees associated with the mill and tailings operations, 135 workers directly involved in mining activities, and 28 workers performing administrative activities. The mine is expected to produce on average 171,000 ounces of gold per year, or about 1.7 million ounces during the mine's life cycle. At a price of $400 per ounce (June 2004), this would equate to a total revenue of $680 million. Given the volatile nature of precious metal prices, however, it is difficult to project the total value of the mine based on current price levels.

Employment Impacts. The operations workforce would total about 225 workers per year for the duration of the mine's operations (Table 4-28). Upon depletion of the mine's gold reserves at the end of the 10th year of operation, the workforce would be ramped down and a small group of workers would be retained to properly close the site to comply with environmental and safety regulations.

Table 4-28
Mine Operation-Generated Employment

Employment	Years 1 through 10
Direct mining jobs	225
Indirect and induced jobs	499
Total employment	724

As shown in Table 4-28, the mine operations would generate almost 500 jobs beyond the direct employment created at the facility itself. Based on IMPLAN data, the average annual wage for a gold mining operations worker is about $67,000, slightly higher than that for a construction worker. The primary reason for the large employment impact difference between the construction and operational phase of the mine is that the latter phase would require a longer-term sustained use of regional labor and material inputs to keep the facility operating. Businesses in the CBJ area would supply the mine and its employees with locally produced goods and services, to the extent practical. Most important, the operations workers would be expected to reside full-time in the CBJ region and thus spend a far greater proportion of their disposable income within the ROI than construction workers residing in the mine camp. Their expenditures would increase local demand and induce some additional employment creation. Because of these differences in industry and individual spending patterns, the ripple effect of the mining operation phase is expected to be much larger than that of the construction phase.

Earnings Impacts. The estimated direct annual earnings generated by operation of the mine are $15.1 million (2002 dollars). In addition, the mine would generate both indirect and induced earnings as a result of the increased economic activity created in the CBJ region. This activity would result from the business-to-business trade conducted by the mine and from increased income and spending of the workers employed by the mine. Using the IMPLAN model, it is estimated that total additional earnings generated by the mine's operation would approach $36.2 million. To put this into context, the total income for the CBJ region in the year 2001 was approximately $1 billion (AEIS, 2002). Therefore, Alternatives B through D would add more than 3 percent to the region's earnings. Because the CBJ is so reliant on the public sector, the mine's contribution to private sector-generated income would be much higher.

Population Impacts. Operation of the mining facility would stimulate ROI economic and population growth. To estimate the size of the population change, the current analysis evaluates the impact of the same high- and low-migration scenarios (80 percent in-migration and 50 percent in-migration, respectively) used for the construction phase of the proposed mine. However, because the in-migrating mine workers would be expected to remain in the CBJ region for the full 10-year life of the mine, it is assumed that all mine workers with families would bring their dependents with them (consistent with the 1997 analysis, 75 percent of workers are assumed to be accompanied by their families). One difference between Alternatives B, C, and D and Alternatives A and A1 is that the configuration of the mine and the means of transportation that would be used would render it impractical to commute from the mine to Haines. The current analysis therefore assumes that workers originating from Haines would relocate to the CBJ for the duration of the project.

Because indirect and induced workers would not be so specialized and because the current CBJ job market is somewhat weak, 50 percent and 25 percent in-migration rates are assumed for these workers under the high- and low-migration scenarios, respectively. In fact, a higher percentage of the local labor force might be able to fill these jobs if the local economy remains weak at the start of mining operations. Other demographic characteristics are assumed to be the same as those for the mine workers. Based on these assumptions, Table 4-29 shows the estimated population changes to the region during mining operations.

Table 4-29
Estimated CBJ Population Changes Associated With Mining Operations

High- Migration Scenario	
Direct operation worker-related population	488
Indirect worker-related population	676
Total population change	1,164
Low-Migration Scenario	
Direct operation worker-related population	305
Indirect worker related population	338
Total population change	643

As shown in Table 4-29, under the high-migration scenario, the operation-induced population change is quite substantial relative to the population of the CBJ. The increase represents about a 3.8 percent increase over the 2002 CBJ population. The increase, however, would likely be spread out over a multiyear period. First, the direct worker in-migrating population would be spread over 2 years as the mine ramped up to full operational capacity. Second, it would take some additional time to generate the indirect and induced employment that would result in additional population growth. Under the low-migration scenario, the population increase would represent about a 2 percent increase over the 2002 CBJ population.

It should also be noted that the population impacts are within historical annual changes. For example, during 1991 the population increased by 3.2 percent over 1990, and in 1996 the population of the CBJ region increased by more than 2.5 percent over the previous year. Nonetheless, the estimated population change induced by the mine operations, especially under the high-migration scenario, would be large relative to average annual changes for the region.

Housing Impacts. Short-term direct adverse impacts would be expected. The operational phase of the project would likely have major impacts on the housing market, especially under the high-migration scenario. Although the CBJ housing market is not nearly so tight as it was during the 1990s, the potential large influx in population could affect housing availability and costs. Vacancy rates have risen dramatically during the past several years. Single-family vacancy rates in the CBJ, for example, increased from 4.4 percent during 2002 to 9.1 percent in 2003. Apartment rental vacancy rates were estimated at 6.2 percent (AHFC, 2003).

Because all direct and indirect jobs would last for the 10-year life cycle of the mine, the analysis assumes that each in-migrating worker would obtain housing. Some portion of the single workers would likely share housing; however, to be conservative the analysis assumes that each in-migrating worker would demand one unit of housing. Table 4-30 shows the projected demand for housing by worker demographics (i.e., single, with family). In total, these workers would require 430 housing units for the 10-year life cycle of the mine.

Table 4-30
Projected Increase in Demand for Housing
During Mine Operation

High–Migration Scenario	
Single direct workers	45
Single indirect workers	62
Direct workers with family	135
Indirect workers with family	187
Total housing demand	430
Low-Migration Scenario	
Single direct workers	28
Single indirect workers	32
Direct workers with family	85
Indirect workers with family	95
Total housing demand	240

Using assumptions developed for the 1997 economic analysis, the study assumes that about 66 percent of the workers with families would reside in single-family or other owner-occupied housing, while the others would obtain multifamily rental housing (28 percent) or reside in mobile homes (6 percent). Conversely, about 64 percent of the single workers would reside in multifamily housing (assumed to be rental), about 30 percent in single-family or other owner-occupied housing, and 6 percent in mobile homes. A breakdown in the increase in demand for housing units by housing type is shown in Table 4-31.

Table 4-31
Projected Increase in Demand for Housing During Mine Operation by Housing Type

High-Migration Scenario	
Multifamily units	160
Single-family or other owner-occupied units	245
Mobile homes	25
Total Units	430
Low-Migration Scenario	
Multifamily units	89
Single-family or other owner-occupied units	137
Mobile homes	14
Total Units	240

The magnitude of housing market impacts would depend on the availability of housing supply versus demand. The economic analysis combined different sources of housing and construction data to estimate current supply conditions. This information includes the annual housing survey conducted for the Alaska Housing Finance Corporation, the 2000 Census, residential building permit data for the CBJ (2000 through 2002), and data from Alaska Department of Labor and Workforce Development (ADLWD) on rental housing characteristics by housing type (e.g., single-family, apartment, or other). For example, according to the ADLWD survey, 81 percent of CBJ rental housing units are apartments, 9 percent are single-family dwellings, and 10 percent are other dwellings (e.g., mobile homes, boats, RVs). As mentioned above, rental vacancy rates were 6.2 percent for apartments and 9.1 percent for single-family rental homes. The vacancy rate for other types of rental housing was 1 percent. Table 4-32 shows rental housing by type and availability based on total units and estimated vacancy rates.

Table 4-32
Estimated Rental Housing Supply During Mine Operation by Housing Type

Housing Unit	Estimated Total Rental Units in CBJ	Vacancy Rate	Estimated Number of Rental Units Available
Multifamily units	3,975	6.2	246
Single-family rental units	442	9.1	40
Mobile homes and others	441	1.0	4

A comparison of the projected demand (Table 4-31) with the current supply of housing (Table 4-32) indicates that Alternatives B, C, and D would result in a shortage of available single-family housing units under both the high-migration and low-migration scenarios. The available supply of mobile homes would also be inadequate. In contrast, the number of multifamily rental housing units available (246 units) would appear to be sufficient to meet the projected additional demand under either scenario (160 units and 89 units, respectively). Under the low-migration scenario, there would be a sufficient number of housing units available overall to meet the needs of in-migrating workers, but workers who might otherwise reside in a single-family dwelling would be compelled to use multi-family housing. Under both scenarios, the additional housing demand from the project-induced population would most likely increase the overall housing rental rates for the CBJ area in the short term, although prices could decrease over time as housing supply was added to fulfill the additional long-term demand.

In addition to the rental supply, there is a supply of homes for sale. Realtor data indicated that approximately 100 homes were for sale in November 2003. However, the cost of single-family homes in the CBJ is relatively high. Most of them sell for more than $200,000, including several homes offered for sale at close to $1 million. Because a significant number of the housing units offered for sale would be beyond the means of most direct and indirect workers, this segment of the housing market could do little to meet the needs of the in-migrating population.

School Impacts. Short-term direct adverse impacts would be expected. The projected impacts on the Juneau School District could be major, especially under the high-migration scenario. Using demographic data from the 2000 Census for Alaska, it is estimated that the in-migrating families would have 323 school-age children (children between 5 and 19 years old). Using age distribution tables from the same census, it is estimated that during the first year (assuming all direct and indirect workers in-migrate during the first year), the 323 students would be fairly evenly distributed among Juneau elementary schools, middle schools, and the one high school (not including the alternative schools). Therefore, 105 students would be added to the elementary schools and 114 students to the middle schools, while high school enrollment would increase by 104 students. The low-migration scenario would pose fewer challenges to the school system. Under that scenario, total enrollment would increase by about 178 students. Increases at each school level would approach about 60 students.

Assuming that the new residents would be distributed across the Juneau School District, elementary schools would incur the least impact because the Juneau School District operates seven elementary schools with a total enrollment exceeding 2,500 students. Nonetheless, the projected enrollment increase under the high-migration scenario would exceed 4 percent of current levels. Similar enrollment increases would be borne by the middle schools and the high school. Additional teachers and staff would need to be added to maintain current teacher-student ratios. Using the 2001–2002 student-teacher ratio for the Juneau School District, 19 new teachers would be required to maintain current class size if the high-migration scenario were to materialize. The impacts would be proportionately smaller if the low-migration scenario occurred. Depending on where the in-migrating workers would reside, specific schools could face capacity issues. If, however, the projected slowdown in population growth materialized, the Juneau District might face declining school enrollments during the proposed mine's life cycle, and the issues of physical capacity limitations and additional staffing needs would be mitigated.

In terms of budgetary impacts, the increase in student enrollment would impose additional cost burdens on the Juneau School District. Using the 2001 per student cost data described in Section 3, the total additional annual cost to educate the additional students would exceed $2.8 million under the high-migration scenario. Using the 42 percent local share burden, the additional students would cost the Juneau School District about $1.18 million per year and would represent about a 5 percent increase over 2001–2002 expenditures. Under the low-migration scenario, these incremental costs would be reduced by about 45 percent.

Tax Impacts. Long-term direct and indirect beneficial impacts would be expected. The operation of the Kensington Mine would generate tax receipts for the local, state, and federal governments through indirect business taxes, property taxes, income taxes, and payroll taxes. Annual total tax revenue estimated using the IMPLAN model approaches $18.4 million (2002 dollars), about $8.3 million of which would be directed to the federal government. The Alaska state and CBJ governments would receive about $10.1 million of the total tax receipts. Additional property taxes accruing to the local government are estimated to exceed $1.4 million on an annual basis. It should be noted that the estimated additional tax revenue generated by the proposed action includes tax revenue receipts generated by indirect and induced economic activities as well as revenues directly generated by operation of the mine.

Other Public Services. Short-term direct adverse impacts would be expected. The projected change in population would cause an increase in demand for public services, including police and fire protection. Under the high-migration scenario, it is estimated that the total population impact on the CBJ would be an increase of 1,164 people. To maintain the CBJ's current ratio of 1 police officer per every 591 people, the CBJ would need to increase the police force by 2 full-time equivalent police officers. Under the low-migration scenario, the population is projected to increase by 643 people and require 1 additional full-time officer. For the fire department, under the high-migration scenario, the CBJ would need to hire about 4 more full-time firefighters to maintain the current ratio of 1 firefighter for every 307 people, or 2 more firefighters under the low-migration scenario.

In addition to police and fire protection, the projected increase in population resulting from the operation of the mine would also increase the demand for other public services, including health care, emergency services, and public utilities providing water, electricity, and waste treatment. However, given the recent downturn in the economy and stagnant population growth during the past 5 years, none of the public service providers are operating at full capacity and would likely not have much difficulty in accommodating the increase in demand from the additional population. Furthermore, tax revenues from the mining operation and new economic activities could be directed toward expanding these services as required.

4.15.4 Summary

Under all the alternatives, construction of the mine would generate employment for up to 2 years. Housing demand would increase by a modest amount depending on the number of workers residing at work camps or sharing housing. Fiscal impacts on the CBJ would also be modestly positive. Operation of the mine would generate about 253 direct jobs under Alternative A and 237 jobs under Alternative A1. About 225 direct jobs would be generated during mine operations under Alternatives B, C, and D. Under the high-migration scenario, which assumes 80 percent of the direct workers would in-migrate and 50 percent of the indirect workers would in-migrate, operation of the mine would significantly increase the demand for housing and for public services such as education. Under the low-migration scenario, which assumes a training and job outreach program, the local labor force is assumed to fill 50 percent of the operation jobs and 50 percent of the indirect jobs generated during the course of the operations. This scenario, which is believed to be the more likely scenario, would still increase the demand for housing and public services but would result in a lower impact on home rental and sales prices. Given projections of declining school enrollment, existing facilities would likely be able to accommodate new students associated with in-migrating families. Under all alternatives, government revenues would increase through a variety of payroll, sales, and property taxes paid by the mine and its employees.

4.16 ENVIRONMENTAL JUSTICE

As discussed in Section 3, environmental justice analyses are performed to identify potential disproportionately high and adverse impacts from proposed actions and identify alternatives that might mitigate the impacts. In general, for a proposed action to result in environmental justice impacts, there must be significant adverse impacts on human health, socioeconomics, or cultural resources. Once a significant impact has been identified, whether such an impact is borne disproportionately by minority or low-income populations must be determined. Because the analysis has not identified any significant adverse impacts on these vulnerable populations in terms of human health or cultural resources from any of the alternatives, there would be no finding of environmental justice impacts in relation to these resource areas. As described in the preceding section, the primary socioeconomic impact on the CBJ region from implementation of any of the alternatives would be to stimulate the regional economy through job and income creation. This impact is positive, and the benefits would reach all segments of the CBJ population, including low-income populations and minority populations.

All alternatives could, however, adversely impact the CBJ housing supply during the operational phase of the mine. As discussed in the preceding section (Section 4.15.3), the magnitude of the housing impact would be contingent on the proportion of mine workers that would be hired from outside the CBJ region. Under the high-migration scenario, the quantity of available housing stock in the CBJ would likely be insufficient to meet the full short-term demand of the incoming workers and their families. Consequently, a large influx of mine workers into the region could lead to increases in both rental and purchase housing cost for residents of the CBJ. It would be expected that over time the housing market would adjust, leading to an increase in supply and a lowering of prices. Low-income residents of the CBJ could be adversely affected if increases in rental rates were to accelerate in the early years of the mine's operation, before housing supply could catch up with the increased demand.

Under the low-migration scenario, housing demand would also increase, but the available housing stock would likely be sufficient to meet the increased demand of the mine workforce. Potential increases in housing costs would be much smaller than under the high-migration scenario and would likely have only minor effects on low-income households.

As discussed earlier, the project proponents have proposed a job outreach program to maximize the hiring of CBJ residents. This approach has been used in the operation of other mines in the CBJ, leading to a workforce composed primarily of local labor. Finally, it should be noted that the CBJ has experienced economic stagnation in recent years. If this trend continues, as is indicated by demographic forecasts, and if proposed large cuts in state government employment levels are implemented, a sufficient quantity of housing units could become available to fill the needs of in-migrating mine employees, thereby reducing impacts on housing costs.

4.17 CULTURAL RESOURCES

The potential impacts of the Proposed Action and alternatives have been assessed. Input was solicited from Auk, Chilkat, and Chilkoot Natives (including a public meeting in Juneau) to judge whether the proposed amendment to the 1998 plan of operations (Alternative B) would change the conclusions of Bowser's (1998) original traditional cultural property (TCP) study. No information was found to change the original conclusion that no properties eligible for the National Register as TCPs would be directly affected by implementing any of the alternatives (Mobley, 2003).

The Cascade Point access road for the marine terminal that would serve the mine has been addressed in a separate EIS and a 1998 Record of Decision that identified No Adverse Effect of the project on archaeological site 49JUN710, although an archaeological monitor would be required on-site during construction (Forest Service, 1998a). The remainder of the project area was surveyed by ICRC in 2003, allowing characterizations of effects under each of the alternatives as summarized in Table 4-33. Potential direct impacts range from none to destruction of Register-eligible features. Potential indirect impacts on Register-eligible features include degradation of setting and feeling and loss of other associative integrity due to specific developments, as well as accelerated cumulative

Table 4-33
Identified Cultural Resource Sites in the Area of Potential Effect

AHRS #	Site Name	Eligibility	Alternatives A and A1	Alternatives B, C and D
JUN-103	Slate Creek Cove Site	eligible	No effect	No effect
JUN-022	**Jualin Mine District**	**eligible**	**No effect**	**Direct and indirect damage to contributing components**
JUN-928	Berners Bay Historic Mining District	Eligible	Adverse effect	Adverse effect
JUN-929	Jualin Mine Wharf	eligible	No effect	Adverse effect
JUN-930	Lower Jualin Mine Camp	eligible	No effect	No effect
JUN-931	Upper Jualin Mine Camp	eligible	No effect	Adverse effect
JUN-932	Jualin Mine Tram	eligible	No effect	Adverse effect
JUN-945	**Comet/Bear/ Kensington Mining District**	**eligible**	**Direct and indirect damage to contributing components**	**Direct and indirect damage to contributing components**
JUN-033	Comet Landing	not eligible	No effect	No effect
JUN-240	Comet/Bear/Kensington Mill Site	eligible	Adverse effect	Adverse effect
JUN-946	Comet/Bear/Kensington Railroad	eligible	Adverse effect	Adverse effect
JUN-947	Comet Mine	eligible	No effect	No effect
JUN-948	Comet Mine Tram	eligible	Adverse effect	No effect
JUN-949	Kensington Mine	eligible	Adverse effect	Adverse effect
JUN-721	*Kensington Mine Adit Bunkhouse*	*not eligible*	*No effect*	*No effect*
JUN-722	*Kensington Mine Adit Generator Building*	*not eligible*	*No effect*	*No effect*
JUN-950	Trite Road	not eligible	No effect	No effect
JUN-951	Bear Mine	eligible	No effect	No effect
JUN-953	Bear-Kensington Mines Tram System	eligible	Adverse effect	No effect
JUN-969	Johnson Prospect	not eligible	No effect	No effect
JUN-970	Eureka Prospect	not eligible	No effect	No effect
JUN-954	**Ivanhoe/Horrible Mining District**	**eligible**	**Direct and indirect damage to contributing components**	**Direct and indirect damage to contributing components**
JUN-956	Horrible Mine Workings	eligible	No effect	No effect
JUN-957	Mellen Mill Site	eligible	Adverse effect	Adverse effect
JUN-958	Portland Mill Site	eligible	No effect	No effect
JUN-959	Portland Mill Site Horrible Mine Tram	not eligible	No effect	No effect
JUN-960	Mellen Mill Site Ivanhoe Tram System	eligible	Adverse effect	Adverse effect
JUN-961	Lynn Canal Mining Co. Horrible Mine Tram	eligible	Adverse effect	Adverse effect
JUN-933	Indiana Mine	eligible	No effect	Adverse effect
JUN-934	Gold King Prospect	not eligible	No effect	No effect
JUN-935	Mystery Lode Prospect	not eligible	No effect	No effect
JUN-936	Johnson Creek Prospect	not eligible	No effect	No effect
JUN-937	Yankee Boy Prospect	not eligible	No effect	No effect
JUN-940	Valentine Prospect	not eligible	No effect	No effect
JUN-941	Snowslide Gulch Prospect	not eligible	No effect	No effect
JUN-942	Hoggatt Creek Prospect	not eligible	No effect	No effect
JUN-943	Thomas Prospect	not eligible	No effect	No effect
JUN-944	Fremming Prospect	not eligible	No effect	No effect
JUN-962	Hope Prospect	not eligible	No effect	No effect
JUN-963	Mexican Prospect	not eligible	No effect	No effect
JUN-964	Ophir Prospect	not eligible	No effect	No effect
JUN-965	Cumberland Prospect	not eligible	No effect	No effect
JUN-966	Elmira Prospect	not eligible	No effect	No effect
JUN-968	Seward Prospect	not eligible	No effect	No effect
JUN-971	Northern Belle Mine	eligible	No effect	No effect

Note: The three mining districts are identified in bold type with their constituent sites listed below; italics identify JUN-721 and JUN-722 as components of JUN-949.

disturbance due to increased public access. Some consequences would be the same under any alternative: for example, the Slate Creek Cove site would receive no effects, regardless of the alternative selected. Under all alternatives, impacts on historic sites will be mitigated by the requirements of the MOA between the Forest Service, the SHPO, and the operator (Forest Service, 2004). Implementation of the MOA over the course of mine construction, operation, and closure would satisfy the requirements of Section 106 of the National Historic Preservation Act.

4.17.1 Effects of Alternative A and A1

Alternatives A and A1 predictably would affect cultural resources on the Kensington side more than on the Jualin side. Under Alternatives A and A1, no effects would occur in the Jualin Mine District or its four constituent sites. Five of the eight Register-eligible sites in the Comet/Bear/Kensington Mining District would be damaged. In the Ivanhoe/Horrible Mining District, all six constituent sites are judged eligible. Under Alternatives A and A1, the eligible Mellen mill site (JUN-957) would be destroyed or damaged, the Lynn Canal Company Horrible Mine Tram (JUN -961) would be adversely affected, and there would be no effects on the Portland Mill Site (JUN-958). The Mellen Mill Site/Ivanhoe Tram Site (JUN-960) is still partly in the Area of Potential Effect (APE) and would be adversely affected.

4.17.2 Effects of Alternatives B, C, and D

Alternative B, which shifts development to the Berners Bay side, would cause direct adverse effects on three of the four Jualin Mine District sites, and the fourth constituent site would be indirectly affected. Of the Comet/Bear/Kensington Mining District's constituent sites, the Comet/Bear/Kensington Mill Site (JUN-240), the Kensington Mine (JUN-949), and the Comet/Bear/Kensington Railroad (JUN-946) would be adversely affected. Adverse effects are also expected for the Mellen Mill Site (JUN-957) and Lynn Canal Mining Company Horrible Mine Tram (JUN-961) within the Ivanhoe/Horrible Mining District. The Indiana Mine (JUN-933) would be directly damaged.

Alternatives C and D, which modify the TSF design, would have no effects on cultural resources beyond those identified for Alternative B.

4.17.3 Summary

Mining sites eligible for the National Register of Historic Places would be adversely affected under any of the alternatives. Under Alternative A or A1, the Jualin Mine District would be mostly left intact (except, perhaps, the Indiana Mine) and the Comet/Bear/Kensington and Ivanhoe/Horrible mining districts would be considerably disturbed. Under Alternative B, C, or D, the latter two districts would be mostly left intact and the Jualin Mine District would be affected. As noted above, implementation of the MOA over the course of mine construction, operation, and closure would satisfy the requirements of Section 106 of the National Historic Preservation Act.

4.18 NOISE

All the alternatives would generate noise associated with employee transportation, construction, and daily operations. The location of the noise sources would be different for Alternatives A and A1 versus Alternatives B, C, and D. Noise levels for specific operations related to construction and operations were obtained from the Hart Crowser Draft Noise Impact Assessment Report, Kensington Mine Project (Hart Crowser, 1997). This analysis assumes that the facilities and equipment described in the report for Alternative A apply to the other alternatives as well.

Sound decays at a constant rate such that the noise level drops by approximately 6 dB as the distance from the source doubles, assuming no absorption by the surrounding terrain. The following equation describes the change in noise levels from one point to another:

$$dB_2/dB_1 = (a)10 \log D_2/D_1$$

where

dB_2 = decibels at distance D_2 from source
dB_1 = measured decibel level at distance D_1 from source
a = dB drop-off rate coefficient
a = 2.0 for a source with no ground or atmospheric absorption
D_1 = distance 1
D_2 = distance 2

Therefore, a noise source measuring 60 dB at 50 feet would measure 54 dB at 100 feet as calculated in the example below:

$$dB_2/60 = (2.0)(10) \log 100/50$$
$$dB_2/60 = (20) \log 2$$
$$dB_2/60 = (20)\ 0.301$$
$$dB_2 = 60 - 6.02$$
$$dB_2 = 53.97$$

The analysis uses this principle, combined with the projected noise levels of various project components, to illustrate anticipated noise levels at different points within the study area. The analysis assumes (1) that no noise attenuation or interference would come from other sources either man-made or environmental and (2) that there are no obstructions between the source and the receiver. These two assumptions result in a conservative estimate of the distance sound might travel for the sources at the process areas, the access roads, and to some extent the marine terminals. In reality, factors such as topography, vegetation, wind, waves, rain, and other background sounds such as boat motors would reduce the perception of noise levels coming from mine-related sources. Note that noise traveling over water is mostly reflected rather than absorbed into the water and is further affected by the temperature inversion that occurs near the air/water interface. Therefore, the rate of the decay in energy (decibel level) of a noise traveling over water is less than what would occur for the same noise traveling over land. The end result is that noises would be louder than calculated for observers on calm waters within Berners Bay or Lynn Canal who have a clear line of sight to the noise sources. In these cases—particularly with helicopter noise versus noise coming from the crew shuttle boat—the analysis still provides a valid comparison because both sound sources would be affected equally.

The analysis uses tabular and graphic approaches to present anticipated project-related noise levels. The tables show the change in decibel levels from various sources to the location of potential receivers, while the figures present the locations of selected noise sources and the distances to target noise levels arising from those noise sources. The figures include 60-dBA, 50-dBA, and 40-dBA isolines that depict where noise levels from a particular source would range between the level of a normal conversation (60 dBA) and a library (40 dBA).

Table 4-34 presents the noise levels of various project components and vehicles at a distance of 50 feet (Hart Crowser, 1997). The decibel levels in this table are used as the starting points for the calculations presented in subsequent tables and figures.

Table 4-34
Estimated Construction Noise Impacts (Alternative A)

Noise Source	dBA at 50 Feet[a]
Blasting	125
Marine terminal – barge unloading	89
DTF/TSF construction	87
Mill yard area activities	85
Mill processing building	79
3,500-kW generator	75
Supply truck	80
Helicopter	102
DTF operation (Alternatives A and A1 only)	90
Haul truck (Alternatives A and A1 only)	85
Crew shuttle boat (Alternatives B, C, and D only)	80

[a]Hart Crowser, 1997.

4.18.1 Effects of Alternative A

Noise sources associated with Alternatives A and A1 include blasting, generators, trucks, helicopters and construction. Potential receivers of noises under Alternatives A and A1 include recreational users within Echo Cove and Berners Bay (helicopter noise), Alaska Marine Highway ferry passengers, recreational users in the vicinity of Comet Beach, and wildlife. The potential impacts from noise associated with Alternatives A and A1 are discussed for construction activity, production activity, and helicopters used to transport personnel to and from the site. An illustration of the distance between noise sources and selected noise levels associated with Alternatives A and A1 is presented in Figure 4-4. Helicopter noise is illustrated in Figure 4-5.

Construction Activity

Noise levels from construction activities would be intermittent and relatively short in duration. Construction-related noise would result from temporary use of diesel-powered generators, quarry blasting, and construction vehicles. The exposure time during construction activities would range from 14 to 18 months (Earthworks, 2003a).

Generator Use. A typical 3,500-kW generator produces a 1-hour L_{eq} noise level of 75 dBA at 50 feet (Hart Crowser, 1997). Under Alternatives A and A1, one 3,000-kW diesel generator would be located at Comet Beach. Generator noise at a Lynn Canal ferry 1 mile west of Comet Beach would be no more than 34.5 dBA (Table 4-35), approximately the sound of a whisper (30 dBA). The generator would not be noticeable on an Alaska Marine Highway ferry in Lynn Canal because background noises on the deck of the ferry (e.g., wind, wake, engines, conversations), estimated at 50 dBA, would exceed or cancel out generator noise.

Blasting. Blasting would be conducted no more than once a day at the borrow areas. The borrow areas under Alternatives A and A1 would be in the vicinity of the 850-foot portal, approximately 6,000 feet west of Comet Beach. Blasting would generate a short-term noise similar in sound level to a thunderclap and lasting several seconds. Blasting would be scheduled and carefully controlled through adherence to the applicant's blasting plan.

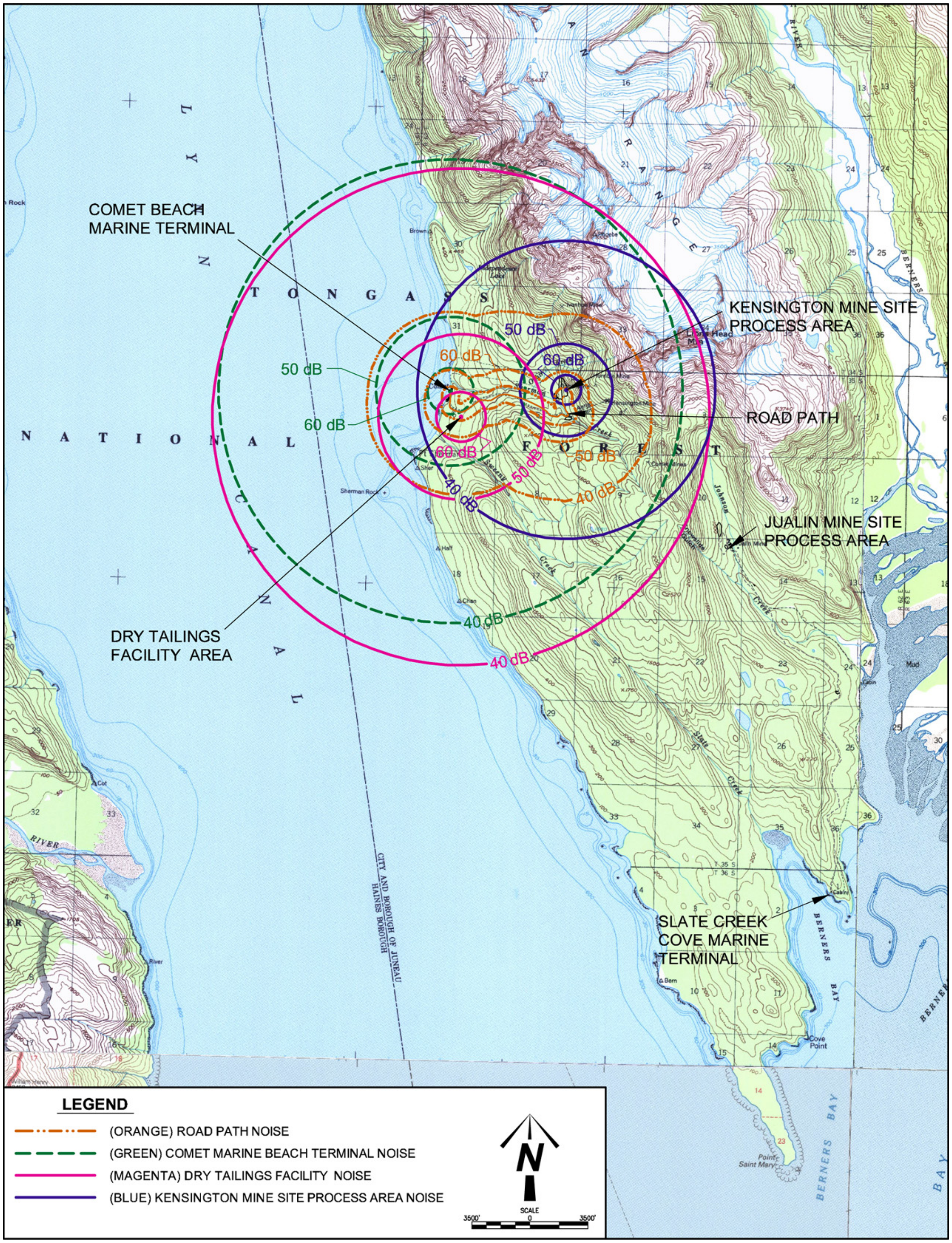


FIGURE 4-4. SELECTED NOISE SOURCES AND LEVELS FOR COMET BEACH AND THE KENSINGTON PROCESS AREA

FIGURE 4-5. TRANSPORTATION-RELATED NOISE LEVELS UNDER ALL ALTERNATIVES

Table 4-35
Estimated Source Noise Levels Associated with Alternatives A and A1 (in decibels)

Noise Source	At 50 Feet (dBA) [a]	At Lynn Canal Ferry, 1 Mile Offshore (dBA)
Generator (3,500 kW)	75	34.5
Blasting	125	77.9
Mill processing building	79	38.5
Mill area yard activities	85	44.5
DTF operation	90	49.5
Comet beach terminal (unloading)	89	48.5
Heliport	102	61.5

[a]Hart Crowser, 1997.

The 1992 FEIS reported that modeling of large-scale blasting at the proposed Quartz Hill Mine near Ketchikan showed that the blast noise level 3 miles from the blast site would be about 65 dBA. Noise at 50 feet from the source is approximately equal to 115 dBA. USEPA recommends that blasting noise not exceed 125 dBA unless noise-minimizing BMPs are implemented. This analysis assumes blast noise to be 125 dBA 50 feet from the blast, the more conservative estimate between USEPA's recommendation and the measured levels at Quartz Hill. Blast noise at the Lynn Canal ferry (1 mile from shore) is estimated to be 77.9 dBA, assuming that a ferry was passing by when blasting occurred. Considering background levels of noise assumed for the ferry, a rumble from blasting would likely be audible on the ferry.

DTF Construction. The DTF would be constructed in the vicinity of Comet Beach. Expected activities associated with DTF construction include land clearing, bulldozing, and grading. DTF construction would occur in phases, intermittently over the life of the project. Hart Crowser (1997) estimated noise from DTF construction to be 87 dBA at 50 feet. DTF construction noise would drop to 46.5 dBA 1 mile offshore and would be inaudible from the deck of a passing ferry.

Vehicle Use. Construction vehicles, such as haul and supply trucks, produce noise levels of 85 dBA and 80 dBA, respectively, at 50 feet (Hart Crowser, 1997). Construction vehicle noise, estimated at a Lynn Canal ferry 1 mile offshore, is estimated to be no greater than 44.5 dBA. These values are based on haul trucks, the louder of the two types of construction vehicles. Other construction-related noises would include loading and grading operations and would generally be intermittent and of short duration. Little to none of the noise resulting from construction activities would be perceived from the deck of a ferry operating 1 mile off Comet Beach.

Production Activity

Noise levels during the operational phase of the Kensington Mine are categorized as continuous. During operation, primary noise sources associated with Alternative A would include the following:

- Mining sources (ore processing, DTF operations).
- Haul road (moving materials between Comet Beach and the process area; hauling waste rock and construction materials between borrow areas/process area and the DTF).
- Power plant (noise from diesel generators).

Alternative A would use four 3,000-kW diesel-powered generators at the mill and one 275-kW generator at Comet Beach. Three of the generators at the mill would operate at the same time, and one would be used as a backup. For passengers on an Alaska Marine Highway ferry, the noise from one generator at Comet Beach (85 dBA) is expected to be louder than the noise from three operating generators at the process area, approximately 6,000 feet west of Comet Beach. Noise levels are the same as those discussed above and would be inaudible from the ferry. Other noise levels associated with production activities modeled for Alternatives A and A1 are shown in Table 4-35.

The mill processing building is assumed to include a flotation circuit, concentrate filtration, reagent preparation, process compressors, and plant loudspeakers. Mill yard activities would include loading waste rock onto haul trucks, unloading supply trucks, water pumps, and plant loudspeakers. DTF activities would include tailings placement and grading, backup alarms, tailing water return pumps, and additional construction, as needed. Figure 4-4 illustrates the extent to which noises associated with the production aspects of Alternatives A and A1 could be heard at given levels.

Helicopter Noise Impacts

Under Alternatives A and A1, employees would be transported to the site by two to three helicopter round trips from the Juneau Airport a day. Helicopter traffic is already widely present along Lynn Canal, primarily for recreational sightseeing, with as many as 200 flights per day possible during the summer months. The vast majority of these flights would be south of Berners Bay.

A noise level of 72 dBA is predicted directly beneath the flight path of a helicopter at 2,000 feet above the ground, which is approximately the same noise level as a vacuum cleaner (Hart Crowser, 1997). Figure 4-5 is a graphic depiction of noise levels associated with the helicopter path between Echo Cove and Comet Beach. Helicopter noise could be heard throughout Berners Bay, although the level would be less than that of a normal conversation (60 dBA), depending on conditions and the altitude of the helicopter.

4.18.2 Effects of Alternative A1

The effects of Alternative A1 would essentially be the same as those described under Alternative A, although the active operations would occur for only 10 years compared to 12 years under Alternative A.

4.18.3 Effects Common to Alternatives B, C and D

Noises associated with Alternatives B, C, and D are similar to those generated under Alternatives A and A1. However, Berners Bay, which includes Echo Cove, Point Bridget State Park, and the Echo Cove Bible Camp, experiences more recreational use than the area surrounding Comet Beach. Therefore, recreational users would potentially experience more project-related noise under these alternatives than under Alternative A or A1. The following sections discuss the potential impacts of noise related to construction, operation, and transportation under Alternatives B, C, and D.

Construction Activity

Construction crews building the tunnel between the Kensington 850-foot portal and the Jualin Mine adit would be transported to Comet Beach by helicopter. A total of 12 to 14 round trips a month would be made between Juneau and Comet Beach during the construction period. Impacts from helicopter transport would be the same as those described under Alternatives A and A1 but would last for less than 14 months under Alternatives B, C, and D. The helicopter path and noise levels would be the same as those presented in Figure 4-5. Workers building the process area and the TSF would access the site by the crew shuttle boat between Slate Creek Cove and Cascade Point or Echo Cove. Approximately one barge a day would be expected to dock at the Slate Creek Cove marine terminal, delivering supplies and materials during the construction period. The path of the crew shuttle, along with the associated noise levels, is presented in Figure 4-5.

Table 4-36 presents expected noise levels from project activities at three locations: 50 feet from the source, Cove Point, and the Berners Bay Cabin on the east side of Berners Bay.

Noise impacts from construction activity associated with Alternatives B, C, and D would be intermittent and last for a period of 14 to 18 months. As discussed above, noise impacts from these alternatives would be concentrated on receivers in and around Berners Bay. Barge unloading could produce sharp sounds from metal-to-metal contact, resulting in the highest modeled noise levels aside from helicopters and blasting. Noise from barge unloading would be approximately 48 dB to a receiver on a boat moored off Cove Point. This decibel level is approximately the same as that of rainfall (50 dBA) or a refrigerator (50 dBA). As noted earlier, during construction barges would be present at the site on nearly a daily basis, although the time necessary for unloading on any given day would be variable.

Under Alternatives B, C, and D, quarry drilling and blasting would be shifted from the Kensington side to one of four borrow area locations on the Jualin side of the operation. Borrow areas in the vicinity of the Slate Creek Cove marine terminal would be used during the construction phase to upgrade the existing Jualin access road. Periodic blasting could occur for the production of road fill and road base. Blasting would not occur more than once a day and would be limited to 14 to 18 months in duration, the expected length of the construction phase. Blasting noise from the Slate Creek Cove borrow area could measure 84.2 dBA off Cove Point, approximately the noise level in a noisy restaurant (85 dBA). The rumble of a blast could also be perceived at the Berners Bay Cabin. Additional blasting might occur at the borrow areas near the proposed TSF and process area locations. These borrow areas are topographically isolated from the Berners Bay receivers; the combination of ridges, peaks, and coniferous forest is expected to attenuate blasting and other construction sounds. Therefore, noise impacts from blasting at these areas are assumed to be negligible under Alternatives B, C, and D.

Table 4-36
Estimated Source Noise Levels Associated with Alternatives B, C, and D (in decibels)

Noise Source	At 50 Feet[a]	Forest Service Cabin	Cove Point
Generator (3,500 kW)	75	25.5	34.2
Barge unloading	89	39.5	48.2
Blasting	125	75.5	84.2
Supply truck	80	30.5	39.2
Helicopter flight path	102	52	62
Barge unloading	89	39.5	48.2
Crew shuttle boat	80[b]	30.5	39.2
Milling process building	72	16.0	16.5

[a] Hart Crowser, 1997.
[b] Measured at the middle of the bow, at full speed (Allen Marine, Inc., 2001).

Production Activity

Noise impacts during production under Alternatives B, C, and D would be similar to those under Alternatives A and A1, except that the processing area would be located near the Jualin adit and tailings would be stored in the TSF.

Modeled noises associated with production activities would occur around the Slate Creek Cove marine terminal and along the Jualin access road. As shown in Figure 4-6, supply trucks moving along the access road to the process area would have the greatest potential to produce noise impacts throughout the project area on a regular basis. Although most of the Jualin access road is lined by forest, there are places along the road where noise from passing trucks could reach portions of Berners Bay, particularly near the northwestern portion. Noises from the supply trucks could be audible at Cove Point under particularly calm conditions; however, even under those conditions, truck noise would probably not be heard at the Berners Bay Cabin.

Because of the location of the process area and the topography and forests between the area and Berners Bay, noises from process area activities would be unlikely to be heard in any portion of the bay (Figure 4-6).

Personnel Transport. Noise impacts from the crew shuttle boat under Alternatives B, C, and D would occur across Berners Bay from Cascade Point to Slate Creek Cove, a distance of approximately 6 miles (Figure 4-5). Three to five shuttle round trips would be necessary per day, with trips expected to take place in the early morning, late afternoon/early evening, and late night during normal operations (Earthworks, 2002a). Each one-way trip is expected to take approximately 15 minutes, depending on site conditions (Coeur, 2001).

The crew shuttle boat would generate approximately 80 dBA of noise, as measured in the middle of the bow under full power (Allen Marine Company, 2001). Measured noise is a combination of the boat's mechanical noises and water/wind resistance. The manufacturer has indicated that these boats could be provided with mufflers to reduce noise to below 80 dBA. For a receiver 1,000 feet from a passing crew shuttle, the noise level would be approximately 53.1 dBA; at 2,000 feet, 47.1 dBA. As shown in Figure 4-5, recreational users in kayaks or on foot along the shoreline in Echo Cove would be able to hear the crew shuttle under Alternative C and possibly under Alternatives B and D as it approached Cascade Point under calm conditions. The shuttle would not be audible in the eastern portion of Berners Bay (north of Cascade Point) or at the head of the bay except potentially under calm conditions in the bay.

No significant impacts are expected from personnel site access. The crew shuttle would be the same type of vessel frequently used for whale-watching tours throughout Southeast Alaska. The noise might be noticed by nearby receivers, but the short duration of each trip (15–20 minutes each way) and the infrequency of the trips (three to five trips per day) would not make crew shuttle noise a regular part of the Berners Bay soundscape.

Supply Delivery. Supply deliveries by barge would shift from Comet Beach under Alternatives A and A1 to the Slate Creek Cove marine terminal under Alternatives B, C, and D. Approximately four barge deliveries would occur at Slate Creek Cove each week, with access through the western portion of Berners Bay. The modeled noise for intermittent barge unloading at the marine terminal is 89 dBA at 50 feet (Hart Crowser, 1997), which would potentially be audible at Cove Point at a level of approximately 50 dBA. The loudest noise generated at the marine terminal would come from loading and unloading of cargo containers with a diesel forklift. Noise levels produced by unloading operations are shown in Figure 4-6. Based on the intermittent and short-term use (four deliveries per week) of the barges, no significant impacts from noise are expected as a result of supply deliveries.

FIGURE 4-6. SELECTED NOISE SOURCES AND LEVELS FOR SLATE CREEK COVE AND THE JUALIN PROCESS AREA

4.18.4 Effects of Alternatives B and D

Under Alternatives B and D, a recycling system would return water from the TSF to the process area. The recycling system would require a pipeline, a pump, and a backup generator (used only in emergencies). The modeled noise for this activity is based on the generator, estimated to produce 76 dBA at 50 feet (Hart Crowser, 1997). As previously discussed, the location of the TSF is such that the generator (or pump) noise would be attenuated by topography, vegetation, and environmental factors. Therefore, the water recycling system is not expected to cause adverse noise levels in the vicinity of the project area.

4.18.5 Effects of Alternative C

The primary difference between Alternative B and Alternative C with respect to noise is the presence of the crew shuttle operation within Echo Cove. As discussed above, noise from the crew shuttle would be audible within much of Echo Cove. Because the water in Echo Cove is generally calmer than that in the main part of Berners Bay, the noise would be expected to carry while the boat was present. The elimination of the recycling water circuit at the TSF under Alternative C would probably not significantly reduce noise levels around the TSF because pumps still would be required to discharge from the TSF to the diversion ditch.

4.18.6 Summary

The noise generated by helicopters used in employee transportation would have the greatest impact over the widest area under Alternatives A and A1. The helicopter used to shuttle workers would make two to three round trips daily and would traverse the mouth of Berners Bay as part of the flight path. Helicopter noise could be heard in most portions of the bay, with noise levels of approximately 50 dBA at the Berners Bay Cabin, approximately 60 dBA in the middle of the bay, and louder nearer the flight path. The noise level at the Berners Bay Cabin would be less than the noise level of a normal conversation (60 dBA). Construction noise impacts under Alternatives A and A1 are not generally expected to have significant adverse impacts on receivers in Lynn Canal and would not affect receivers in Berners Bay at all. Most noise-generating activities would occur within a 14- to 18-month period, before mining operations begin. With the exception of blasting, the loudest noise measured 1 mile offshore (46.5 dBA) would result from DTF construction. The sound of DTF construction 1 mile offshore would also be less than that of a normal conversation (60 dBA) and would be inaudible over background ferry noise. Blasting, though considerably louder, would occur only once a day and could be scheduled to occur when ferry traffic is not expected in the area. The loudest noises during operations would be DTF operation and barge unloading, which would produce noise levels of 49.5 dBA and 48.5 dBA, respectively, which again would be less than the noise generated by a normal conversation.

Under Alternatives B, C, and D, the helicopter transport of employees at the beginning of the construction period would create the most widespread noise within the project area, as described for Alternatives A and A1. Blasting could also be heard throughout Berners Bay during construction but would be limited to a maximum of once a day; it would sound like the rumble of thunder. During regular operations, noise generated by the crew shuttle boat (80 dBA at 50 feet) would have the potential to affect the largest number of receivers, particularly within Echo Cove under Alternative C. Depending on conditions in Echo Cove at any point in time, the arrival and departure of the shuttle from Cascade Point under Alternatives B and D could also be audible in Echo Cove. Barge unloading operations at the Slate Creek Cove marine terminal could affect receivers within Berners Bay, although again noise levels throughout most of the bay would be less than the level of a normal conversation. Because activities at the Jualin process area and TSF are separated from Berners Bay by forest and varied topography, noise impacts from those areas are not expected to adversely affect recreational users of Berners Bay. For the same reason, passengers on Alaska Marine Highway ferries would not be able to hear noises from any of the mine-related construction or operations associated with Alternatives B, C, or D.

4.19 TRANSPORTATION

All three significant issues discussed in Section 1.6 relate to transportation concerns. These concerns include how seeing or hearing a shuttle boat or dock facilities would affect the wildland recreational experience in Berners Bay and what effect the wakes generated by the shuttle boat crossings would have on the shoreline and boaters. The significant issues also addressed concerns that mine-related transportation could disturb birds, fish, and wildlife in Berners Bay and in turn cause direct and indirect impacts on human users from a recreational and economic perspective. Other concerns included collisions with marine mammals and the potential impacts on water quality from spills of ore concentrate, process chemicals, or petrochemicals.

4.19.1 Effects of Alternative A

Under Alternative A, employees would be transported to the site by helicopter from the Juneau Airport and housed on-site for 1 to 2 weeks at a time. Employee transport would involve 2 to 3 trips per day 7 days a week during construction and 12 total trips per week Monday though Friday during operations. Buses would carry the employees from the heliport to the personnel camp at Comet Beach (construction) or below the process area (operations).

All deliveries to and shipments from the site would be through a marine facility at Comet Beach. During peak construction, supplies would be delivered by barge up to seven times a week. Operations would require three to four barge deliveries a week. A single barge delivery monthly would supply the site with 540,000 gallons of diesel fuel during construction and operations. Fuel is discussed in detail below. Shipping the monthly production of 1,400 tons of concentrate off-site would require four to five barge trips each month.

As discussed in the 1997 SEIS, the additional barge traffic associated with the Kensington project operations would represent a 2 percent increase in Lynn Canal traffic during the summer months and a 33 percent increase during the winter months. The larger percentage increase during the winter would have a minimal impact because the actual number of vessels would be small. As described in the 1992 FEIS, the project's barge traffic could affect commercial gillnet fishing in the vicinity of Point Sherman during the commercial fishing season. To minimize potential impacts, the barges would be scheduled on non-fishing days. If deliveries were necessary during fishing days, the barges would approach Comet Beach in a perpendicular manner from the middle of Lynn Canal to minimize the time the barges were within the fishing areas.

Materials and fuel would be moved between Comet Beach and the process area using trucks along the approximately 1.5-mile-long access road. Flotation concentrate would be delivered from the process area to the laydown area at Comet Beach using 20-ton containers on flatbed trucks.

The existing access road at the project site would be upgraded to support construction, mining, and ore-processing activities. A portion of the road would be relocated around the DTF. Vehicle traffic on the access road would comprise the following:

- Personnel movement to and from the heliport to the housing camp and other facilities

- Haulage of supplies, process chemicals, explosives, and fuel trucks
- Haulage of waste rock for DTF construction and reclamation activities
- Road maintenance and equipment maintenance vehicles

Vehicles using the access road would include semi-tractor/trailers, flatbed trucks, buses, carryalls, half-ton and three-quarter-ton trucks, diesel tank trucks, fire trucks, an ambulance, forklifts, a grader, a snowplow, an explosives vehicle, and other vehicles as required to support mine and mill operations.

It is estimated that approximately 10,500 vehicle round trips per year would be made on the access road. The risks of accidents associated with transportation on the access road were estimated using statistical data supplied by the Alaska Department of Transportation and Public Facilities (ADOT&PF) for rural highways in Alaska (ADOT&PF, 1995a, 1995b). These data are expected to establish an upper bound on the potential risk of an accident because average vehicle speeds are expected to be much lower on the access road than the average vehicle speeds on rural highways.

Based on an estimated accident rate for trucks on the access road of about two per million miles (ADOT&PF, 1995a) and using the 1.5-mile length of the access road, the risk of a vehicle accident is estimated to be 6.3 percent per year (i.e., a probability of about 1 in 16 that a single accident would occur). When projected over the 14-year life of the project, the cumulative risk is approximately 88 percent that a vehicle accident would occur during the life of the project. The risk of personal injury as a result of a transportation accident is estimated to be 9.6 percent (about 1 in 10), and thus the probability that a vehicle accident would result in personal injury is 8.5 percent. The risk of a fatality as a result of a transportation accident is estimated to be 0.096 percent (about 1 in 1,000). This results in a cumulative probability for this project of 0.085 (about 1 in 1,000) percent that an accident resulting in a fatality would occur during the life of the project.

Fuel Transportation

Diesel fuel would be supplied to the Kensington Mine project by the regularly scheduled barges that supply diesel to facilities throughout Southeast Alaska. As discussed in the 1992 FEIS, spill contingency plans for the three major oil terminals in Haines and Skagway show a combined annual throughput of 42.5 million gallons per year. Each barge typically contains about 80,000 barrels (3.2 million gallons) of oil. At present, the fuel barges provide about 85 transfers annually. Under Alternative A, approximately 6.5 million gallons of diesel fuel would be used annually at the mine, potentially increasing diesel transport by 15 percent, or slightly more than two barge loads per year. According to U.S. Coast Guard (USCG)-reported data regarding oil spills, no events have been reported from fuel barge accidents (i.e., sinking or collision damage) in Lynn Canal.

Under this alternative, therefore, the risk associated with barge transport of fuel is minimal. The transfer of diesel fuel from the supply barge to the marine terminal at Comet Beach presents the risk of a diesel fuel spill into Lynn Canal during transfer operations. The diesel fuel would be pumped from transport containers on the barge to a storage tank at Comet Beach using a flexible transfer hose. All fuel transfers would be conducted in accordance with the specific requirements of the approved Contingency Plan (C-Plan), facility response plan (FRP); and spill prevention, control and countermeasures (SPCC) plan to be approved by USEPA, as well as USCG and other applicable federal, state, and local regulations. The impacts of fueling-related spills are discussed under Aquatic Resources: Marine (Section 4.10).

A 5,000-gallon tanker truck would be used to transport diesel fuel from storage tanks at the marine terminal to the process area. The fuel transfer process would require approximately 1,300 diesel on-site fuel shipments annually. The probability that an accident would result in a diesel fuel spill is estimated to be 0.187 per million miles (Harwood and Russell, 1990). Combining these factors, the probability of an accident that would release the entire contents of a tank truck is estimated to be about 0.036 percent per year (about 1 in 2,700) or 0.5 percent (1 in 200) over the life of the project. The impacts of potential spills from truck transport are discussed under Aquatic Resources: Freshwater (Section 4.9).

4.19.2 Effects of Alternative A1

The effects of Alternative A1 would be the same as those described for Alternative A, except that fuel use would be lower and the overall number of vehicle trips would be lower than the number under Alternative A. There would be about 9,668 vehicle round trips per year and, therefore, a 58 percent risk of an accident over the 10-year mine life. The risk of an accident-related personal injury would be about 5.8 percent, and the risk of a fatality would be about 0.058 percent during the mine life.

The fuel use would be approximately comparable to that under Alternative B (3.4 million gallons used and 468 on-site diesel fuel tank truck trips made per year). The probability of an accident that would release the entire contents of a tank truck is estimated to be about 0.013 percent per year (about 1 in 7,692), or 0.13 percent (about 1 in 769) over the life of the mine.

4.19.3 Effects Common to Alternatives B, C, and D

There are three primary transportation differences between Alternatives A and A1 and Alternatives B, C, and D: the location of the marine terminals; the use of a crew shuttle to move employees between Slate Creek Cove and Cascade Point (Alternatives B and D) or Echo Cove (Alternative C); and the daily transportation of workers. Fuel deliveries to Slate Creek Cove would use isotainers rather than the fuel barge delivery system proposed at Comet Beach.

Construction Transportation

The mine development equipment and supplies would be delivered by barge to Comet Beach and unloaded there for truck transport to the Kensington Mine site. During the first quarter of the construction activity, the marine terminal at Slate Creek Cove would be completed, allowing delivery of construction materials, supplies, and personnel required for the construction of the process area and other facilities on the Jualin side of the mining operation. The access road to the Jualin site is approximately 5 miles long, and it would be upgraded to include turnouts at 1,500-foot intervals. It is expected that during construction up to seven barge deliveries per week would be required. Truck traffic on the access road would vary as required by the construction schedule and barge deliveries. A one-way trip along the access road would take approximately 15 to 20 minutes.

Employee transportation requirements would be different for the construction and operation phases. Although final decisions have not been made, temporary housing would be provided during the construction phase. This would apply to the workers developing the mine access on the Kensington side of the project area. These workers would be brought to the site by helicopter from Juneau. The crew building the marine terminal at Slate Creek Cove would live on a barge while the facility was being built. Once the Slate Creek Cove terminal was completed, workers tasked with building the mill buildings and TSF would be able to access the site by crew shuttle boat.

Operations

During the operational phase, workers would access the site by crew shuttle between Cascade Point (Alternatives B and D) or Echo Cove (Alternative C) and Slate Creek Cove. Approximately three to five round trips per day would be required during operation. Each crossing would require approximately 15 minutes, depending on weather conditions. The crew shuttle is expected to be a 75-foot monohull boat, with a draft of 7.5 feet and a cruising speed of 18 mph. The shuttle would have the capacity to transport up to 149 people and would be propeller-driven an powered by 3 diesel engines. The exhaust system would be above the waterline reducing the noise levels generated underwater.

The crew shuttle would be similar to others operated in the region. The wake from a monohull depends on speed and other factors. The wake size would be diminished by the natural dampening effects of the large waterbody and natural wave action. (USACE, 2001).

Buses would be used to transport personnel the 30 miles between the Juneau area and Cascade Point (or Echo Cove) using the Glacier Highway, and also on the mine access road between Slate Creek Cove and the Jualin Mine site. An average of three round trips per day would be expected to occur at each location. Given the number of full-time employees and the staggered work schedules, this project is expected to have little impact on traffic in and around Juneau. The CBJ Allowable Use Permit (Appendix I) requires the operator to establish a policy that employees must use bus transportation from a centralized location in Juneau to Cascade Point.

Supplies would be delivered to the Slate Creek Cove marine terminal by barge. Fuel and supply deliveries would require an estimated three to four barge deliveries per week (Earthworks, 2002a). The barges would be similar to other barges operated in the region. The barge traffic would access Slate Creek Cove by passing through the northwest corner of Berners Bay on a line from Lynn Canal to the cove. Commercial tugs and barges produce many more waves, which occur over a period of about 7 minutes, compared with recreational boat wake wave trains, which occur over a period of about 24 seconds (USACE, 2001).

It is estimated that approximately 5,350 vehicle round trips per year would be made on the access road. The risks of accidents associated with transportation on the access road were estimated using statistical data supplied by the ADOT&PF for rural highways in the state of Alaska (ADOT&PF, 1995a, 1995b). As noted for Alternative A, these data establish an upper bound on the potential risk of accident because average vehicle speeds on the access road would be much lower than average vehicle speeds on rural highways. Based on an accident rate for trucks on the access road estimated at two per million miles (ADOT&PF, 1995a) and using the 5-mile length of the access road, the probability of a vehicle accident is estimated to be 9 percent per year (i.e., a probability of about 1 in 11 that a single accident would occur). When projected over the 10-year life of the project, the cumulative estimate is that one vehicle accident would be expected during the life of the project. The risk of personal injury as a result of a transportation accident is estimated to be 9.6 percent (about 1 in 10), or a cumulative probability of 10 percent that an accident involving a personal injury would occur during the life of the project. The risk of a fatality as a result of a transportation accident is estimated to be 0.096 percent (about 1 in 1,000). The cumulative probability for this project is a 0.1 (about 1 in 1,000) percent chance that an accident involving a fatality would occur during the life of the project.

Isotainers with a capacity of 6,500 gallons are proposed for transporting diesel to the project site under Alternatives B, C, and D. These tank containers are designed for multimodal transportation and conform to the requirements established by the International Standards Organization (ISO). ISO standard 1496-3 applies to tank containers for liquids, gases, and pressurized dry bulk. Tanks conforming to ISO 1496-3 are enclosed within a structural frame designed to isolate the shell of the tank from the forces encountered during handling, transport, and storage. The frame would protect the tank in the event it is dropped or involved in a rollover-type accident. The design of the tanks would allow them to be stacked on supply barges, then loaded onto flatbed trailers by crane or forklift for hauling to the laydown and process areas. Isotainers are regularly used to move materials throughout Alaska, including at the Greens Creek Mine.

Annual fuel consumption is estimated at 3.4 million gallons for Alternatives B and C and 3.5 million gallons for Alternative D. Approximately nine isotainers would be delivered to the Slate Creek Cove marine terminal weekly (Earthworks, 2003a). The isotainers would be unloaded like other cargo and would be stored in lined and bermed laydown areas at Slate Creek Cove, the mine portal, and the process area. Flatbed trucks would deliver the isotainers to the mine portal area and process area. The isotainers would be connected to pipe headers, such that they would become the storage tanks feeding the power plant and fueling islands throughout the mine. An advantage provided by the proposed Slate Creek Cove site is that barge traffic could be scheduled with greater regularity, allowing the project to reduce the required on-site storage quantities of expendable substances, including fuel.

In addition to diesel fuel, approximately 6,500 gallons of aviation fuel (in isotainers) and a maximum of 5,000 gallons of gasoline (in isotainers or 55-gallon drums) would be stored at the Jualin Mine site. Secondary containment would also be provided for these fuels.

Under Alternatives B, C, and D, the risk associated with barge transport of fuel and the risk of a spill during transfer of diesel fuel from the supply barge to the marine terminal are minimal because of the use of the individual containers. The isotainers would be unloaded in accordance with the specific requirements of the approved SPCC plan and applicable federal, state, and local regulations.

Trucking the isotainers from the laydown area to the process area would require approximately 568 round trips annually. The probability that an accident would result in a diesel fuel spill is estimated to be less than 0.187 per million miles because the isotainers would be less likely to rupture in the event of an accident compared with standard tank trucks (Harwood and Russell, 1990). Combining these factors, the probability of an accident that would release the entire contents of an isotainer during truck transport is estimated to be less than 0.04 percent (1 in 2,500) per year, or less than 0.4 percent (1 in 250) over the life of the project. In addition, because of the use of isotainers, the magnitude of a spill is generally expected to be much less than the total contents (6,500 gallons). The impacts of potential spills from truck transport are discussed under Aquatic Resources: Freshwater (Section 4.9). Note that only a portion of the road crosses or is adjacent to Johnson Creek. Other sections are significant distances from the creek, thereby limiting any impacts from spills that might occur and the amount of material that would actually reach the water.

The operation would generate approximately 100 tons of flotation concentrate daily. This production rate would require, on average, the transfer by truck of five concentrate containers per day. Each container would hold 20 tons of concentrate. The concentrate would be shipped by barge approximately four to five times per month from the Slate Creek Cove marine terminal to an off-site gold recovery processing facility.

Overall, the barge traffic would have a minor effect on Lynn Canal. In Berners Bay, however, the barge traffic (three to four trips per week) and crew shuttle traffic (four round trips per day) represent traffic that was not present before.

4.19.4 Effects of Alternatives B and D

The effects unique to Alternatives B and D are those related to the use of a marine facility at Cascade Point as the point of departure for employees headed toward the mine operation. In terms of transportation, these differences would affect recreational boat use, as discussed under Land Use and Recreation (Section 4.13).

4.19.5 Effects of Alternative C

The effects unique to Alternative C are those related to the use of a marine facility in Echo Cove as the "land side" terminus of the personnel ferry. The impact from transportation applies to recreational boat use from the Echo Cove boat ramp, which is discussed under Land Use and Recreation (Section 4.13).

4.19.6 Summary

Table 4-37 summarizes transportation impacts associated with the project. Transportation-related effects are also discussed under a number of other resources, including surface water quality, marine and freshwater aquatic resources, noise, visuals, and recreation.

Table 4-37
Summary of Transportation Impacts for All Alternatives

Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Barge traffic	Deliveries to Comet Beach; up to seven barges weekly during construction and three or four during operations.	Same as Alternative A.	Deliveries to Comet Beach early in construction phase, after which deliveries to Slate Creek Cove. Numbers of barges same as Alternative A.	Same as Alternative B.	Same as Alternative B.
Employee transportation	Two to four helicopter trips Monday through Friday during operations (12 trips total).	Same as Alternative A.	Three to five crew shuttle trips daily between Slate Creek Cove and Cascade Point.	Three to five crew shuttle trips daily between Slate Creek Cove and Echo Cove.	Same as Alternative B.
Vehicle trips/accident risk	10,500 vehicle trips annually; accident probability 6.3 percent per year.	9,668 vehicle trips annually; accident probability 3.8 percent per year.	5,350 vehicle trips on access road annually; accident probability 9 percent per year.	Same as Alternative B.	Same as Alternative B.
Fuel release due to accident	Risk of 5,000-gallon spill 0.036 percent per year	Risk of 5,000-gallon spill 0.012 percent per year.	Risk of spill less than 0.04 percent per year; typically would be significantly less than 6,500 gallons.	Same as Alternative B.	Same as Alternative B.

4.20 SUBSISTENCE

4.20.1 Effects Common to All Alternatives

The Kensington Gold Project is located within the CBJ, whose residents are considered non-rural for subsistence purposes in terms of the Alaska National Interest Lands Conservation Act (ANILCA). Although hunting and fishing by CBJ residents would be considered sporting activities, the use of the area by residents of other Southeast Alaska communities could be considered subsistence use. Documented subsistence use of the area is limited. The ADF&G 1990 Subsistence Use Maps show that rural residents of Skagway use the offshore areas of Comet Beach for salmon, while rural residents of Haines use the uplands south of Comet Beach to harvest deer and the offshore areas of Comet Beach to gather fish (e.g., halibut). Rural residents of Wrangell use Echo Cove to gather invertebrates. Most of the subsistence resource harvest is for salmon, halibut, and invertebrates, in salt water, where federal subsistence regulations do not apply. The only upland use is for deer by residents of Haines. This use is very small (on average less than one deer per year) and does not contribute to the wildlife analysis areas where these residents obtain 75 percent of their deer, the criteria for consideration for subsistence use. Therefore, no significant effects on subsistence resources would be expected as a result of implementing any of the alternatives.

4.21 CUMULATIVE EFFECTS

The National Environmental Policy Act (NEPA) defines *cumulative effects* as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions.” This section discusses the cumulative effects associated with the Kensington Gold Project. Figure 4-7 illustrates the other projects under consideration in this analysis: Goldbelt’s proposed development at Echo Cove, the Cascade Point Access Road, the Juneau Access Road, and the Cape Fox land exchange. The extension of mining activities is also considered but not depicted in the figure.

4.21.1 Descriptions of Other Projects

Echo Cove Development (Goldbelt)

Goldbelt, Inc., an Alaska Native corporation, owns approximately 1,400 acres along the east and west shores of Echo Cove. The proposed action includes the construction and use of a dock at Cascade Point to transfer workers to the mine site. This aspect is addressed in detail in the full analysis in this document. The remaining aspects of Goldbelt’s Echo Cove development are analyzed here in terms of cumulative effects. The Forest Service has taken this approach because construction of the dock is a specific proposal, while the other aspects of the development are considered to be in the conceptual or planning stages.

In March 1996 Goldbelt released the *Echo Cove Master Plan* (Master Plan), a document that described the development proposed for its Echo Cove property. The Master Plan calls for development of approximately 10 percent of the Echo Cove lands. The initial phase is described as construction of a staging area and log transfer facility at Cascade Point. However, Goldbelt logged the area using a helicopter and a barge to remove the logs from the site. There are no plans for additional logging. Subsequent phases of the Master Plan are still in the planning stages, but they could include a convenience store/gas station, power generation station, and water and sewage treatment facilities. Goldbelt identified the following goals for the development of a dock at Echo Cove:

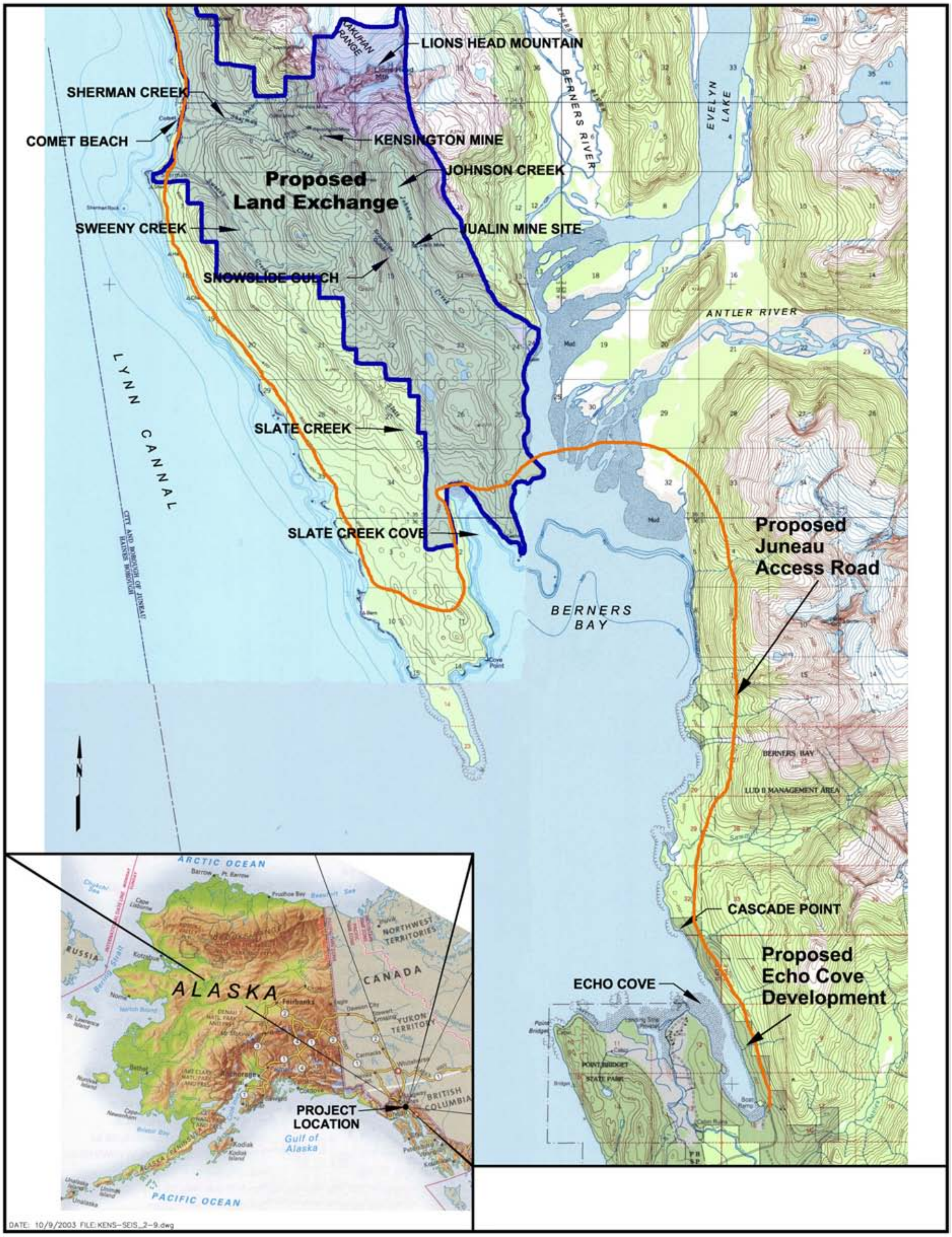


FIGURE 4-7. CUMULATIVE EFFECTS

- High-speed ferry service to Haines or Skagway
- Increased tourism opportunities, including operations with new excursion ships
- Support of the Lynn Canal fishing industry

A high-speed ferry to Haines or Skagway might be dependent on the outcome of the Juneau Access EIS process and is not considered further as part of Goldbelt's actions. Boats used for tourism would be similar in size to the crew shuttle used to transport workers to Slate Creek Cove. The fisheries dock would allow fishermen working in Lynn Canal a place to unload fish for shipment to processing plants or shipping terminals in Juneau. Goldbelt also includes a provision for mine housing and other personnel support for the Jualin Mine as one of the goals for development.

Cascade Point Access Road

The Forest Service completed an FEIS for the Cascade Point Access Road in March 1998. The Forest Service Supervisor selected Alternative B, with modifications in the Record of Decision (ROD). This alternative authorized the issuance of a road easement to Goldbelt for construction of the 2.5-mile access road across National Forest lands for the purpose of developing the area. The road would be gated to restrict public access during construction and until one of the planned public facilities was constructed on private land at Cascade Point. The modifications included signage identifying points where land ownership changed from public to private; public vehicular use of the road upon completion of initial dock development when, in the opinion of the Forest Service in collaboration with Goldbelt, development activities do not create hazards to public safety; construction of a turnout with parking on National Forest System land where public land extends to the beach; and on-site monitoring of cultural resources by an archaeologist during construction of the road.

Juneau Access Road

The Alaska Department of Transportation and Public Facilities (ADOT&PF), in cooperation with the Federal Highway Administration, is developing a Supplemental Draft EIS to assess the potential impacts associated with improving access to Juneau. Alternatives 2 and 2A in the EIS involve a "hard link" along east Lynn Canal between the end of the existing Glacier Highway to the Katzehin River. From the Katzehin River, one alternative would continue with a road to Skagway while the other would involve a ferry terminal. Under these alternatives, the road would be constructed around Berners Bay. The initial proposal included a causeway across the head of Berners Bay, although the new proposal would include crossings of the Antler/Gilkey and Berners rivers in forested wetlands and uplands upstream of where the causeway would have crossed. This analysis assumes that mine employees would access the mine via the road rather than the crew shuttle boat if the road were completed during the operating life of the mine.

Extension of Mining Operations

The 1997 SEIS evaluated the expansion of mining activities into the Jualin deposit under the cumulative effects analysis and assumed that it could add an additional 4 to 5 years to the proposed operation. There is no information available indicating that additional exploration activities have been conducted on the Jualin deposit. This cumulative effects discussion focuses on expansion of the mine under Alternatives B, C, and D to the level approved in the 1997 ROD (i.e., Alternative A). The project's life span is assumed to be extended by 5–10 years. If Alternative B, C, or D were selected, any such expansion would require additional permitting and NEPA review.

Alternative A would generate a maximum of 20 million tons of tailings. The DTF was sized to hold these 20 million tons of tailings, although The operator proposed to backfill at least 25 percent of the tailings produced. Under Alternative B, backfilling 40 percent of the tailings is an operational requirement, resulting in approximately 4.5 million tons being deposited in the TSF and 3 million tons being backfilled. This discussion, for the purposes of cumulative effects, assumes that the operator could mine enough ore to generate a total of 20 million tons of tailings as proposed under Alternative A. This would result in the generation of an additional 12.5 million tons of tailings beyond those covered in this Final SEIS. The assumption is that all these tailings would be deposited in the TSF, creating a need for storage of a total of 17 million tons. This scenario represents the worst-case scenario in terms of tailings storage. It is likely that a portion of the tailings would continue to be backfilled into the mine. If operations were extended under the Alternative A1 scenario, the outcome would be the same as that under Alternative A.

Under Alternatives B, C, and D, expanding the storage capacity of the TSF to accommodate an additional 12.5 million tons of tailings would require enlargement of the dam. Rough calculations indicate that the final height of the dam would need to be approximately 175 feet, almost double its height under Alternatives B, C, and D. The construction methods, stability, and design criteria would have to be thoroughly investigated to determine the actual height, size, and construction requirements. Assuming the same depth of water covering the tailings (9 to 20 feet), the ultimate size of the lake would be approximately 150 acres, enveloping both Lower and Upper Slate lakes.

Cape Fox/Sealaska Land Exchange

Congress recently considered legislation that would have enacted a land exchange between the Forest Service and Cape Fox, Inc., and the Forest Service and Sealaska, Inc. Cape Fox is an Alaska Native Village Corporation, and Sealaska is an Alaska Native Regional Corporation. The exchange with Cape Fox would convey the surface rights to approximately 2,700 acres of land in the Johnson and Slate creek drainages, in the same area where activities are proposed for the Kensington Gold Project. In return, the Forest Service would receive lands owned by Cape Fox determined to be of equal value and identified after the legislation is enacted. The exchange would also convey surface and subsurface rights to approximately 9,300 acres of land in the Johnson, Sherman, and Sweeny creek drainages to Sealaska, as well as the subsurface rights under the land conveyed to Cape Fox. The Forest Service would receive Sealaska lands of equal value identified after the legislation is enacted. It should be noted that the land exchange was being considered by Congress and is not a Forest Service action, nor is it subject to review under NEPA. The land exchange legislation was not passed during the 108th Congress, and whether it will be considered in the 109th Congress is not known.

If the land exchange is enacted, the lands surrounding the Kensington Gold Project would come under the ownership of Cape Fox and Sealaska. The mine operator and other owners of patented claims would retain their ownership. The use of the lands conveyed to Cape Fox and Sealaska would be subject to the same regulatory framework that governs any other private lands in Alaska. The operator has an agreement with Cape Fox and Sealaska that would allow it to continue the permitting process for the Kensington Gold Project and operate the mine either as currently permitted or as proposed under the amended plan of operations. The result of the exchange would be that the Forest Service would cease to be involved from a regulatory or land management standpoint. The operation would still be required to obtain permits from ADNR, USEPA, and USACE. Statutory requirements under NEPA, as enforced by USEPA and USACE, would still have to be satisfied; however, one of these agencies would assume the role of lead agency. Reclamation standards would be established under the terms of the ADNR, USEPA, and USACE permitting requirements, but they would also reflect the desires of the landowners—in this case, Cape Fox and Sealaska.

Although the lands would become private and could be used for timber harvest or the development of recreation or housing, these actions are not considered reasonably foreseeable in terms of cumulative effects. There are no further proposals for the land other than to allow the Kensington Gold Project to continue with the permitting process. Therefore, the discussion of cumulative effects related to the land exchange is limited to the potential impacts of a change in regulatory jurisdiction, primarily affecting reclamation.

4.21.2 Air Quality

Air pollution increases resulting from the Kensington Gold Project would be very localized and confined to the vicinity of the site. Annual average nitrogen dioxide (NO_2) concentrations would decrease to below significant levels within 0.6 mile of the project boundary. Similarly, particulate matter less than 10 microns in diameter (PM_{10}) and sulfur dioxide (SO_2) modeled concentrations are less than 1 $\mu g/m^3$ within 1.0 mile of the project boundary. The air quality impacts from both helicopter and marine transportation to and from the site would be minimal. The only projects that would contribute to cumulative air quality impacts would be projects in immediate proximity to the Kensington Gold Project. The discussion of cumulative effects on air quality, therefore, is limited to the Juneau Access Road and the potential extension of mining activities.

The Draft EIS for the Juneau Access Road projects a maximum carbon monoxide concentration of 9 parts per million (approximately 550 $\mu g/m^3$) from road traffic. As a result, the air quality emissions of the combined Kensington Gold and Juneau Access Road projects would be well below the National Ambient Air Quality Standards (USDOT and ADTPF, 1997). There would be minimal air quality impacts if the high-speed ferry alternative is selected instead of the road. Expanding the mine to process the additional ore could contribute to cumulative effects on air quality by extending the life of the Kensington facilities. The extended use of the Kensington facilities would not produce emissions any different from those discussed in Section 4.2 of this SEIS. Therefore, no significant cumulative effects related to air quality are expected.

4.21.3 Geology/Geochemistry

The processing of additional ore under Alternatives B, C, and D is the only source of potential cumulative impact on local geology and geochemistry at the Kensington Mine. The extension of mining would result in the generation of additional waste rock and tailings. As indicated in Section 2, Alternatives B, C, and D focus on mining a higher grade of ore. As shown in the analysis of Alternative A in Section 4.3, the waste rock and tailings produced by additional processing would not generate acid and would have very low, if any, potential for metals mobility. No cumulative geologic/geochemical impacts are expected.

4.21.4 Geotechnical Stability

The Draft EIS for the Juneau Access Road indicates that the proposed action would cross 58 avalanche paths between Echo Cove and Skagway (USDOT and ADTPF, 1997). None of these avalanche paths are within the Kensington Gold Project area. No other aspects of the Juneau Access Road would create additional geotechnical concerns for the Kensington Gold Project; therefore, the road would not contribute to cumulative effects in terms of geotechnical stability.

The primary geotechnical concerns are associated with an extended mine life and use of facilities under Alternatives B, C, and D to process the additional ore, as well as the disposal of the resulting tailings (as much as a total of 17 million tons). Tailings disposal would necessitate increasing the height of the TSF dam to approximately 175 feet, resulting in substantially larger tailings disposal and pond areas. In all likelihood, the enlarged TSF would envelop both Upper and Lower Slate lakes. The available geotechnical data suggest that such a stable dam could be constructed, although substantial additional dam safety analysis would be required. A modified dam design would have to be reviewed and permitted by the State of Alaska. An enlarged dam would also need to meet the appropriate long-term financial assurance similar to the dam under consideration in the Proposed Action. No cumulative geotechnical effects, therefore, are expected.

4.21.5 Surface Water Hydrology

Because the Kensington Gold Project would affect surface water hydrology only in the Sherman Creek, Slate Creek, and Johnson Creek drainages, the potential cumulative effects on surface water hydrology are considered only for those areas. The projects that could contribute to cumulative effects within those areas would be the Juneau Access Road and the expansion of the mine under Alternatives B, C, and D to produce the larger volume of ore proposed under Alternative A.

The Juneau Access Road would include crossings of Sherman Creek, each of the intermittent streams below the DTF, Lower Slate Creek, and Lower Johnson Creek (USDOT and ADTPF, 1997). The potential for impacts on surface water hydrology would occur only during construction of the stream crossings. These impacts would not be significant because the Alaska Department of Transportation would have to minimize impacts on stream flows, provide for fish passage, and implement water resource BMPs. Any contribution to cumulative impacts on surface water hydrology from the Juneau Access Road would be minimal. As discussed previously, processing the additional ore under Alternatives B, C, and D would likely extend the period of surface water hydrology impacts on Sherman and Johnson creeks. In Slate Creek, both Lower and Upper Slate lakes would be used for tailings disposal behind a larger dam structure. Under Alternative B, water quality in Lower Slate Lake is not expected to change, although the operator would continue to have difficulty meeting NPDES permit limits and maintaining continuous downstream flow. Under Alternatives C and D, new and longer diversions would presumably have to be designed and constructed to carry flow around the TSF and maintain natural flows in East Fork Slate Creek.

4.21.6 Surface Water Quality

The Kensington Gold Project could cause minor sediment loadings during construction and operations. Assuming the Juneau Access Road was constructed, it would cross Sherman Creek, Sweeny Creek, the intermittent creeks that cross the terrace area, Lower Slate Creek, and Lower Johnson Creek. Increased sediment loadings could occur in all these water bodies, especially during road construction. The Juneau Access Road Draft EIS describes the BMPs that would be used during construction to minimize the extent of erosion and potential impacts on anadromous and resident fish (see below) (USDOT and ADTPF, 1997). With properly designed and implemented BMPs, any cumulative sediment loadings would be minimized. The road could also require the use of salt, primarily magnesium chloride, or sand. If salt, magnesium chloride, or sand were used, there could be elevated TDS or sediment loadings into freshwater streams. The use of such chemicals would have to be evaluated and mitigated, as necessary, to ensure compliance with water quality standards. The implementation of BMPs should prevent impacts on creeks from these sources. Impacts within the creeks resulting from the road would occur from the crossings downstream to Lynn Canal. In most if not all cases, this would translate into a relatively small part of each creek.

Cumulative effects could also arise under Alternatives B, C, and D if facilities are used to process the additional ore proposed under Alternative A. Any effects from the extended use of Jualin side facilities would arise from the longer period during which sediment could enter the creeks and the increased duration of discharges from the permitted discharge points. Any potential effect would be an extension of the effects discussed in Section 4.6. One potential additive effect would be the accumulation of sediments within the creeks or the accumulation of metals in fish tissue. These possibilities have been acknowledged in the preceding analysis. Because they would be minimized under each alternative and would be monitored during operations, it is unlikely that they would contribute to cumulative effects. Under all alternatives, compliance with water quality-based permit limits at all times would continue to be required at all discharge points during the extended operations, and no cumulative adverse impacts on downstream water quality would occur.

4.21.7 Groundwater Hydrology and Quality

The processing of additional ore under Alternatives B, C, and D is the only source of potential impact on local groundwater hydrology at the Kensington Mine. The mine water impacts have been discussed for Alternative A (in Section 4.6). Since the Upper and Lower Slate lakes do not appear to have a significant connection to groundwater, an expanded TSF would not affect groundwater hydrology. In addition, because the tailings are not expected to generate leachate with elevated pollutant concentrations, no impacts on groundwater quality are predicted.

4.21.8 Aquatic Resources: Freshwater

As described in Section 4.9, the Kensington Gold Project would cause impacts on freshwater aquatic life only through construction of the diversions under Alternative A and the TSF under Alternatives B, C, and D.

Under Alternatives B, C, and D, the extension of mining activities would lengthen the period during which operations could affect aquatic resources in Sherman, Johnson, and Slate creeks. The expansion of the TSF under Alternatives B, C, and D would inundate the area currently containing both Upper and Lower Slate lakes, as well as Mid-Lake East Fork Slate Creek and the tributaries that support Upper Slate Lake. Although the spawning habitat for Dolly Varden char in the Slate lakes has not been clearly identified, all of it would be covered with tailings and/or inundated by raising the TSF impoundment enough to store 17 million tons of tailings. Using the assumptions that were applied in the analysis of Alternative B (Section 4.9), all fish in Upper and Lower Slate lakes would be eliminated during operations. This would affect fish passage in that the upstream source of fish to East Fork Slate Creek below the TSF would be eliminated and the population potentially lost. The operator would be under the same constraints in developing a suitable reclamation plan that would restore fish habitat within the combined, reclaimed lake after closure. The surface area of the lake would be almost three times the size of the lake analyzed under Alternative B.

4.21.9 Aquatic Resources: Marine

The Kensington Gold Project would not affect marine resources as a part of mining operations. The dredging necessary to construct the marine terminal would affect marine mammals, as would barge and crew shuttle traffic throughout the duration of the project. An extension of the project life would extend the duration of the effects described in Section 4.10 but would not cumulatively increase the magnitude of effects.

The construction of the landing facilities at Echo Cove could increase boat traffic in Berners Bay. A change in traffic volume and patterns could force a shift in fishing locations for a small number of shrimp and crab pot fishermen but is not expected to affect marine resources within the bay; therefore, it would not contribute to cumulative effects on marine aquatic resources. Any contribution to cumulative impacts on marine resources from the Cascade Point Access Road would be minimal.

The Juneau Access Road would include crossings of some streams draining into Berners Bay. The potential for impacts would occur mostly during construction with possible increased sediment loads at stream crossings. Similar to the dock facilities supporting the Kensington Gold Project, the loading would be minimized by use of BMPs. The potential water quality impacts on both the freshwater and marine environments from other contaminants in Juneau Access Road runoff (e.g. oils, salts, other toxics) have been predicted to be negligible (URS, 2004a). Therefore, any contribution to cumulative impacts on marine resources from the Juneau Access Road project would be minimal. The Juneau Access Road would eliminate the need for crew shuttle access to the Kensington Project and would result in a reduction of marine traffic and its attendant potential impacts on fish and marine mammals.

4.21.10 Wildlife

The Kensington Gold Project, when combined with other projects occurring or potentially occurring in the Berners Bay area, would produce additional impacts on wildlife and their habitat, but it is not likely to add significantly because of the amount, distribution, and proximity of proposed disturbance and the use of mitigation measures.

Reasonable and foreseeable impacts on wildlife and their habitat would likely occur as a result of partial or full development of Goldbelt's Master Plan at Echo Cove and the associated construction of the Cascade Point Access Road. The extent of total acres of wildlife habitat potentially disturbed is unclear; however, based on available modeling information, further reductions in assumed carrying capacity for brown bear, black bear, American marten, and mountain goats would occur, ranging from less than 6 percent for mountain goats to 55 percent for marten, if full development ensued (Forest Service, 1998a).

The Juneau Access Improvements Supplemental Draft EIS project area partially overlaps this project area and would add cumulatively to impacts on wildlife and their habitats within the Berners Bay area. Construction of the Juneau Access Road around Berners Bay would result in the permanent loss of approximately 413 acres of terrestrial habitat, most of which is within the beach or estuary fringe and contains 364 acres of productive old-growth forest (URS, 2004b). For species that use productive old growth for some or all of their life requisites, the worst-case scenario associated with the Kensington Gold Project would be the loss of approximately 149 acres of productive old-growth habitat. Other habitats, such as wetlands, would eventually be restored to their previous condition during reclamation.

Very little of the disturbance associated with any alternatives for the Kensington Gold Project is in beach areas affected by the Juneau Access Road. Although the effects of the Kensington Project would be limited in these areas, the cumulative impacts from the Juneau Access Improvements Project on both terrestrial and marine wildlife species would include direct habitat loss, fragmentation, and disturbance from construction, maintenance, and vehicle traffic associated with the road. Marine birds would be affected by disturbance during the nesting season and migration use of the bay, and by loss of habitat. Terrestrial mammals would be affected by loss of habitat, habitat fragmentation, and mortality from vehicle collisions. For wide-ranging carnivores, the proposed access road would likely exclude movement between preferred habitat for species such as wolf and black and brown bear. The moose population could be adversely affected because much of the identified critical foraging habitat would be affected. Terrestrial birds would be affected by loss of habitat, nest disturbance, and edge effects. The existing roads within the project area might limit movement for some wildlife species currently, and similar effects would occur cumulatively as road traffic increases. However, if the Juneau Access Road was constructed, crew shuttle boat traffic would no longer occur. Limited barge traffic to Slate Creek Cove would still occur and therefore add cumulatively to the existing boat traffic using the bay.

Because no additional development is currently proposed, the Cape Fox/Seaalaska land exchange would not cause any cumulative effects on wildlife and their habitat.

The additional impacts associated with the projects described above would be additive to those predicted from the Kensington Gold Project and would encompass a much larger area. However, seasonal restrictions on barge traffic, as well as expansion of the existing small old-growth habitats under Alternatives B, C, and D, would increase habitat protection and connectivity between the beach fringe and higher-elevation areas, and other mitigation and monitoring associated with the Kensington Gold Project would limit the extent of the additive cumulative impacts within the Berners Bay watershed (see Tables 2-6 and 2-7).

4.21.11 Soils, Vegetation, and Wetlands

The Kensington Gold Project, combined with some or all of the other projects discussed in this section, would produce additional impacts on soils, vegetation, and wetland resources.

Soils

Reasonable and foreseeable impacts on soils would likely occur as a result of Goldbelt's development of Echo Cove and construction of both the Cascade Point Access Road and the Juneau Access Road. Road building would entail removing the top layers of soil and replacing them with suitable fill material. The removed soil would be stockpiled or used as fill elsewhere. There is also the potential that soils salvaged during the construction of the Juneau Access Road could be used for reclamation of the Kensington Gold Project, depending on the distance and timing of the projects. The result of road construction would be a complete loss of the resource within the footprint of the roadway. The Cascade Point Access Road would be shorter and narrower than the Juneau Access Road and therefore would cause a smaller impact. However, the two road alignments overlap for the length of the Cascade Point Access Road.

Construction of a lodge, housing, and related support facilities at Cascade Point would also affect soils within the footprint of the development. Construction typically requires that soil be stripped from foundation areas. The soil could be replaced following construction, limiting the extent of the permanent impact. Because the development would be confined to Goldbelt's 1,400-acre land holdings in Echo Cove, the impacts on soils, on a local and regional basis, would be minimal. The land exchange would not affect soil resources to any greater degree than that discussed for the Kensington Gold Project.

Vegetation

Vegetation would also be directly affected by construction of the access roads and the Echo Cove development. The Juneau Access Road project would permanently remove approximately 742 acres of primarily forested vegetation. The dominant species are typical in Southeast Alaska, and they include western hemlock, hemlock-spruce, and mixed conifer forests. Portions of the road would affect old-growth forests, including three OGHs in or near the Kensington Gold Project area. Indirect impacts from the construction of the road would include blowdowns, slope erosion, and firewood collection. Recreational users of areas immediately adjacent to the road would also affect vegetation. Similar impacts would result from the Echo Cove development, although on a much smaller scale.

The development at Echo Cove would also affect vegetation resources as a result of construction activities. Development of a lodge and housing would presumably take advantage of the natural setting by minimizing the amount of vegetation cleared in the construction process.

Extending mining activities to process additional ore would result in the expansion of the TSF and an increase in the water level. The final water level of the TSF would likely result in the two lakes combining into one, resulting in the inundation of a small amount of productive old growth on the west side of Upper Slate Lake. The remaining vegetation that would be affected would be primarily forested wetlands. In total, the expansion would likely result in the inundation of less than 100 additional acres, primarily forested wetlands.

The land exchange, as currently proposed, would not affect vegetation resources beyond the impacts discussed for the Kensington Gold Project. The extension of mining activities would result in a longer duration of impacts on vegetation. The road and mine could produce cumulative impacts on vegetation if the mine operations coincided with construction of the road. Although the road impacts would be permanent, the impacts from the mining operation would extend past the operational life of the mine until forest communities became reestablished. Recovery following reclamation would likely take 20 to 50 years. Reclamation of mining disturbances would have to minimize erosion off-site, but objectives would reflect the desires of the landowner(s).

Wetlands

The Kensington Gold Project would affect 268 acres under Alternative A, 187 acres under Alternative A1, 94.5 acres under Alternative B, 114 acres under Alternative C, and 96 acres under Alternative D. Construction of the Cascade Point Access Road would affect 2.5 acres of forested wetlands and 0.2 acre of a scrub-shrub/emergent wetland. The forested wetlands were rated high for "disturbance of sensitive wildlife" and "ecological replacement cost," and the scrub-shrub/emergent wetland was rated high for "regional ecological diversity" and "groundwater discharge." Other wetland functions received low to moderate ratings. If the entire development were to be built out as described in the Master Plan, impacts on an additional 5 acres of forested wetlands could occur.

Wetlands identified within the Juneau Access Improvements Supplemental Draft EIS project area include a mixture of palustrine and riverine scrub-shrub, forested, and emergent types, as well as an estuarine emergent area at the north end of Berners Bay. Value ratings for most of the Berners Bay wetlands are moderately high to very high (URS, 2004c). Construction of the road around Berners Bay would affect 18 individual wetlands between Echo Cove and Slate Creek. Most of the impacts (19.1 acres) would occur in palustrine forested wetlands; 3.4 acres of palustrine emergent wetlands and 0.7 acre of scrub-shrub wetlands would also be affected. Between Slate Creek and Point Sherman, construction would affect 59.2 acres of forested wetlands and 3.2 of emergent wetlands.

Direct impacts from highway construction would result from the placement of fill, causing the immediate loss of the habitat under the road prism. Wetland hydrology would be affected by the placement of fill, eliminating or reducing surface or shallow groundwater flow down-gradient of the road areas. In the vicinity of culvert outfalls, wetlands might actually receive more water than in their undisturbed state. These types of impacts would primarily produce a shift in species composition reflecting the new hydrologic condition, with upland species increasing in areas where hydrology has been altered and wetland species increasing where surface or subsurface flows increase. The severity of the impact would depend on the type of wetland affected. Forested wetlands typically support a mixture of obligate wetland species, as well as upland species. Wetland species would increase in wetter areas, and upland species would increase in drier areas. Palustrine emergent and scrub-shrub wetlands tend to support more obligate species and would undergo more noticeable changes in response to alterations of hydrology compared to forested areas. In most cases, the effects on species composition would be localized. The wetlands technical report supporting the Juneau Access Improvements Supplemental Draft EIS (URS, 2004c) states that the bridge crossing the head of Berners Bay has been aligned to avoid affecting estuarine emergent (salt marsh) wetlands.

The extension of mining activities would require the expansion of the TSF to hold the additional tailings, resulting in the inundation of additional wetlands. The final level of the tailings deposition and the ultimate TSF/lake level cannot be determined; however, it is likely that the level would cause the two lakes to combine into one. If that were the case, the extent of inundation around Upper Slate Lake would include an additional 12 acres of primarily palustrine emergent and forest wetlands around Upper Slate Lake. Palustrine forested wetlands and upland forest/wetland complex around the perimeter of the TSF would also be inundated with an increase in the water level of the TSF. The total acreage of forested wetlands and wetland complex inundated would be on the order of 100 acres.

Because no further development of the area is proposed, the land exchange would have no effect on wetlands beyond those discussed in relation to the Kensington Gold Project.

If all the above projects were to be implemented, the maximum cumulative effect on wetlands would be more than 400 acres under Alternative A, 320 acres under Alternative A1, 230 acres under Alternatives B and D, and 250 acres under Alternative C. Most of the wetlands affected by the Kensington Gold Project would eventually be restored to their previous condition, whereas wetlands filled for the Juneau Access Road would be permanently lost. Changes to the hydrologic regime along the road alignment would result in some gains and losses or other changes in wetlands immediately adjacent to the road. Specifically, under Alternatives B, C, and D, the cumulative effects would be distributed around Berners Bay in the middle to lower watersheds. These impacts would be distributed across a number of wetland types, and the total acreage represents a relatively small number on a regional basis. (The jurisdictional wetland delineation for the Jualin Project identified 3,298 acres of wetlands within that study area alone [ABR, 2000c].) In summary, although individual wetlands would be affected, losses of wetland diversity or function within the Sherman Creek and greater Berners Bay watershed would not be expected under any alternatives.

4.21.12 Land Use and Recreation

Alternatives A and A1 would have little impact on recreational use, although construction of the Juneau Access Road combined with the TSF would cause highly visible changes in the landscape viewed by cruise ship and ferry passengers in Lynn Canal. As documented in Section 4.13.3, Alternatives B, C, and D would have specific impacts on recreational use in Berners Bay. Although there would be very limited displacement of recreational users, they would be affected by the noise and visual effects of the project. If combined with other proposed projects in the study area, Alternatives B, C, and D would open up access to an area now classified as semi-primitive, which could dramatically alter the nature of the recreational experience.

The Juneau Access Road project would increase access to essentially the entire periphery of Berners Bay, as well as the Lynn Canal shoreline. The number of people using the area for hunting, fishing, camping, hiking, and other activities would increase with improved access. Although some of the current users would feel that the quality of their recreational experience had been diminished, others would consider the improved access a benefit.

Alternatives B, C, and D would have minimal recreational access effects in the Berners Bay area. Development of the Juneau Access Road project would require relocation of the Berners Bay Cabin across the bay, near Point St. Mary. Recreation mitigation measures would include construction of a new day-use structure to replace the cabin, trail heads, trails, scenic viewpoints, and day-use picnic areas (USDOT and ADTPF, 1997). These mitigation measures would improve access for recreation but would also change the nature of the recreational experience to a less primitive one, reducing the potential for experiencing solitude. Increased access to the area would increase possibilities for littering and degradation of the natural environment, disrupt bear viewing, and increase negative encounters between humans and bears.

Construction of the Cascade Point Access Road, marina, and public facilities would also increase access for recreation, although not to the same extent as the Juneau Access Road. The combination of a tourism lodge, convenience store, and marina could attract people to the area by car and boat. Ferries and other boat traffic would likely increase, altering the existing pattern of small motorboats and kayaks. People could begin living at the Cascade Point site, putting additional pressure on recreational resources. Providing access to Cascade Point could facilitate foot traffic to the Sawmill Creek estuary, located only a mile north of the point over relatively flat terrain. Increased recreational pressure at Sawmill Creek could affect the area's remote character. However, any formal improvement in access would need to be approved by the Forest Service and would require an environmental impact analysis. Hunting and fishing could be affected by direct impacts on fish and game populations or by the indirect impact of increased hunting and fishing pressure.

The proposed projects, including Alternatives B, C, and D, would cumulatively increase noise levels in the area, which would affect recreation in Berners Bay. An analysis of cumulative noise impacts from the Juneau Access Road and Cascade Point facilities showed no detectable increase in sound levels at Point Bridget State Park or Sawmill Creek; boaters in nonmotorized vessels traveling near the Cascade Point development would notice an increase in noise levels (Forest Service, 1998a).

The proposed projects, including Alternatives B, C, and D, would also have visual impacts that would alter the recreational experience in Berners Bay. The impacts are described under Visual Resources (4.21.13). In summary, the marine terminals at Slate Creek Cove and Cascade Point/Echo Cove and the daily boat traffic would be visible to recreational users. Portions of the Juneau Access Road would be visible from Berners Bay. The Cascade Point facilities would be most visible from Echo Cove because of their location on the south-facing slope. The plan to leave a strip of existing vegetation between the structures and Berners Bay would screen most of the facilities from the bay. The marine facility, breakwater, dock, and lodge structure would not be screened by vegetation and thus would be visible from the southern parts of the bay.

The land exchange would affect recreational opportunities because the area under consideration would come under private ownership. The change in ownership status would most directly affect the hunters who currently use the Forest Service lands adjacent to the proposed Kensington facilities.

4.21.13 Visual Resources

As noted in Section 4.21.12, the combined effects of the Alternatives A and A1 and the construction and operation of the Juneau Access Road would alter the visual landscape along the Lynn Canal Visual Priority Travel Route. Alternatives B, C, and D, if combined with the Cascade Point Access Road and public facilities and the Juneau Access Road, would result in a change in the character of Berners Bay. The remote nature of the bay, now frequented mostly by kayaks and relatively small motorboats, would be dramatically altered, with crew shuttles/ferries, commercial fishing boats, and other larger craft potentially becoming more prevalent. The predominantly natural-appearing shoreline would be broken by areas of development along the eastern and southern shores of Berners Bay, as well as the proposed project facilities at Slate Creek Cove and the project access road.

Most of the housing and other commercial structures planned at Cascade Point would be screened from the bay by existing vegetation but would be visible from Echo Cove because of the south-facing site. The exception would be the lodge structure, which would be above the beach cliff known as Echo Rock and thus would be visible from other portions of Berners Bay (Minch et al., 1996). The

Cascade Point facility would probably result in a moderate adverse visual impact, but it would also provide an excellent view of Berners Bay, Lynn Canal, and the Chilkat Range (USDOT and ADTPF, 1997). The eastern and northern shores of Berners Bay are within land use designation II and thus have a retention VQO. The Cascade Point facilities are on private land and thus would not need to conform to this VQO.

The Juneau Access Road would lie within the Transportation and Utility System LUD and therefore would need to conform to the Modification VQO for foreground views. Portions of the road would be visible from Berners Bay. Cuts and fills for the roadway would create a high visual impact at Sawmill Cove and other parts of the bay (USDOT and ADTPF, 1997). The section of road between Echo Cove and Cascade Point would not be visible from the bay (Forest Service, 1998a). The portion of the Juneau Access Road that follows the Lynn Canal shoreline should not be visible from the canal because it would be low on the slope and parallel to the shoreline with a vegetative buffer (Forest Service, 1997b).

The land exchange would not affect visual resources except those discussed for the Kensington Gold Project based on current status.

4.21.14 Socioeconomics

The Kensington Project would generate 253 jobs during operations under Alternative A and 237 jobs under Alternative A1. About 180 indirect jobs would also be created under Alternatives A and A1. Under Alternatives B, C, and D, 225 direct mining jobs and nearly 500 indirect and induced jobs would be generated. The only reasonably foreseeable project besides the Kensington Gold Project that would affect Juneau's economy would be the Juneau Access Road. It is unclear whether the Juneau Access Road could be completed within the projected life of the mine. Construction of the road could produce approximately 200 jobs, which could in turn create approximately 150 indirect jobs. Upon completion, the road would affect the economies of Juneau, Haines, and Skagway because consumers would have vehicular access into and out of Juneau. The Juneau Access Road Draft EIS indicates that nonresident spending in Juneau due to the road could result in an additional 200 jobs (USDOT and ADTPF, 1997). An extension of the Kensington operations into additional reserves would be more likely to extend the economic impacts on the CBJ (for a longer time) than to expand them.

4.21.15 Cultural Resources

The Cascade Point Access Road, Juneau Access Road, and Kensington Gold Project would each improve access to cultural resources that form part of the same regional fabric. Some of these resources are eligible for inclusion in the National Register of Historic Places, whereas others are not. People using the access roads or employed at the mine might not be aware of the location of specific resources and might not necessarily seek them out; however, the increased access to such resources could produce impacts related to intentional or unintentional visits. Cumulative impacts on these sites could damage the associative integrity of the sites and the cultural resources within the area as a whole. The land exchange could also improve access to these types of resources. Resources within the land exchange boundaries would become private property, losing some of the protection currently extended under federal jurisdiction.

4.21.16 Noise

Noise levels within Berners Bay in the absence of aircraft and vessels ranges from approximately 30 dBA in the forest with no wind to 60 dBA or more in the vicinity of a loud waterfall or moderate surf.

Depending on the size, engine type, and exhaust configuration, boats can produce noise in the range of 70 to 90 dBA. Therefore, people recreating in the forest surrounding Berners Bay would be more likely to experience lower noise levels than those recreating on the water. Water-based recreationists have the potential to be exposed to varying noise levels, depending on their location, weather conditions, and activities occurring in the vicinity.

The noise levels associated with helicopters used in employee transportation would have the greatest impact under Alternatives A and A1 with noise levels being heard throughout the Bay. The loudest levels of greater than 60 dBA would be heard under the flight path above the mouth of the bay. Under Alternatives B, C, and D, the greatest noise effects would be associated with the crew shuttle boat (80 dBA at 50 feet).

The development at Cascade Point, including the access road, would produce more noise on an ongoing basis than in predevelopment conditions. Light traffic on the Cascade Point Access Road would produce noise levels on the order of 40 dBA. Activities associated with a normal development would likely produce levels in the 50 to 70 dBA range based on a sample of noise ordinances (WDOE, no date; SMC, no date). These noise levels could be perceived within Echo Cove, depending on the ambient conditions. National Forest lands north of the development would absorb most noise in that direction; therefore, noises from the development would not be expected to carry north of Cascade Point and into the larger portions of Berners Bay.

The Juneau Access Improvements Draft EIS estimated annual traffic volume under the East Lynn Canal alternative at 210,000 vehicles, equating to 575 vehicles a day or 24 vehicles per hour. The noise level generated by traffic is dependent on volume and speed. For example, one truck traveling at 55 miles per hour (mph) sounds equivalent to 28 cars traveling 55 mph, and traffic traveling at 65 mph sounds twice as loud as traffic traveling at 30 mph (FHWA, 2004). Freeway traffic produces noise levels of approximately 70 dBA; trucks can reach 90 dBA. The extent of screening that would remain between the road and Berners Bay would play a large role in the perception of highway noise by users in the bay. Recreational users along the shoreline of the bay would likely perceive highway noise. The noise levels from the highway would be similar to those occurring under Alternatives B, C, and D of the Kensington Project. However, the noises from the highway would tend to be more regular, whereas noises from the mining operations would be more intermittent (i.e., occurring only during unloading of barges and operation of the crew shuttle).

The land exchange would not result in any increases in noise beyond the noise generated by the Kensington Gold Project operations because no other uses for that land are being proposed.

4.21.17 Transportation

The scope of the transportation analysis includes the transportation to the project site from Juneau; the off-site transportation, including the barge traffic using Lynn Canal; and the potential future use of the Cascade Point marine terminal by a high-speed ferry and the commercial fishing fleet. As discussed previously, transportation to and from the Kensington Gold Project site under Alternatives A and A1 would not affect Berners Bay.

Goldbelt has completed all logging activities at the Echo Cove development site that would require barge transport. Under the current Echo Cove master plan, the cumulative effects on transportation that could arise would be from construction of a high-speed ferry terminal and the use of the Cascade Point facilities by commercial fishermen. The master plan projects four north- and south-bound high-speed ferry trips per day from Echo Cove to Haines/Skagway. Even considering the crew shuttle operation associated with Alternatives B, C, and D, little cumulative effect is expected. Assuming 15 minutes for a one-way crossing of Berners Bay, four round trips for the potential high-speed ferry plus four round trips for the project crew shuttle would result in a total of 2 hours per day when a crew shuttle was operating in Berners Bay. The operation times of these boats could overlap, which would reduce the total length of time they would operate in the bay. In addition, the path of the high-speed ferry could be directed to minimize the period when the ferry would actually be in Berners Bay. Under Alternatives B, C, and D, the project crew shuttle would by necessity travel across Berners Bay between Cascade Point/Echo Cove and Slate Creek Cove.

The Juneau Access Road would likely affect the current transportation plan for all alternatives. With a highway along the east side of Berners Bay, personnel and some supplies could be transported to the Kensington site by vehicle rather than by ferry, barge, or helicopter. It is likely that barge shipments would continue to be used for large-volume shipments such as fuel and concentrate. The Juneau Access Road Draft EIS predicts daily traffic averages of 618 cars through the year 2005 and 1,429 cars between the years 2005 and 2025 for the proposed action (FHWA, 1997).

The extension of mining activities would extend the period for barge and crew shuttle activities in Berners Bay by another 4 to 5 years. It is unlikely that there would be an increase in traffic because an extension in mining activities would not require any change in employment or material supply levels from the previous operating period.

4.21.18 Subsistence

Subsistence uses are not currently documented for the project area. Therefore, none of the alternatives, combined with the other projects under consideration, would affect subsistence uses.

4.22 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

An irreversible commitment of resources applies primarily to the loss of nonrenewable resources (e.g., minerals or cultural resources) and resources that are renewable only over a long period of time (e.g., soil productivity). Irretrievable commitments apply to loss of production or use of renewable resources. These opportunities are foregone for the period of the proposed action, during which the resource cannot be used. These decision are reversible, but the utilization opportunities foregone are irretrievable. Table 4-38 presents the irreversible and irretrievable commitment of resources for the Kensington Gold Project.

Table 4-38
Irreversible and Irretrievable Commitment of Resources

Resource	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Air quality	No foreseeable or predicted irreversible or irretrievable commitments.	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Geology/ geochemistry	Irreversible commitment of 17.5 million tons of ore and 1.8 million tons of waste rock.	Irreversible commitment of 7.3 million tons of ore and very little waste rock.	Irreversible commitment of 7.3 million tons of ore and 1.8 million tons of waste rock.	Same as Alternative B	Same as Alternative B
Surface water hydrology	No foreseeable or predicted irreversible or irretrievable commitments.	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A

Table 4-38
Irreversible and Irretrievable Commitment of Resources (continued)

Resource	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Surface water quality	No foreseeable or predicted irreversible or irretrievable impacts.	Same as Alternative A	Same as Alternative A for the Sherman Creek drainage. Irretrievable impacts on water quality in the TSF during operations. Surface water quality would return to natural conditions within the TSF after closure.	Same as Alternative B	Same as Alternative B.
Groundwater hydrology	No foreseeable or predicted irreversible or irretrievable impacts.	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Groundwater quality	No foreseeable or predicted irreversible or irretrievable impacts.	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Aquatic resources: freshwater	Irretrievable loss of aquatic organisms (125 to 170 Dolly Varden char) in diverted portions of Ophir Creek.	Same as Alternative A	Same as Alternative A plus irretrievable commitment of Lower Slate Lake fish population (1,000 Dolly Varden char) during operations.	Same as Alternative B	Same as Alternative B
Aquatic resources: marine	Irretrievable commitment of intertidal habitats and organisms associated with Comet Beach terminal.	Same as Alternative A	Irretrievable commitment of intertidal habitats and organisms associated with Slate Creek Cove and Cascade Point. Irretrievable commitment of herring spawning habitat at Cascade Point.	Irretrievable commitment of intertidal habitats and organisms associated with Slate Creek Cove.	Same as Alternative B
Wildlife	Irretrievable commitment of wildlife habitat	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Soils, vegetation, and wetlands	Irreversible commitment of 72 acres of old-growth forest and 147 acres of wetlands. Irreversible commitment of 245 acres of soil.	Irreversible commitment of 72 acres of old-growth forest and 77 acres of wetlands. Irreversible commitment of 164 acres of soil.	Irreversible commitment of 25 acres of old-growth forest and 36 acres of wetlands at the TSF. Irreversible commitment of about 140 acres of soil until successful revegetation; 36 acres permanently affected by inundation in the larger TSF.	Same as Alternative B	Same as Alternative B

Table 4-38
Irreversible and Irretrievable Commitment of Resources (continued)

Resource	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Land use and recreation	No foreseeable or predicted commitment relative to land use or recreation.	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Visual quality	Irretrievable commitments related to visual quality in Lynn Canal during operation primarily related to the TSF.	Same as Alternative A	Irretrievable commitments related to visual quality in Berners Bay and Lynn Canal during operation, less impacts than Alternatives A and A1.	Same as Alternative B	Same as Alternative B
Socio-economics	No foreseeable or predicted irreversible or irretrievable commitments.	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Subsistence	No foreseeable or predicted irreversible or irretrievable commitments.	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Cultural resources	Irretrievable commitments of cultural resources at 11 sites eligible for listing in the National Register of Historical Places.	Same as Alternative A	Irretrievable commitments of cultural resources at 14 sites eligible for listing in the National Register of Historical Places.	Same as Alternative B	Same as Alternative B
Noise	No foreseeable or predicted irreversible or irretrievable commitments.	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A
Transportation	No foreseeable or predicted irreversible or irretrievable commitments.	Same as Alternative A	Same as Alternative A	Same as Alternative A	Same as Alternative A

Section 5

List of Preparers

SECTION 5.0
LIST OF PREPARERS

Preparer	Degree/Years of Experience	Project Role
Tetra Tech, Inc., Team		
Ronald Rimelman	B.S., Chemical Engineering Years of experience: 18	Project Manager
Gene Weglinski	M.S., Horticulture B.S., Botany Years of experience: 13	Deputy Project Manager/Soils, Vegetation and Wetlands
Eric Farstad	B.S., Meteorology Years of experience: 12	Air Quality
Susan Ernst Corser	M.U.P., Urban Planning M.A., Landscape Design B.A., Geology/Environmental Studies Years of experience: 17	Land Use/Visual Analysis
Richard Frechette	B.S., Geological Engineering Years of experience: 19	Geotechnical Engineering
Susan Hale	Years of experience: 24	Public Involvement
Alan Karnovitz	M.P.P., Public Policy B.S., Biology Years of experience: 21	Socioeconomics
Michael Kelly	M.S., Microbiology B.S., Fisheries Science Years of experience: 25	Marine Fisheries
Lisa Bithell Kirk	M.S., Geology B.S., Geology Years of experience: 20	Geochemistry
Charles Mobley	Ph.D., Anthropology/Archaeology M.A., Conservation Archaeology B.A., Anthropology Years of experience: 24	Cultural Resources
Patrick Mullen	M.A., Zoology/Wildlife Biology B.S., Biology Years of experience: 18	Wildlife Biology
Rob Naeser	M.S., Environmental Science B.A., Economics Years of experience: 6	Noise
Doug Rogness	M.S., Hydrology B.S., Geology Years of experience: 22	Hydrology/Hydrogeology
Walter Vering	M.S., Natural Resources B.A., Biology Years of experience: 10	Freshwater Fisheries
Steve Negri	M.S., Wildlife Ecology Years of experience: 11	Wildlife
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Preparer	Degree/Years of Experience	Project Role
U.S. Forest Service		
Steve Hohensee	M.S., Geology Years of experience: 15	Interdisciplinary Team Leader
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Myra Gilliam	B.A., Anthropology Years of experience: 8	Archaeology
Pete Schneider	B.S., Zoology Years of experience: 4	Fisheries Biology
Larry Rickards	B.S., Wildlife Mgmt Years of experience: 20	Wildlife Biology
Matt Phillips	B.S., Landscape Architecture Years of experience: 10	Landscape Architecture
Cynthia Lagoudakis	B.S., Forest Management Years of experience: 17	Recreation Forestry
Rick Turner	M.S., Ecology Years of experience: 8	Ecology
U.S. Environmental Protection Agency		
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Bill Riley	B.A., Human Biology Years of experience: 29	Formerly USEPA Mining Coordinator (now Environmental Assessment Office Director)
Hanh Gold	B.S., Electrical Engineering Years of experience: 10	NEPA Compliance Coordinator/USEPA Project Manager
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Alaska Department of Natural Resources		
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Preparer	Degree/Years of Experience	Project Role
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Carl Schrader	M.S., Biology Years of experience: 18	Fish and game

Section 6

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Section 7

Acronyms and Abbreviations

SECTION 7
ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ABA	acid-base accounting test
ACMP	Alaska Coastal Management Program
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADLWD	Alaska Department of Labor and Workforce Development
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation and Public Facilities
AEIS	Alaska Economic Information System
AHFC	Alaska Housing and Finance Corporation
AHRS	Alaska Heritage Resource Survey
ANILCA	Alaska National Interest Lands Conservation Act
BA/BE	Biological Assessment/ Biological Evaluation
BEA	Bureau of Economic Analysis
BMP	best management practice
CAA	Clean Air Act
CBJ	City and Borough of Juneau
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIL	carbon-in-leach
CMRI	Colorado Mineral Research Institute
CO	carbon monoxide
COPC	constituents of potential concern
C-Plan	Contingency Plan
CWA	Clean Water Act
cy	cubic yards
dB	decibel
dBA	A-weighted decibel
DTF	dry tailings facility
E	endangered
EA	Environmental Assessment
EFH	essential fish habitat
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
EVC	Existing Visual Condition
FEIS	Final Environmental Impact Statement
FLAG	Federal Land Manager's Air Quality –Related Values Work Group
FRP	Facility Response Plan
FSEIS	Final Supplemental Environmental Impact Statement
FY	fiscal year
GIS	geographic information systems
GMU	Game Management Unit
gpm	gallons per minute
ha	hectares
HDPE	high-density polyethylene
HPAH	high-fraction polycyclic aromatic hydrocarbon
ICRC	Integrated Concepts and Research Corporation
IMPLAN	Impact Analysis for Planning Model
ISCST-3	Industrial Source Complex Short-Term 3 Model
ISO	International Standards Organization

JUN	Jualin Mine District
km	kilometers
KVA	key viewing areas
kW	kilowatt
kWh	kilowatt-hour
lb	pound
lb/ft²	pounds per square foot
L_{dn}	day-night average noise level
L_{eq}	weighted noise equivalent
LUD	land use designation
m	meter
m^3	cubic meter
mbf	1,000 board feet
MgCl	magnesium chloride
mg/kg	milligram/kilogram
MIS	management indicator species
ML	Modified Landscape
MLLW	mean lower low water
MPRSA	Marine Protection, Research and Sanctuaries Act
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSHA	Mine Safety and Health Administration
msl	mean sea level
MW	megawatt
MWMT	meteoric water mobility test
NAAQS	National Ambient Air Quality Standards
ND	not detected
NEPA	National Environmental Policy Act
NH_4	ammonia
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_3	nitrate
NOI	Notice of Intent
NO_x	nitrogen oxides
NP:AP	neutralization potential-to-acidification potential ratio
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NTU	nephelometric turbidity unit
O_3	ozone
OGH	old-growth habitat
OHMP	Office of Habitat Management and Permitting
OPMP	Office of Project Management & Planning
ORV	off-road vehicle
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to 10 micrometers
PMP	probable maximum precipitation
POG	productive old growth
ppm	parts per million
PSD	Prevention of Significant Deterioration
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
ROI	Region of Influence
ROS	recreational opportunity spectrum
RS	Revised Statute
SAG	semiautogenous grinding
SAR	sodium absorption ratio
SC	specific conductance
SCR	selective catalytic reduction
SDWA	Safe Drinking Water Act
SEARHC	Southeast Alaska Regional Health Corporation

SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SO_x	sulfur oxides
SPCC	spill prevention, containment, and countermeasures
SPLP	synthetic precipitate leaching procedure
SPM	Semi-Primitive Motorized
SPNM	Semi-Primitive Non-Motorized
s.u.	standard units
SWMU	solid waste management unit
SWPPP	Storm Water Pollution Prevention Plan
T	threatened
TCLP	toxicity characteristic leaching procedure
TCP	traditional cultural property
TDS	total dissolved solids
TOC	total organic carbon
tpd	tons per day
TPH	total petroleum hydrocarbon
TSCA	Toxic Substances Control Act
TSF	tailings storage facility
TSS	total suspended solids
U.S.C.	United States Code
UA	use area
USDOC	United States Department of Commerce
USDOL	United States Department of Labor
UIC	Underground Injection Control
UPH	unaccompanied personnel housing
USACE	United States Army Corps of Engineers
USDOE	United States Department of Education
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VAC	Visual Absorption Capability
VMS	Visual Management System
VOC	volatile organic compound
VPTR	Visual Priority Travel Route
VQO	Visual Quality Objective
$\mu g/m^3$	micrograms per cubic meter

Section 8

Glossary

SECTION 8.0
GLOSSARY

100-year flood	A stream discharge that occurs on the average of once every 100 years.
Acid-base accounting	A test method to predict acid mine drainage. The “static” test compares a waste rock’s maximum potential acidity with its maximum neutralization potential.
Acid-generating potential	The long-term potential of a material or waste to generate acid, as related to acid mine drainage.
Acid mine drainage	Drainage of water from areas that have been mined for mineral ores. The water has a low pH because of its contact with sulfur-bearing material. Dissolved metals, including heavy metals, might be present. Acid mine drainage might be harmful to aquatic organisms and to drinking water supplies.
Acre-foot (ac-ft)	The amount of water that covers an acre of land to a depth of 1 foot; equal to 325,827 gallons.
Adit	A horizontal or nearly horizontal access tunnel into a mine from the surface.
Adsorb	To take up and hold by the physical or chemical forces of molecules.
Airshed	An area of land over which the pattern of air movement is influenced by major topographic features.
Alaska-Juneau (A-J) Project	Exploration work conducted by Echo Bay Exploration, Incorporated, at the old Alaska-Juneau Mine near downtown Juneau.
Alkaline	Having the qualities of a base; basic (pH greater than 7.0).
Alkaline chlorination	A treatment method by chemical reaction used to break down by chlorination the toxic cyanide radical (NC) into nontoxic sodium bicarbonate, nitrogen, sodium chloride, and water. This method can be used to treat mill effluent and tailings.
Alkalinity	A measure of the alkali content of a sample occasionally expressed as the number of milliequivalents of hydrogen ion that can be neutralized.

Alluvium	Material, including clay, silt, sand, gravel, and mud, deposited by flowing water.
Alternatives	For National Environmental Policy Act purposes, alternatives to the Proposed Action examined in an environmental impact statement or environmental assessment. The discussion of alternatives must "sharply [define] the issues and [provide] a clear basis for choice…by the decision maker and the public" (40 CFR 1502.14).
Ameliorate	To influence or alter conditions so as to cause improvement.
Anadromous	Describes fish that migrate upstream from salt water to fresh water to spawn (breed), such as salmon, some trout and char species, and shad. Also describes the fishery or habitat used for spawning by these species.
Ankerite	A mineral; a ferroan variety of dolomite (i.e., iron replaces the magnesium); Ca (Fe, Mg, Mn) $(CO_3)_2$.
Aquatic	Growing, living, frequenting, or taking place in water. In this SEIS, used to indicate habitat, vegetation, and wildlife in fresh water.
Aquifer	A zone, stratum, or group of strata acting as a hydraulic unit that stores or transmits water in sufficient quantities for beneficial use.
Aspect	The direction toward which a slope faces.
Attainment area	A geographic region within which National Ambient Air Quality Standards (NAAQS) are met. Three categories of attainment—Class I, Class II, and Class III—are defined by the level of degradation of air quality which may be permitted.
Ball mill	Equipment used to reduce ore particles to a finer size. It includes a large rotating cylinder partially filled with steel balls.
Barrel	A U.S. unit of measure equal to 42 gallons of petroleum.
Base drain	A drain for water at the bottom of an impoundment or a storm runoff catchment.
Base flow	A sustained or fair-weather flow of a stream.
Baseline data	Data gathered prior to the Proposed Action to characterize predevelopment site conditions.
Bathymetry	The measurement of depths of water in an ocean, lake, or sea.

Benthic	All underwater bottom terrain from the shoreline to the greatest deeps.
Berm	An earthen embankment; dike.
Best available control technology	Pollution control as defined by USEPA for a specific emission or pollutant stream and required for meeting pollution control regulations.
Bioaccumulation	Pertaining to concentration of a compound, usually potentially toxic, in the tissues of an organism.
Bioassay	The study of living organisms to measure the effect of a substance, factor, or condition by comparing before-and-after exposure or other data.
Biodegradable	Capable of being broken down by the action of living organisms such as microorganisms.
Biomass	The amount (weight or mass) of living material.
Biomonitoring	The use of living organisms to test the suitability of effluents for discharge into receiving waters and to test the quality of such waters downstream from the discharge.
Biota	All living material in a given area; often refers to vegetation.
Bond	An agreed-to sum of money which, under contract, one party pays another party under the condition that when certain obligations or acts are met, the money will be returned; an example is mining reclamation. *See* Reclamation guarantee.
Borough	An area incorporated for the purpose of self-government; a municipal corporation.
Borrow area	Source area for earthen construction material, such as sand and gravel, till, or topsoil used in construction or reclamation.
Breakwater	An offshore structure for breaking the forces of waves to protect a harbor or beach.
Cadmium	A tin-white, malleable, ductile, toxic, bivalent metallic element used in electroplating of iron and steel and in the manufacture of bearing metals.
Calcite	A mineral, calcium carbonate ($CaCO_3$). One of the most common minerals; the principal constituent of limestone.
Canopy cover	The spreading, branchy layer of forest vegetation.

Carbon-in-leach	A chemical process used to concentrate/beneficiate and recover gold from ore.
Carbon monoxide	A colorless, odorless, very toxic gas formed as a product of incomplete combustion of carbon.
Catchment area	The drainage area or basin drained by a river, stream, or system of streams.
Cathode	The negative terminal on an electrolytic cell; the electrode at which electrons enter a device from the external circuit.
Char	Fish that is closely related to trout. The char genus (*Salvelinus)* comprises Dolly Varden present in the project area.
Chlorite	A term used for a group of hydrous, sheet-like silicates of aluminum, iron, and magnesium.
Climax plant community	The stabilized plant community on a particular site. The relative composition of species does not change so long as the environment remains the same.
Closure	The final stage of mining, which involves closing all mine openings, regrading, and reclaiming.
Colluvial	Describes soil material that has moved downhill and has accumulated on lower slopes and at the bottom of a hill, consisting of alluvium in part and also containing angular fragments of the original rocks; i.e., cliff and avalanche debris.
Concentrate	The ore that contains the mineral sought following the concentration process (e.g., flotation, gravity).
Conductivity (electrical)	An electrical measurement to determine the amount of salinity or total dissolved solids in soils, surface water, and groundwater.
Cone of depression	The geometry or shape of an inverted cone on the water table or artesian pressure surface caused by pumping of a well. The cone of depression disappears over time after well pumping ceases.
Conifer	A broad classification of trees, mostly evergreens, that bear cones and have needle-shaped or scale-like leaves; timber commercially identified as softwood.
Copper	A red, ductile, malleable native metal found in hydrothermal deposits, cavities of basic igneous rocks, and zones of oxidization of copper veins.

Council on Environmental Quality (CEQ)	A body established by the National Environmental Protection Act (NEPA) to draft regulations for implementing and monitoring NEPA. CEQ regulations are presented in 40 CFR/Parts 1500–1508.
Cover	Living or nonliving material (e.g., vegetation) used by fish and wildlife for protection from predators and to ameliorate conditions of weather.
Criteria	Standards on which a judgment or decision can be based. Water quality criteria can be based on various standards, including aquatic life or human health.
Cubic feet per second (cfs)	One cubic foot per second (cfs) equals 448.33 gallons per minute.
Cumulative impacts	Combined impacts of past, present, and reasonable foreseeably future actions. For example, the impacts of a proposed timber sale and the development of a mine together result in cumulative impacts.
Cyanidation	A process of extracting precious metals such as gold by exposing prepared ore to a cyanide solution.
Cyanide solution	In commercial dissolution of gold from its ores, an alkaline aqueous solution of sodium cyanide or calcium cyanide.
Deciduous	Vegetation that sheds its leaves annually and replaces them following a period of dormancy.
Decommissioning	Suspension or closure of operations.
Deleterious	Hurtful, noxious, or destructive.
Demography	A statistical study of the characteristics of human populations with reference to size, density, growth, distribution, migration, and effect on social and economic conditions.
Depletion	Use of water in a manner that makes it no longer available to other users in the same system.
Deposit	A natural accumulation, such as precious metals, minerals, coal, gas, oil, and dust, that may be pursued for its intrinsic value; gold deposit.
Development	The work of driving openings to and into a proven ore body to prepare it for mining and transporting the ore.
Dewatering	The reduction of aquatic habitats by diversion of stream flow; removal of water from underground mine workings.

Diamond drilling	Rock drilling that makes use of a diamond-tipped drill bit. Often used when recovering a core sample of rock.
Dilution	The act of mixing or thinning and thereby decreasing a certain strength or concentration.
Diorite	A plutonic igneous rock composed of sodic plagioclase and hornblende, biotite, or pyroxene. Small amounts of quartz and orthoclase may be present.
Direct impacts	Impacts that are caused by the action and occur at the same time and place (40 CFR 1508.7). Synonymous with direct effects.
Discharge	The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second, million gallons per day, gallons per minute, or cubic meters per second.
Dispersion	The act of distributing or separating into lower concentrations or less dense units.
Diversion	Removing water from its natural course of location, or controlling water in its natural course of location, by means of a ditch, canal, flume, reservoir, bypass, pipeline, conduit, well, pump, or other structure or device.
Dry tailings facility (DTF)	A geotechnically engineered embankment used for the disposal of dewatered mine tailing.
Earthquake	Sudden movement of the earth resulting from faulting, volcanism, or other mechanisms within the earth.
Effluent discharge	Disposal of water previously used, as in a milling process.
Endangered species	Any species that is in danger of extinction throughout all or a significant portion of its range.
Environmental Impact Statement (EIS)	A detailed written statement of the potential environmental effects resulting from a action proposed by a federal agency required by section 102(2)(c) of the National Environmental Policy Act (40 CFR 1508.11).
Ephemeral stream	A stream channel that is normally dry; stream flow occurs for short periods of time in response to storm events.
Erosion	The wearing away of the land surface by running water, wind, ice, or other agents.
Escapement	The number of adult anadromous fish (e.g., salmon) that escape fishing pressure and enter their natal steams to spawn.

Estuarine	Of, relating to, or formed in a place where an ocean tide meets the current of a freshwater stream.
Exploration	The search for economic deposits of minerals, ore, gas, oil, or coal through the practices of geology, geochemistry, geophysics, drilling, shaft sinking, and/or mapping.
Fault	A displacement of rock along a shear surface.
Feasibility study	As applied to mining, a study that follows discovery of a mineral and is prepared by the mining company or an independent consultant. Its purpose is to analyze the rate of monetary return that can be expected from the mine at a certain rate of production. Based on this study, a decision to develop the ore body may be made.
Filter cake	Low-moisture-content solids that remain after the extraction of water by filtering or a mechanical belt press.
Fines	Fine particulate matter; specifically, particles less than 0.4 mm in diameter.
Fishery	All activities related to human harvest of a fisheries resource.
Flocculation	The addition of an agent to a settling pond that causes suspended particles to aggregate and settle out more rapidly than they would under natural conditions.
FLOOD	A computer model used to make independent estimates of storm rainfall and flood flows in ungauged (unmeasured) watersheds.
Flotation	An ore concentration process that separates ground ore from waste in a mixture of ore, water, and chemicals. When air is forced through the ore/water mixture, the chemicals cause certain minerals to adhere to the air bubbles and float to the top in a froth, thus effecting a separation.
Flotation circuit	The portion of the milling process where the flotation process occurs. *See* Flotation.
Flotation concentrate	The layer of mineral-laden foam built up at the surface of a flotation cell.

Forest Plan	Each of the National Forests administered by the USDA Forest Service is operated under a "Land and Resource Management Plan" as required by the National Forest Management Act of 1976. The 1976 Act was an amendment to the Multiple Use Sustained Yield Act of 1960 and the Forest and Rangeland Renewable Resources Planning Act of 1974. Forest plans are prepared under the authority of these acts. For the Tongass National Forest, the existing Forest Plan is the Tongass Land Management Plan, as amended in 1986. This plan is being revised.
Friable	Easy to break, or crumbling naturally. Used to describe certain rocks and minerals.
Fry	A recently hatched fish.
Fugitive dust	Dust particles suspended randomly in the air from road travel, excavation, or rock-loading operations.
Fugitive emissions	Emissions not caught by a capture system.
Furrow	A trench or ditch in the earth that might act as a watercourse for drainage or irrigation.
Geomorphic	Pertaining to the form of the surface of the earth.
Geotechnical	Related to branch of engineering that is essentially concerned with the engineering design aspects of slope stability, settlement, earth pressures, bearing capacity, seepage control, and erosion.
Geotextile	A synthetic fabric used in the construction of earthen structures, such as embankments, landfills, and roads.
Gill net	A flat net suspended vertically in the water with mesh that allows the head of a fish to pass but entangles its gill covers upon withdrawal.
Glacial float	Rock moved by glacial activity.
Glaciofluvial	Of, relating to, or coming from streams deriving much or all of their water from the melting of a glacier.
Grade	The content of precious metals per volume of rock (expressed in ounces per ton).
Gradient	The inclination or the rate of regular or graded ascent or descent (as of a slope, roadway, or pipeline).

Gypsum	A naturally hydrated calcium sulfate, $CaSO_4 \cdot 2H_2O$, white or colorless, sometimes tinted grayish, reddish, yellowish, bluish, or brownish. Insoluble in water; soluble in ammonium salts, acids, and sodium chlorides.
Habitat	The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting living conditions.
Hardness	Quality of water that prevents lathering because of the presence of calcium and magnesium salts, which form insoluble soaps.
Hazardous waste	By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity) or appears on special USEPA lists.
Heavy metals	A group of elements, usually acquired by organisms in trace amounts, that are often toxic in higher concentrations. Heavy metals include copper, lead, mercury, molybdenum, nickel, cobalt, chromium, iron, silver, and others.
Herbaceous	Lacking woody tissue; used to describe vegetation.
Heterogeneous	Not uniform in structure or composition.
Hydraulic barrier	An abrupt change in geology or soil type that inhibits the flow of water.
Hydraulic conductivity	A measure of the ability of soil to permit the flow of groundwater under a pressure gradient; permeability.
Hydrogen sulfide	A colorless, flammable, poisonous gas.
Hydrologic system	All physical factors, such as precipitation, stream flow, snowmelt, and groundwater, that affect the hydrology of a specific area.
Hydrophytic	Pertaining to aquatic plants that require an abundance of water for growth.
Impermeable	Having a texture that does not permit the passage of fluids through its mass.
Impoundment	The accumulation of any form of water in a reservoir or other storage area.
Incised	Cut into.

Increment	The amount of change from an existing concentration or amount, such as air pollutant concentrations.
Indigenous	Originating, developing, or produced naturally in a particular land, region, or environment; native.
Indirect impacts	Effects that are caused by the action and occur later in time or are farther removed in distance but are still reasonably foreseeable (40 CFR 1508.8). Synonymous with indirect effects.
Infauna	Aquatic animals living in and on soft bottom substrates.
Infiltration	The movement of water or some other fluid into the soil through pores or other openings.
Infiltration gallery	A horizontal well or subsurface drain that intercepts the underflow in permeable materials or the infiltration of surface water.
In situ	A Latin term meaning "in place," in the natural or original position.
ISOcontainer	A container that conforms to criteria established by the International Standards Organization for the transport of hazardous materials.
Jurisdictional wetland	A wetland area delineated or identified by specific technical criteria, field indicators, and other information for purposes of public agency jurisdiction. The public agencies that administer jurisdictional wetlands are the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, USEPA, and the USDA Natural Resources Conservation Service.
Land management plan	*See* Forest Plan.
Land Use Designation (LUD)	Designation that compels the Forest Service to manage lands "in a roadless state to retain their wildland character, but permitting wildlife and fish habitat improvement and primitive recreational facility development" (Tongass Land Management Plan, amended 1986). Management implications for LUD areas state that mineral development is subject to existing laws and regulations.
Lime	Calcium oxide. Sometimes used as an abbreviated name for any rock consisting predominantly of calcium carbonate.
Long-term impacts	Impacts that result in permanent changes to the environment. An example is a topographic change resulting from tailings disposal in a creek drainage.

Marine discharge	Disposal of mine water, treated sewage, and/or stormwater bypass.
Marine outfall	The mouth or outlet of a river, stream, or pipeline where it enters the sea.
Median	The value of the middle number of a data set such that half of the data values are greater than the median and half of the data values are less than the median.
Microclimate	The local climate of a given area or habitat characterized by uniformity over the site.
Migratory	Moving from place to place, daily or seasonally.
Milling	The act or process of grinding, extraction, or mineral processing.
Mine drainage	Gravity flow of water from a mine to a point remote from the mining operations.
Mines Safety and Health Administration (MSHA)	A federal agency under the Department of Labor that regulates worker health and safety in mining operations.
Minimum stream flow requirement	A set amount of water to be maintained in a watercourse for the purpose of reasonably maintaining the environment.
Mining plan	*See* Operating plan.
Mitigation measure	A step planned or taken to lessen the effects of an action.
Mixing zone	An area between an effluent discharge point and the associated water quality compliance monitoring station.
Modified Landscape	A Land Use Designation category in which users would view a somewhat modified landscape.
Monitoring	Continued testing of specific environmental parameters and of project waste streams for purposes of comparing with permit stipulations, pollution control regulations, mitigation plan goals, and so forth.
Multiple use	The management concepts under which National Forest lands are managed. It involves the management of resources in combinations that will best serve the public.
National Environmental Policy Act of 1969 (NEPA)	National charter for protection of the environment. It establishes policy, sets goals, and provides means for carrying out the policy. The regulations for implementing the act are at 40 CFR parts 1500–1508.

National Pollutant Discharge Elimination System (NPDES)	A program authorized by sections 318, 402, and 405 of the Clean Water Act, and implemented by regulations at 40 CFR part 122. The NPDES program requires permits for the discharge of pollutants from any point source into waters of the United States.
National Register of Historic Places (NRHP)	A list, maintained by the National Park Service, of areas that have been designated as being of historical significance.
NEPA process	All measures necessary to comply with the requirements of section 2 and Title I of NEPA.
New Source Performance Standards	Standards set by USEPA defining the allowable pollutant discharge (air and water) and applicable pollution control for new facilities by industrial category (Clean Air Act and Clean Water Act).
Nonpoint pollution	Pollution caused by sources that are nonstationary. In mining, nonpoint air pollution results from such activities as blasting and hauling minerals over roads, as well as dust from mineral stockpiles, tailings, and waste dumps prior to mulching and/or revegetation.
Oligotrophic	Having a deficiency in plant nutrients that is usually accompanied by an abundance of dissolved oxygen.
Operating plan	Plan submitted by the mining operator that outlines the steps the mining company will take to mine and reclaim the site. The operating plan is submitted prior to starting mining operations. Synonymous with the term mining plan (36 CFR part 228).
Ore	Any deposit of rock from which a valuable mineral can be economically extracted.
Ore body	Generally, a solid and fairly continuous mass of ore, which might include low-grade ore and waste as well as pay ore, but is individualized by form or character from adjoining rock.
Ore reserve	Ore of which the grade and tonnage have been established with reasonable assurance by drilling and other means.
Organic Act	The 1897 act that contains the basic authority for management of National Forests.
Organic matter	Matter composed of once-living organisms (carbon compounds).
Organism	A living individual of any plant or animal species.
Orographic effects	Pertaining to relief factors such as hills, mountains, plateaus, valleys, and slopes; usually used to describe weather patterns.

Outfall	A structure (pipeline) extending into a body of water for the purpose of discharging a waste stream, storm runoff, or water.
Oxide	A compound of oxygen with one or more elements or radicals.
Ozone	Form of oxygen (O_3) found largely in the stratosphere; a product of reaction between ultraviolet light and oxygen, or formed during combustion of hydrocarbon fuels.
Palustrine	Of, or relating to, shallow ponds, marshes, or swamps.
Palustrine forested	A forested wetland dominated by woody vegetation more than 20 feet tall.
Palustrine scrub-shrub	A wetland area dominated by woody vegetation less than 20 feet tall.
Paste backfill	The disposal of thickened mine tailings, after mixing with cement, in underground mines to provide wall or ground support.
Peak flow	Highest flow; can be quantified as daily or instantaneous.
Permeability	The capacity of a material for transmitting a fluid. Degree of permeability depends on the size and shape of the pores, their interconnections, and the extent of the latter.
pH	Symbol for the negative common logarithm of the hydrogen ion concentration (acidity) of a solution. The pH scale runs from 0 to 14, with a pH of 7 considered neutral. A pH number below 7 indicates acidity, and a pH value above 7 indicates alkalinity or a base.
Phyllite	A foliated metamorphic rock that is intermediate in composition and fabric between slate schist.
Physiography	A science that deals with the features and phenomena of nature; physical geography.
Piezometer	A device for measuring moderate pressures of liquids.
Piezometric head	The level to which a liquid rises in a piezometer, representing the static pressure of a waterbody.
Piezometric surface	Any imaginary surface coinciding with the hydraulic pressure level of water in a confined aquifer, or the surface representing the static head of groundwater and defined by the level to which water will rise in a well. A water table is a particular piezometric surface.

Plan of Operations	*See* Operating plan.
Plate filter	A filter used to remove gold precipitate from solution.
Point source	Stationary sources of potential pollutants. In terms of mining, some examples of point sources are crushing and screening equipment, conveyors, and pond outlet pipes.
Pollution	Human-caused or natural alteration of the physical, biological, and radiological integrity of water, air, or other aspects of the environment producing undesired effects.
Polychaete	Any of a class of mostly marine, annelid worms, having on most segments a pair of fleshy, leg-like appendages bearing numerous bristles.
Portal	The entrance to a tunnel or underground mine.
Potable water	Suitable, safe, or prepared for drinking.
Potentiometric surface	Surface to which water in an aquifer would rise by hydrostatic pressure.
Precious metal	Any of the less common and highly valuable metals: gold, silver, platinum.
Precipitation	The process of removing solid or liquid particles from a gas or smoke; the process of forming a precipitate from a solution (flocculation); rain, mist, snow, and the like.
Prehistoric	Relating to the times just preceding the period of recorded history.
Prescriptive mitigation	The rules or directive in place giving precise instructions on the abatement or alleviation of certain issues.
Prevention of Significant Deterioration (PSD)	Under the provisions of the federal Clean Air Act, a proposed new source of air pollution may be required to apply for a PSD permit if certain emission limits are expected to be exceeded.
Pristine	Pertaining to pure, original, uncontaminated conditions.
Probable maximum flood (PMF)	A flood calculated to be the largest probable under any circumstances.
Probable maximum precipitation (PMP)	The theoretical physical maximum amount of precipitation that could occur at a given point or location.

Process area	The area that encompasses the adit, mill, and processing facilities.
Process make-up water	Water required to make up for losses within the closed mill system.
Project area	The area within which all surface disturbance and development activity would occur.
Prospect	A property in which the mineral value has not been proven by exploration.
Public scoping	An early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).
Pycnocline	A gradient marking vertical changes in density.
Pyrite	A common mineral consisting of iron disulfide (FeS_2) with a pale brass-yellow color and brilliant metallic luster. It is burned to make sulfur dioxide and sulfuric acid.
Pyritic	Relating to or resembling pyrite, a common mineral; iron disulfide.
Quartz	A mineral, silicon dioxide (SiO_2), that next to feldspar is the most common mineral. It usually occurs in colorless, transparent crystals, but can be yellow, brown, purple, pink, or green.
Receiving waters	A river, lake, ocean, stream, or other watercourse into which wastewater or treated effluent is discharged.
Reclamation	Returning an area to a productive land use by regrading and reseeding areas disturbed during mining activity.
Reclamation guarantee	A binding commitment payable to a governmental agency in the event that decommissioning and reclamation of an operation is not completed according to an approved plan. *See* Bond.
Record of Decision (ROD)	A document that discloses the decision on an environmental impact statement and the reasons why the decision was made; it is signed by the official responsible for implementing the identified action. The environmental consequences disclosed in an EIS are considered by the responsible official in reaching a decision (40 CFR 1505.2).
Redox	A chemical reaction in which one component loses electrons (is oxidized) and another gains electrons (is reduced).

Residence time	The amount of time a receptor organism or object is in contact with a source.
Resident	A species that is found in a particular habitat for a particular time period (e.g., winter, summer, year-round) as opposed to species found only when passing through during migration.
Resource Conservation and Recovery Act (RCRA)	A 1976 act that is the primary law governing the regulation of solid and hazardous waste, as opposed to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund), which provides the government with the authority and funds to clean up active or abandoned sites when there is a release or substantial threat of a release of hazardous substance from a facility.
Richter Scale	A numerical (logarithmic) measure of earthquake magnitude.
Riparian	A type of ecological community that occurs adjacent to streams and rivers. It is characterized by certain types of vegetation, soils, hydrology, and fauna that are suited to conditions more moist than those normally found in the area.
Riprap	A layer of large rocks placed together to prevent erosion of embankments, causeways, or other surfaces.
Riverine	Of or relating to rivers, creeks, and streams.
Runoff	Precipitation that is not retained on the site where it falls and not absorbed by the soil; natural drainage away from an area.
Salinity	A measure of the dissolved salts in sea water.
Salmonids	Fish species (salmon, trout, and char) that belong to the same family; salmonidae.
Saturation	The extent or degree to which the voids in a material contain oil, gas, or water. Usually expressed in percent related to total void or pore space.
Section 10 Permit	A permit issued under section 10 of the Rivers and Harbors Act of 1899. Section 10 requires a permit for any structure or work that might obstruct traditionally navigable waters. This permit is issued by the U.S. Army Corps of Engineers.
Section 404 Permit	A permit issued under Section 404 of the Clean Water Act. Section 404 specifies that anyone wishing to place dredged or fill materials into the waters of the United States and adjacent jurisdictional wetlands must apply to the U.S. Army Corps of Engineers for approval.

Sedentary	Not migratory; staying in one place; stationary.
Sediment	Material suspended in liquid or air; also, the same material once it has been deposited by water.
Sediment basin	A pond, depression, or other device used to trap and hold sediment.
Sediment loading	The mass of solid erosion products deposited by or carried in water or air.
Sediment pond	Structure constructed by excavation or by building an embankment whose purpose is to retain water and allow for settlement of fines (suspended solids) and reduction in turbidity.
Seepage	The slow movement of gravitational water through the soil.
Selenium	A nonmetallic, toxic element related to sulfur and tellurium; a by-product of the electrolytic refining of copper.
Semiautogenous	Produced or created without external help or influence.
Sensitive species	A plant or animal listed by a state or federal agency as being of environmental concern; includes threatened and endangered species.
Sensitivity level	A measure of viewer interest in the scenic quality of the landscape.
Settling ponds	*See* Sediment pond.
Short-term impacts	Impacts occurring during project construction and operation, and ceasing upon project closure and reclamation.
Significant issues	Of the issues raised during the scoping process for an environmental impact statement, certain issues are determined to be “significant’ by the lead public agency. Determining which issues are significant, and thus meriting detailed study in the EIS, is the final step of the scoping process and varies with each project and each location. Significant issues are used to develop alternatives.
Slurry	A watery mixture or suspension of insoluble matter, such as mud or lime.
Sodium hydroxide	A common laboratory reagent that is strongly alkaline when in solution with water.

Solid waste	Garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities.
Spawn	To produce or deposit eggs or sperm; the eggs or sperm product (fish reproduction).
Spill Prevention, Containment, and Countermeasure (SPCC) Plan	A plan that USEPA requires of facilities storing more than a given threshold of fuel or hazardous material. It is a contingency plan for avoidance of, containment of, and response to hazardous materials spills or leaks.
Stockpiling	Storage of soils or rock material.
Stope	An excavation in a mine made for the purpose of extracting ore.
Stoping	A process by which ore is excavated in an underground mine; removal of ore from an underground excavation (stope).
Stormwater	Overland flow generated as the result of a storm event.
Strata	A tabular mass or thin sheet of earth of one kind formed by natural causes usually in a series of layers of varying makeup; sedimentary units.
Stream channel geometry	The cross section of a stream channel (end view).
Stream flow	The discharge (flow of water) in a natural channel.
Stream gradient	The rate of fall or loss of elevation over the physical length of a segment or total stream usually expressed in feet change per feet in distance (%).
Study area	The zone around the project area within which most potential direct and indirect effects on a specific resource would occur.
Subaqueous	Living, formed, or found under water.
Subsidence	A local lowering of land surface caused by the collapse of rock and soil into an underground void or by the removal of groundwater; it can result in stability failures such as landslides and mine roof cave-ins.

Subsistence use	Section 803 of the Alaska National Interest Lands Conservation Act defines subsistence use as follows: "The customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of the non-edible by-products of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade."
Substrate	An underlayer of earth or rock.
Succession	Changes in the plant communities composing an ecosystem as the ecosystem evolves from one type to another; e.g., wetland becoming grassy meadows.
Sulfide	A compound of sulfur with more than one element. Except for the sulfides of the alkali metals, the metallic sulfides are usually insoluble in water and occur in many cases as minerals.
Sump	In the case of an underground mine, an excavation made underground to collect water, from which water is pumped to the surface or to another sump nearer the surface.
Surficial	Characteristic of, relating to, formed on, situated at, or occurring on the earth's surface; especially, consisting of unconsolidated residual, alluvial, or glacial deposits lying on the bedrock.
Synchronous	Recurring or operating at exactly the same periods.
Tailings	The noneconomic constituents of the ground ore material that remain after the valuable minerals have been removed from raw materials.
Taxa (taxon)	Any group of organisms, populations, or the like considered to be sufficiently distinct from other such groups to be treated as a separate unit.
Terrestrial	Of or relating to the earth, soil, or land; an inhabitant of the earth or land.
Thermistor	A resistor made of semiconductors having resistance that varies rapidly and predictably with temperature.
Threatened species	A plant or wildlife species that is officially designated by the U.S. Fish and Wildlife Service as having its existence threatened and is protected by the federal Threatened and Endangered Species Act.

Tideland	Land that is overflowed by the tide but exposed during times of low water.
Till	Nonsorted, nonstratified sediment carried or deposited by a glacier.
Timber slash	Noneconomic timber refuse that is cut but remains in the area after timber harvest.
Topography	The physical configuration of a land surface.
Toxicity tests	Laboratory analyses generally used to determine the degree of danger posed by a substance to animal or plant life.
Trace metals	Metals present in minor amounts in the earth's crust (trace elements).
Transect	A sample area in the form of a long, narrow, continuous strip that is used for the tabulation of data.
Transmissivity (coefficient of)	A measure of the ability of an aquifer to transmit water.
Turbidity	Reduced water clarity resulting from the presence of suspended matter.
Unavoidable effects	Effects that cannot be eliminated. Many effects that could occur from a project can be eliminated or minimized by management requirements and constraints and mitigation measures. The remaining effects are considered unavoidable.
Understory	A foliage layer lying beneath and shaded by the main canopy of a forest.
Vein	A mineralized zone having a more or less regular development in length, width, and depth. Commonly dipping at a steep angle to the horizontal.
Visual Quality Objective (VQO)	Objective identified by the Forest Service for management of the visual resources.
Visual resources	The visual quality of the landscape. The Forest Service manages viewsheds as a resource, establishing specific management objectives for different areas of Forest Service land.
Waste rock	Also known as development rock, waste rock is the non-ore rock extracted to gain access into the ore zone. It contains no gold or gold below the economic cutoff level.
Water balance	A measure of continuity of water flow in a fixed or open system.

Watershed	The entire land area that contributes water to a particular drainage system or stream.
Waters of the United States	All waters that are currently or could have been used in interstate or foreign commerce, including waters that are subject to the ebb and flow of the tide; wetlands; and lakes, rivers, streams, mudflats, sandflats, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds.
Weathering	The process whereby larger particles of soils and rock are reduced to finer particles by wind, water, temperature changes, plant and bacteria action, and chemical reaction.
Wetlands	Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.
Wilderness	Land designated by Congress as a component of the National Wilderness Preservation System.
Xanthates	A class of chemicals known as “collector” chemicals that attach to floating minerals, making them normally incapable of adhering to the froth in a flotation circuit.

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Section 10

List of Recipients

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LIST OF RECIPIENTS

Bruce Abel

Donald B. Abel, Jr.

Nicole and Jesse Ackmann

Glenn Adams

Eunice Akagi

James W. Akins

David Albert

Steven J. Allwine
Endenhall Auto Center

Dale Anderson
Admiralty Tours

Thomas Andriesen

Don Argetsinger
Koniag

Sheila M. Arkell

William Ashby

Bruce Baker
Natural Resource Consultant

James W. Balsiger
NOAA/NMFS

Stan Beadle

Vivian L. Bearden

Larry Beck

James Becker

Jane Bell

Marsha E. Bennett
Airport Shopping Center

Jim Bentley

Barry Bergdoll
URS

Douglas B. Berringer, Jr.

Anissa Berry-Frick

Bruce Berryhill

Lucinda and Wayne Bertholl

Barbara Bigelow

Carolyn Bishop

Janine Blaeloch
Western Land Exchange Project

Marilyn Blair
Cape Fox

Norman and Patricia Blank

Karen Blejwas

Doug Blumer
NC Machinery Co.

Steven Borell
Alaska Miners Assoc.

Cindy Bowhay

Aaron Brakel

Judith Brakel

Floyd Branson

Floyd Branson

Clint Brenner

Karen Brewer Tarver

Tom Brice
AWP

Ray Briggs
Gee Whiz Ent.

Emma Brown

William Brown

Benjamin Browne

Jason Brune
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Rhonda Burnham
Harbor Bar

Douglas Burringer

Todd Buxton

Jim Calvin
Mcdowell Group

Jim Cameron
Cameron Plumbing and Heating

Patty Campbell

Scott Carey
Lynn Canal Conservation, Inc.

Becky Carls

Paul Carlson

Stephen Carlton

R. David Carnes, P.E.

Daren L. Case

Mike Case
Haines Borough, Mayor

Cindy Cashen

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Travis Church

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Janet Craig

Laurie Craig

Chuck Craig

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Murray Damitio

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Karen Doxey

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Art Dunn

Gary Eddy

Larry Edwards

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Alaska Juneau Communications, Inc.

George Elgee
Elgee Reheld Mertz LLC

Andrew Eller

Thomas Ely

Joann Erskine

Robert Fagen

Laurie Fagnani
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Doniece Falcon

Michael Fenster

Eric Ferrin

Emily Ferry

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Thea Hale

Tim Hall

Robert Hamilton
Kootznoowoo

Edward Hamlie

Dave Hanna

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Karen Hansen
Coeur Alaska, Inc.

Kathy Hansen
Southeast Alaska Fisherman's Alliance

Ronald Hansen
Hansen Engineering, L.L.C.

James Hanson

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Gee Whiz Ent.

Irene Haralabatos

Jerry Harmon
AJ Mine/Gastineau Mill

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Gene Harrison

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Taku Conservation Society

Sherry Hassell

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Lynden

Clayton Hawkes

Jesse Hay

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Haines Chamber of Commerce

Gary Hess

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Marion Hobbs

Paul M. Hoffman

Family Hoffmeister
Hoffmeister Entertainment

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Eric Holle

Kevin Hood

Betsy Hooker

Jacqueline Hudson

John Hudson
Friends of Berners Bay

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R.L. Hurley

John Hyde

Harold D. Iler

Gordon Jackson
Tlingit and Haida Indian Tribes of Alaska

Jerry D. Jacobsen

Gary Jacobson

Zachary Jacobson

Howard R. Jaeger
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Lynden

Solan Jensen
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Sidney Jeremy
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Kelly Jesup

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Gerry Landry
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Ed Lapeyri
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Diana and Pete Lapham
Chelkat Snowburners

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John Leeds
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Joyce Levine

Walton Levine

Stephen Lewis

Gary Lidholm
Port Chilkoot Bible Church

Erik Lie-Nielson

Julia Lilloughby

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Lil Lundy

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Lynn Miller
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Rosa Miller
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Kake Tribal Corporation

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Sidney Moffatt

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Robert Venables

Laura Vidic

Steve Virg-In

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Gee Whiz Ent.

Tom Waldo
Earthjustice

Karen L. Walker
Women Sail Alaska

Lynda Walker

Phillip Walker

Darlene and Russ Walton

Jennifer Wanamaker

Randy Wanamaker

Sam Wanamaker

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Michael Ward
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Tom Ward
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Theodore Ward

John B. Warder, Jr.

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Nancy Waterman

Dennis and Chloe Watson
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MajaBritt Watters

Larry Welp

David Werner

Bruce B. Weyhrauch
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White Construction

John White

Kevin White

Jeremy Whitmore
AJ Mine/Gastineau Mill

Jeremy, Ursala and Vespasia Whitmore

Mike Wiley

George Williams

Lew Williams

Thomas C. Williams

James Williams

Mary F. Willson

Dorothy S. and Jim Wilson

Jim Wilson
Coastal Helicopter, Inc.

Woody Wilson

Brad, Darnell, John, and Teri Winge

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Aldrick and Alison Withrow
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Chris Wyatt
Juneau Chamber of Commerce

James M. Young
Juneau Ecomonic Development Council

Michelle & Adam Zenger

SUMMARY

The Kensington Gold Project is an underground gold mine approximately 45 miles north-northwest of Juneau, Alaska. The recent history of the Kensington Gold Project began in 1990 when the Kensington Venture (a joint venture between Coeur Alaska, Inc. [Coeur] and Echo Bay Exploration) submitted plans to develop the mine to the U.S. Department of Agriculture, National Forest Service, Juneau Ranger District (Forest Service). The Forest Service completed the *Kensington Gold Project Final Environmental Impact Statement* (1992 FEIS) and Record of Decision (ROD) in 1992 evaluating the environmental impacts that could arise from the project and identifying an alternative to permit.

The selected alternative (Alternative F, Water Treatment Option 1) would have used underground techniques to recover the ore, processed the ore on-site using flotation and cyanidation circuits, and disposed of the tailings in a tailings impoundment built in the Sherman Creek drainage. The impoundment would have been sized to accommodate 30 million tons of tailings. The proposal included discharging wastewater to Lynn Canal following treatment and shuttling employees to the mine site using helicopters. The operation would have used liquefied petroleum gas to fuel on-site generators. A marine terminal developed at Comet Beach in Lynn Canal would have handled supply deliveries and gold shipments. The Kensington Venture never obtained all the permits necessary to build the mine, and in 1995 Coeur became the sole stakeholder in the property. Coeur then submitted an Amended Plan of Operations to the Forest Service in September 1995.

In June 1996 Coeur revised the Amended Plan of Operations it had submitted in 1995 in response to issues raised during scoping and at meetings with state and federal agencies. The revised plan was analyzed in the *Kensington Gold Project Final Supplemental Environmental Impact Statement* (1997 SEIS) and approved in a ROD signed in August 1997. The 1997 SEIS considered Coeur's proposal for off-site processing of flotation tailings and the use of a 20 million-ton dry tailings facility (DTF) rather than the Sherman Creek tailings impoundment for tailings disposal. The proposal included using diesel instead of liquefied petroleum gas to fuel generators, and discharging mine water to Sherman Creek and DTF effluent to Camp Creek. Coeur obtained all permits necessary for construction from federal, state, and local authorities under what became an approved Plan of Operations.

Coeur has not yet constructed the mine. To improve efficiency and reduce the extent of disturbance of the approved project, Coeur submitted an amended Plan of Operations (Amended Plan) to the Forest Service in early November 2001. The 2001 Amended Plan forms the basis for this Final Supplemental Environmental Impact Statement (SEIS). The Amended Plan proposes a number of changes to the approved plan, including changing the location of the processing facilities, tailings disposal, and site access and employing a different means of transportation. The operation would also mine a smaller portion of the ore body containing a higher average gold concentration than that proposed under previous iterations. The Amended Plan also proposes to use a dock to be built at Cascade Point on property held by Goldbelt Incorporated, an Alaska Native corporation.

The Forest Service has determined that a decision on the Amended Plan would be a major federal action requiring an SEIS under the National Environmental Policy Act (NEPA). The Council on Environmental Quality issues NEPA regulations and guidelines. According to requirements defined under Chapter V, Council on Environmental Quality (40 CFR Part 1500), this final SEIS analyzes and discloses the direct, indirect, and cumulative impacts associated with the proposed changes to the

approved Plan of Operations. The document is intended to supplement the 1997 SEIS and 1992 FEIS, although information from those documents has been brought forward into this document to the extent practical to make it easier for the reader.

This summary briefly describes the contents of the final SEIS as follows:

- Section 1, Purpose and Need for the Proposed Action, describes the project revisions as proposed by the operator; discusses the need for the SEIS and other federal, state, and local permits; and identifies issues raised during the scoping process and addressed in this analysis.
- Section 2, Description of Proposed Action and Other Alternatives describes how the alternatives were developed, discusses the revised proposal offered by the operator, and identifies the other alternatives under consideration.
- Section 3, Affected Environment, provides updated and supplemental information collected since publication of the 1992 FEIS on the physical and biological environment and socioeconomic conditions that would be affected by the alternatives.
- Section 4, Environmental Consequences, describes the potential environmental consequences of all the alternatives.

This summary provides an overview of the SEIS, including important information from Sections 1 through 4. The body of the final SEIS provides more detailed information. The planning record provides additional documentation of the environmental analysis beyond the information in the 1992 FEIS and the 1997 SEIS. The planning record is available to the public from the Juneau Ranger District Office in electronic format (on a CD-ROM).

PURPOSE AND NEED FOR ACTION

The purpose of the proposed action is to consider certain changes to the 1998 approved Plan of Operations for the Kensington Gold Project regarding access, tailings disposal, and support facilities. The proposed action is needed to improve efficiency and reduce the area of surface disturbance and other environmental impacts. The proposed action would provide more reliable all-weather transportation with greater worker safety compared to the approved project. The improved reliability of access would allow the operator to reduce fuel storage, as well as inventories of materials and supplies. Tailings disposal would require a smaller area of disturbance under the proposed action compared to the approved plan and would be more cost-effective.

The Forest Supervisor of the Tongass National Forest is the responsible official for this decision. The Forest Supervisor's decision is documented in the accompanying ROD. As cooperating agencies, the U.S. Environmental Protection Agency (USEPA) and U.S. Army Corps of Engineers (USACE) will also issue RODs prior to issuing their final permits for the Kensington Gold Project.

The Forest Service and cooperating agencies solicited input from the public during a scoping period early in this process. Two scoping meetings were held—one in Juneau on September 19, 2002, and one in Haines on September 21, 2002. Based on comments received during the scoping period, the following significant issues were identified:

- Issue 1: Mine-related transportation would affect users of, and resources in, Berners Bay.
- Issue 2: Construction and operation of the tailings disposal facility and other mine facilities would affect aquatic resources from Slate and Johnson creeks to Slate Creek Cove and Berners Bay.
- Issue 3: The Lower Slate Lake tailings storage facility (TSF), docks, access road, and other mine facilities would affect the scenic character of Berners Bay for recreationists.

The draft SEIS was released to the public for comment on June 23, 2004. Public meetings were held in Juneau on February 24, 2004, and in Haines on February 26, 2004. The Forest Service received 1,415 individual comments on the draft SEIS, which have been considered in developing this final SEIS.

Compliance with other laws is normally guaranteed through a separate permitting process that begins after a preferred alternative is selected and approved. The Kensington Gold Project would require major permits or approvals from the following agencies:

Federal

- Forest Service (Amended Plan of Operations approval)
- USEPA (Amended National Pollutant Discharge Elimination System [NPDES] permit)
- USACE (Clean Water Act Section 10 and Section 404 permits)
- National Marine Fisheries Service (*Endangered Species Act* and *Magnuson-Stevens Fishery Conservation and Management Act* compliance)
- U.S. Fish and Wildlife Service (*Endangered Species Act, Migratory Bird Treaty Act,* and *Bald Eagle Protection Act* compliance)

State

- Alaska Department of Natural Resources (ADNR) (Title 41 authorizations [fish passage], water rights authorizations, coastal zone consistency review, tideland leases, approval of dam construction and operation)
- Alaska Department of Environmental Conservation (NPDES and Section 404 permit certifications, Air Quality Control Permit)

City and Borough of Juneau (Allowable Use Permit)

On June 21, 2004, USEPA and the State of Alaska issued draft permits and USACE issued a public notice for permits for the proposed action. Public comments received on the permits and notice have been considered in preparing this final SEIS, as appropriate.

DESCRIPTION OF ALTERNATIVES, INCLUDING THE PROPOSED ACTION

NEPA requires the Forest Service to consider alternatives to the Proposed Action that address the significant issues identified during scoping. The alternatives can alter or reduce the magnitude of potential environmental impacts associated with the Proposed Action. The 1992 FEIS broadly covered a range of issues related to the entire Kensington Gold Project, along with potential options for many project components. The 1997 SEIS analysis focused on alternatives related specifically to the changes proposed at that time. Likewise, the analysis in this final SEIS focuses on changes to the Plan of Operations approved in 1997.

A NEPA analysis includes a No Action Alternative, which, if selected, would maintain the status quo. The No Action Alternative in the 1992 FEIS reflected a no build alternative; its selection would have denied the Plan of Operations, resulting in no mine being built. Because this final SEIS is a supplement to a NEPA analysis that resulted in a permitted project (the 1997 Plan of Operations), the No Action Alternative in this case represents no changes to the approved project. The significant issues are addressed in the discussion of the No Action Alternative and Alternative C, Dock Location and Design/Diversion. This final SEIS also includes an alternative (Alternative A1) that reflects a mining scenario that could occur if the No Action Alternative was selected. Alternative A1 represents one potential operating scenario under the approved Plan of Operations if the operator chose to lower the production rate and pursued a smaller portion of "high-grade" gold ore similar to what is included in the Proposed Action. The following discussion summarizes the project alternatives studied in detail.

Alternative A: No Action

The No Action Alternative functions as the baseline against which the effects of other alternatives are compared. As noted above, the No Action Alternative reflects a previous action, which in this case is the project identified in the ROD issued for the 1997 SEIS. Alternative A corresponds to the 1997 SEIS Alternative D. This alternative includes underground crushing of ore with aboveground grinding and flotation. Flotation concentrate would be shipped to a processing facility off-site. There would be no on-site cyanidation circuit. Employees would be housed on-site and transported by helicopter for weekly rotations. Supplies, including fuel, would be delivered to a marine terminal on Comet Beach. Tailings would be dewatered before being placed in the DTF. The DTF would have the design capacity to hold 20 million tons of tailings and would include an engineered berm around each cell of the facility. The production rate would be 4,000 tons of ore per day and 400 tons of waste rock per day. The waste rock would be used in the construction of the DTF. Road and DTF construction would require the development of sand and gravel and till borrow areas.

Alternative A1: Reduced Mining Rate, DTF

Alternative A1 illustrates the impacts that might occur if the No Action Alternative was selected under current economic conditions. Alternative A1 reflects a mining plan similar to that described for Alternative A but uses a mining rate and tailings production levels consistent with the Proposed Action (2,000 tons per day and 7.5 million tons total, respectively). Because the costs and revenues under this scenario do not directly correlate with those of Alternative B or C, this alternative represents one of the outcomes that could occur if Alternative A was selected.

Alternative A1 would result in 4.5 million tons of tailings being placed in the DTF, assuming that 40 percent of the tailings would be backfilled. The DTF would be approximately 65 percent smaller than it would be under Alternative A. The reduced mining rate presented under Alternative A1 would produce very limited amounts of waste rock. Because waste rock would not be available for use in DTF construction under this alternative, the impact analysis assumes the same number of acres of sand and gravel borrow areas would be required as under Alternative A, although the coarse and fine till borrow area would be reduced in size. Other aspects of Alternative A1, including transportation of employees and materials, would be the same as those described under Alternative A. The life of the operation would be reduced to 10 years following 2 years of construction.

Alternative B: Proposed Action

Alternative B reflects a number of changes to the mine plan compared to the No Action Alternative, including constructing a TSF in Lower Slate Lake, relocating milling operations to the Johnson Creek drainage, and eliminating the personnel camp. The operation would mine a smaller amount of ore with a higher average gold concentration compared with that proposed under Alternative A. Alternative B would include the development of a tunnel connecting the Kensington and Jualin areas of the mine. Access to the site would be from marine terminals built in Slate Creek Cove and at Cascade Point. A daily shuttle boat service would transport employees to and from the project site. The TSF would be sized to accommodate the disposal of 4.5 million tons of tailings. Borrow areas would need to be developed for construction of the TSF dam and roads. The production rate would be approximately 2,000 tons of ore per day. This alternative includes recycling water from the TSF to the mill circuit. Alternative B would require upgrading the 5-mile-long access road and constructing a 3.5-mile pipeline access road and a 1-mile cutoff road connecting the other two roads.

Alternative C: Dock Location and Design/Diversion

Alternative C would include a dock in Echo Cove, approximately 0.75 mile north of the existing Echo Cove boat ramp. Mine workers would use this dock to reach the shuttle boat that would transport them to the dock at Slate Creek Cove. The landing craft ramp at the Slate Creek Cove marine terminal would be eliminated, minimizing the amount of fill placed in the intertidal zone. Alternative C would not include recycling water from the TSF and the mill circuit. This alternative would include diversion channels to direct the flow from Mid-Lake East Fork Slate Creek and overland runoff from undisturbed areas around the TSF. The diversion would discharge to a spillway at the top of the TSF dam. The diversions would require a dam on Upper Slate Lake to maintain water levels sufficient to reach the spillway at the TSF dam. The purpose of the diversion would be to minimize the volume of fresh water in contact with the tailings. The remaining project components, including the production rate of 2,000 tons per day of ore and the access tunnel, would be the same as those under Alternative B.

Alternative D: Modified TSF Design and Water Treatment

Alternative D was developed subsequent to publication of the draft SEIS to address concerns about the TSF effluent meeting NPDES permit limitations intended to protect downstream water quality in East Fork Slate Creek below the TSF. Alternative D includes a dam in Mid-Lake East Fork Slate Creek that would gravity-feed a pipeline diversion around the TSF. Water would be pumped from the TSF to a reverse osmosis treatment system, which would provide solids and metals removal to ensure compliance with permit limits. The treatment system would discharge to the diversion pipeline. Alternative D also includes a cover over the tailings unless the operator can demonstrate that the tailings would not cause toxicity after closure. The remaining project components would be same as those under Alternative B.

COMPARISON OF ALTERNATIVES

The analysis considers the individual components of each alternative in determining the extent to which the various resources would be affected. Ultimately, the significant issues identified during the scoping process form the basis for the comparison and evaluation of the alternatives.

MITIGATION AND MONITORING

Mitigation measures are designed to ensure that environmental impacts would be minimized during construction, operation, and closure of the Kensington Gold Project. A number of mitigation measures have either been included in the 2001 Amended Plan or identified in developing this final SEIS. These mitigation measures and potentially others would be put in place when the Plan of Operations is finalized and as part of other permits and approvals. The purpose of the mitigation measures, including best management practices, would be to minimize impacts on resources, including air quality, water quality, aquatic life, and cultural resources. A monitoring plan developed in conjunction with the mitigation requirements would measure the effectiveness of the mitigation activities and identify any need for additional safeguards.

AFFECTED ENVIRONMENT

The analysis presented in this final SEIS is based on detailed baseline data collected from prior to the 1992 FEIS through 2003. The following are some of the key pieces of baseline data:

- Acid-base accounting of the ore body, waste rock, and tailings indicates a low potential for acid generation.
- The major creeks in the study area (including Sherman, Slate, and Johnson creeks) support resident Dolly Varden char and anadromous fish populations, although barriers within 2,000 feet of the mouth of each creek limit anadromous use. An estimated 60,000 pink salmon entered Johnson Creek in 1999, along with nearly 15,000 chum and 650 coho salmon.
- Spawning habitat for the depressed Lynn Canal Pacific herring stock includes the eastern shore of Berners Bay.
- Lower Slate Lake supports a resident population of approximately 1,000 Dolly Varden char within a littoral zone limited by the contour and depth of the lake.
- Large numbers of seabirds, shorebirds, and marine mammals, including Steller sea lions and humpback whales, enter Berners Bay for limited periods in the spring. They feed on eulachon that congregate in the areas surrounding Slate Creek Cove prior to spawning in the Antler and Berners rivers.
- Wildlife habitat is limited by the distribution of old-growth habitat within the study area. The 17,773-acre study area contains approximately 11 percent high-volume old-growth timber, and slightly over 29 percent of the project area (approximately 5,200 acres) consists of medium-volume old-growth forest. Over 50 percent of the site (more than 9,300 acres) consists of low-productivity forest or non-forested land cover.
- More than 5,700 acres of wetlands occur in the study area, ranging from subtidal estuarine types to scrub-shrub muskegs. Forested wetlands alone and within complexes with uplands account for more than 4,800 acres.
- Land-based recreation uses in the project area are limited, although the boat ramp at Echo Cove is a popular starting point for boaters and kayakers using Berners Bay.

ENVIRONMENTAL CONSEQUENCES

Section 4 of the Final SEIS provides a comparison of the impacts of the various alternatives. The following are highlights of the differences in impacts between the alternatives:

- Under Alternative A, the DTF would be visible from Lynn Canal. Under Alternative A1, the DTF would have the same height, although the footprint would be reduced. Under Alternatives B, C, and D, the process area and TSF would have very limited visual impacts from Berners Bay.
- Under all alternatives, there would be no adverse impacts on water quality in Sherman Creek. Under Alternatives B, C, and D, the water quality of the Lower Slate Lake would be adversely affected during operations. Under Alternative B, exceedances of water quality standards in the TSF could preclude discharge and minimum downstream flows might not be maintained at all times. Under Alternative C, minimum instream flows would be maintained by the diversions. The operator, however, would have to install additional treatment to meet water quality standards. The discharge from the TSF would not always meet NPDES permit limits intended to protect downstream water quality. Under Alternative D, the treatment system would ensure compliance with permit limits and water quality standards below the TSF.
- Under Alternatives A and A1, approximately 100 to 200 Dolly Varden char would be lost due to construction of the Ophir and Ivanhoe creek diversions. Under Alternatives B, C, and D, approximately 1,000 Dolly Varden char would be lost in the TSF during operations, but the lake would be restored to equivalent or better habitat after closure. Under Alternative B, the discharge from the TSF could cause adverse impacts on resident fish populations in the immediate vicinity of the discharge points. None of the alternatives would affect the anadromous fish populations in Sherman, Slate, and Johnson creeks.
- Alternatives B, C, and D would affect marine mammals in Berners Bay, although the effects would be reduced by following National Marine Fisheries Service (NMFS) guidelines and applying additional mitigation measures developed in consultation with the NMFS. Alternatives B and D could have a limited impact on herring spawning habitat at Cascade Point; herring populations are depressed in the area. These impacts would be avoided at Echo Cove, although dredging at the entrance to the cove during construction and periodic maintenance, as well as the installation of navigation buoys, could affect other resources.
- Alternative A would affect 268 acres of wetlands; Alternative A1 would affect 187 acres; and Alternatives B, C, and D would affect 95, 118, and 99 acres, respectively, during operations. The impacts would occur primarily on forested wetlands, although Alternatives B, C, and D would affect a greater number of wetland types, including the Upper and Lower Slate lakes.
- Under Alternatives B and C, barges and ferries would affect the recreational experience in Berners Bay through visual, noise, and traffic-related effects. Alternatives A and A1 would not include operations in Berners Bay.
- Shuttle boat and barge transport would be safer and more reliable under Alternatives B, C, and D. On-site fuel storage would be reduced; fuel would be transported to and stored at the site in isotainers, which would minimize the risk and extent of spills.

The following table provides a more detailed summary of the relative impacts of each alternative by resource area.

Summary of Potential Impacts of Each Alternative by Resource

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Air quality	Air quality	Predicted pollutant emissions less than state and federal standards. Fugitive Sources: DTF – more than 100 acres, although concurrent reclamation would occur Waste rock storage – 15 acres used temporarily prior to incorporation in the DTF Borrow areas – 54.7 acres Access roads – 3 miles Stationary Sources: Four 3.3-MW generators plus one 275-kW generator	Predicted pollutant emissions less than state and federal standards. Fugitive Sources: DTF – less than 50 acres disturbance No waste rock storage – any available backfilled or incorporated into the DTF Borrow areas – 36.6 acres Access roads – 3 miles Stationary Sources: Four 3.3-MW generators plus one 275-kW generator	Predicted pollutant emissions less than Alternative A and less than state and federal standards Fugitive Sources: TSF – none Waste rock storage – 36.3 acres Borrow areas – 7.2 acres Access roads – 10 miles Stationary Sources: Three 3.3-MW generators plus two smaller generators	Same as Alternative B with the deletion of a small generator from the TSF because there would be no recycling system.	Same as Alternative B, except approximately 2.0 percent greater emissions due to reverse osmosis system, still below state and federal air quality standards.
Geology	Waste rock generated	All waste rock generated incorporated into construction of the DTF.	Small amount of waste rock generated used in DTF construction.	Waste rock disposal at Kensington 850-foot portal (31.5 acres) and Jualin process area (4.8 acres). Most waste rock generated from Kensington-to-Jualin access tunnel.	Same as Alternative B.	Same as Alternative B.
	Tailings generated	20.0 million tons stored in DTF; 6.0 million tons backfilled.	4.5 million tons stored in DTF; 3.0 million tons backfilled.	4.5 million tons stored in TSF; 3.0 million tons backfilled.	Same as Alternative B.	Same as Alternative B.
Geotechnical stability	Probability of DTF/TSF failure	Low probability of failure due to construction of berm around DTF.	Same as Alternative A.	Low probability of dam failure.	Same as Alternative B.	Same as Alternative B.

Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Surface water hydrology	Water withdrawals	Up to 0.52 cfs from infiltration gallery in upper Sherman Creek.	Same as Alternative A.	0.3 cfs from infiltration gallery in Johnson Creek (demand reduced because of recycling).	0.52 cfs from infiltration gallery in Johnson Creek.	Same as Alternative B.
	Diversions	Four diversions totaling 2.3 miles. Only Ophir Creek diversion directly affects stream flow. All diversions except around DTF removed at closure. Potential impact on Ivanhoe Creek because of increased flows from Ophir Creek diversion.	Same as Alternative A with smaller diversion around the smaller DTF.	One 1,500-foot diversion above the waste rock disposal/850-foot adit area on the Kensington side and 2,500-foot diversion around the process area on the Jualin side. 0.75 mile total diversions.	Same as Alternative B plus two 2,550-foot diversions constructed around the northern and eastern portions of the TSF. 1.75 miles total diversions.	Same as Alternative B plus a 3,500-foot pipeline diversion around the TSF. 1.75 miles total diversions.
	Stream flow	Potential impact on instream flows during critical flow period in Sherman Creek between withdrawal and discharge point. Mitigated by state requirements for maintaining instream flows necessary to maintain fish habitat. Mine drainage would provide alternative water supply. Discharge of mine drainage to Sherman Creek would increase average stream flow 1.3 cfs.	Same as Alternative A.	Potential impact on instream flows in Johnson Creek drainage from the infiltration gallery (water supply) and in East Fork Slate Creek as a result of the TSF. Mitigated by state requirements for maintaining instream flows necessary to maintain fish habitat. Discharge of mine drainage to Sherman Creek increases average stream flow 1.3 cfs. Potential impacts on flows in East Fork Slate Creek below TSF if discharges prohibited by non-compliance with NPDES permit limits.	Same as Alternative B, except no impacts on flow below the TSF.	Same as Alternative C.

Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Surface water quality	Sedimentation	Highest potential for sediment loading to Sherman Creek would be during construction. Sediment controlled through polymer added to sediment ponds and BMPs. With proper construction and maintenance, sediment loadings should be consistent with natural conditions. Potential effects of crossings reduced by use of bridges instead of conduits.	Same as Alternative A.	Highest potential for sediment loading in Slate and Johnson creeks would be during construction. BMPs implemented to control erosion.	Same as Alternative B.	Same as Alternative B.
	Effluent quality	No impacts; effluent would comply with water quality-based NPDES permit limits at the discharge point. Negligible on-site acid generation potential.	Same as Alternative A.	Same as Alternative A for mine drainage. TSF water quality may not meet NPDES permit limits, necessitating additional treatment.	Same as Alternative B.	Same as Alternative A.
	Spills	Access road parallels Sherman Creek. Potential for spills of diesel, concentrate, and supplies. Potential for water quality impacts from spills at Comet Beach dock facility.	Same as Alternative A.	Portions of access road parallel Johnson Creek. Potential for spills of concentrate and supplies. Isotainers reduce risk of diesel spill compared to Alternative A.	Same as Alternative B	Same as Alternative B.

Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Groundwater Hydrology	Groundwater flow	Underground mine drainage would create a localized cone of depression. Projected flow of mine drainage of 4 cfs during initial operations, declining to a steady state of 1 cfs. Minimal impacts on overall sitewide hydrology and hydrogeology. DTF would have limited effects in the terrace area. Infiltration gallery would remove 0.5 cfs from alluvium adjacent to Sherman Creek; limited by ADNR water rights permit.	Similar to Alternative A with potentially a smaller cone of depression corresponding to a smaller portion of the deposit being mined.	Similar to Alternative A without affecting terrace area. Some potential for addition of mine discharge from the tunnel connecting Jualin and Kensington sides. Discharge would ultimately be to Sherman Creek. Infiltration gallery would remove 0.3 cfs from alluvium adjacent to Johnson Creek; limited by ADNR water rights permit.	Same as Alternative B except the withdrawal of 0.52 cfs from alluvium in Johnson Creek. The diversions around the TSF would intercept shallow groundwater and discharge to Slate Creek downstream of the TSF. Would result in no effect on overall hydrologic balance in system.	Same as Alternative B.
Groundwater quality	Groundwater quality	No effects from the mine workings. Infiltration through waste rock and DTF consistent with background groundwater quality. Negligible acid generation potential.	Same as Alternative A.	Same as Alternative A. Generally, infiltration from TSF consistent with background groundwater quality	Same as Alternative B.	Same as Alternative B.
Aquatic resources: freshwater	Habitat loss (linear feet)	2,450-foot temporary loss in Ophir Creek during operations; channel restored during closure.	Same as Alternative A.	Lake: loss of all habitat (20 acres) in Lower Slate Lake during operations. Streams: loss of habitat in Mid-lake East Fork (approximately 1,200 feet) due to inundation as TSF water levels rise and in East Fork Slate Creek (200 feet) due to construction of dam.	Same as Alternative B plus inundation of additional habitat around Upper Slate Lake.	Same as Alternative B.

Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Aquatic resources: freshwater (continued)	Stream crossings	Five crossings within Sherman Creek drainage. Upgrading of crossings would have minimal impact on habitat.	Same as Alternative A.	Five crossings (three in Sherman Creek, two in Johnson Creek drainage). Upgrading of crossings would have minimal impact on habitat.	Same as Alternative B.	Same as Alternative B.
	Fish mortality	Potential loss of approximately 100–200 Dolly Varden char resulting from Ophir and Ivanhoe creek diversions.	Same as Alternative A.	100 percent mortality (estimated at 996 individual Dolly Varden char) in Lower Slate Lake during operations of the TSF. Three-spine sticklebacks and benthic organisms also eliminated during operations. Potential impacts on fish below the TSF due to discharge limited by compliance with NPDES permit limits.	Same as Alternative B.	Same as Alternative B in the TSF during operations, no impacts downstream of the TSF
	Water withdrawals	0.52 of cfs withdrawn from alluvium in Sherman Creek.	Same as Alternative A.	0.3 cfs withdrawn from alluvium in Johnson Creek.	0.52 cfs withdrawn from alluvium in Johnson Creek	Same as Alternative B.
Aquatic resources: marine	Water quality	Negligible – primarily during construction.	Same as Alternative A.	Increased sediment locally during construction at Slate Creek Cove and Cascade Point.	Increased sediment locally during construction (Slate Creek Cove/Echo Cove) and maintenance dredging activities (Echo Cove).	Same as Alternative B.
	Nearshore organisms	Temporary displacement following dredging of barge terminal (2.1 acres). Risk of acute and chronic exposure of nearshore benthic organisms to hydrocarbon toxicity from fuel transfer and storage spills at Comet Beach.	Same as Alternative A.	Temporary displacement during dredging at Cascade Point and permanent loss in above-MLLW portion of Cascade Point breakwater. Risk of acute and chronic exposure of nearshore benthic organisms to hydrocarbon toxicity from fueling and spills.	Intermittent disturbances during maintenance dredging operations within Echo Cove. Risk of acute and chronic exposure of nearshore benthic organisms to hydrocarbon toxicity from fueling and spills.	Same as Alternative B.

Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Aquatic resources: marine (continued)	Marine mammals	Minimal.	Same as Alternative A.	Construction (noise) and operations (ferry/barge traffic) could affect Steller sea lions, harbor seals, and humpback whales.	Same as Alternative B.	Same as Alternative B.
	Fish	Sediments generated during construction could temporarily affect Essential Fish Habitat (EFH).	Same as Alternative A.	Temporary impacts on EFH at Slate Creek Cove and Cascade Point during construction. Small amount of herring spawning habitat potentially lost at Cascade Point.	Temporary impacts on EFH at Slate Creek Cove and Echo Cove during construction. Herring spawning habitat not affected by Echo Cove dock.	Same as Alternative B.
Wildlife	Habitat affected	268 acres affected from construction through operations, including 268 acres of wetlands and 134 acres of old growth.	187 acres affected from construction through operations, including 187 acres of wetlands and 104.3 acres of old growth.	195.5 acres affected from construction through operations, including 94 acres of wetlands and 140.6 acres of old growth.	215.5 acres affected from construction through operations, including 114 acres of wetlands and 149.3 acres of old growth.	197.5 acres affected from construction through operations, including 94 acres of wetlands and 141.7 acres of old growth.
Soils	Total disturbance	268 acres affected from construction through operations.	187 acres affected from construction through operations.	113 acres affected from construction through operations.	133 acres affected from construction through operations.	115 acres affected from construction through operations.
Vegetation	Total disturbance	268 acres.	187 acres.	118 acres.	134 acres.	120 acres.
	Impacts on old growth	135 acres.	104 acres.	141 acres.	149 acres.	142 acres.
Wetlands	Short-term loss	268 acres.	187 acres.	94.5 acres.	118.4 acres.	98.6 acres.
	Long-term loss	164 acres.	124 acres.	Wetland restoration figures not provided. Inundated areas would become aquatic habitat permanently. Reclamation should restore areas impacted by fill placement and diversions.	Similar to Alternative B.	Same as Alternative B.

Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Wetlands (continued)	Type of wetlands lost (majority)	Forested.	Forested.	Forested.	Forested.	Forested
	Permanent loss of function/ value	Temporary or permanent loss of hydrologic control (moderate to high value), sediment retention (low to high value), and riparian support (moderate to high value).	Temporary or permanent loss of hydrologic control (moderate to high value), sediment retention (low to high values), and riparian support (moderate to high values).	Temporary and permanent losses of carbon/detrital production export values (high value), wildlife habitat (moderate to high), and surface water control (moderate) primarily within the Slate Creek drainage.	Similar to Alternative B with the addition of the forested and muskeg wetlands affected by the diversion (1.2 acres) and expansion of Upper Slate Lake (11.2 acres).	Same as Alternative B.
Land use/ recreation	Consistency with Forest Service management prescriptions	Consistent during operation and following mine closure.	Same as Alternative A.	Operations consistent with Modified Landscape LUD, but access road and TSF might not be consistent with a short section designated as Semi-primitive Non-Motorized.	Same as Alternative B.	Same as Alternative B.
	Change in land use patterns	No long-term changes anticipated. Displacement of small number of hunters during operations.	Same as Alternative A.	Ferry and barge activity within Berners Bay may impact some recreational users. Three to five round trips per day for the crew shuttle and three to four barges per week.	Similar to Alternative B except for presence of the crew shuttle boat in Echo Cove rather than Cascade Point.	Same as Alternative B.
Visual resources	Effects on achievement of Visual Quality Objectives (VQOs)	Borrow pits, DTF, roads, and structures would probably not meet VQO (Modification) during operations. Would likely meet VQOs after reclamation.	Similar to Alternative A although the DTF and till borrow area would be smaller.	During operations, the Slate Creek Cove facility would not conform to the Retention VQO. Other aspects of the project would meet applicable VQOs.	Same as Alternative B.	Same as Alternative B.

Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Visual resources	Views from Visual Priority Travel Routes (VPTRs)	DTF and process area visible from Lynn Canal.	Similar to Alternative A although DTF would be smaller.	Waste rock storage near Kensington portal visible from Lynn Canal. Cascade Point and Slate Creek Cove marine terminals would create visual impacts from VPTRs in Echo Cove and Berners Bay. Pipeline access road across Snowslide Gulch visible from portions of Berners Bay, including Berners Bay cabin. Small features of Jualin process area might be visible from northern end of Berners Bay.	Similar to Alternative B except dock in Echo Cove would create less of a visual impact than the breakwater at Cascade Point.	Same as Alternative B.
Socioeconomic resources	Direct employment and payroll effects	Increase of 164 and 338 workers during first and second years of construction, respectively, and average of 253 workers during operations. Local hire as high as 50 percent, including some commuter from Haines.	Same as Alternative A.	Increase of 135 and 179 workers during first and second years of construction, respectively, and average of 225 workers during operations. Local hiring as high as 50 percent, primarily from Juneau.	Same as Alternative B.	Same as Alternative B.
	Housing effects	Total housing requirement would increase by 45 units during each of the 2 years of construction and by 127 units during operations, assuming 50 percent local hire. May cause short-term pressure on local housing market.	Same as Alternative A although shorter operational life.	Total housing requirement would increase by 79 and 35 units during first 2 years of construction and by 240 units in Juneau during operations, assuming 50 percent local hire. May cause short-term pressure on local housing market.	Same as Alternative B.	Same as Alternative B.

Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Socioeconomic resources (continued)	Effects on CBJ revenues and expenditures	Increase in property tax revenues. Increase in sales tax revenues. Increase in revenues from state sources. Possible increase in workload and related cost for CBJ.	Same as Alternative A although shorter operational life.	Similar to Alternative A.	Similar to Alternative A.	Same as Alternative B.
Cultural Resources	Historic properties or culturally significant sites	No impacts on traditional cultural properties. Potential impacts on 11 sites eligible for inclusion in the National Register of Historic Places would be mitigated per the Memorandum of Agreement (MOA).	Same as Alternative A.	No impacts on traditional cultural properties. Potential impacts on 14 sites eligible for inclusion in the National Register of Historic Places would be mitigated per the MOA.	Same as Alternative B.	Same as Alternative B.
Noise	Locations of receptors hearing project-related noises	Blasting and loading/offloading operations could be heard by receivers in Lynn Canal (e.g., ferry, cruise ships). Helicopter flights potentially audible in Echo Cove and western portions of Berners Bay.	Same as Alternative A.	Blasting (construction) would be heard in Berners Bay, including at the Berners Bay Cabin. Barge loading/unloading operations audible at Cove Point under some conditions. Loading and truck noises potentially audible at head of Berners Bay. Ferry would be audible at 2,000 feet depending on background conditions.	Same as Alternative B.	Same as Alternative B.
Transportation	Barge traffic	Supply deliveries to and ore concentrate transport from Comet Beach; up to seven barges weekly during construction and three or four during operations.	Same as Alternative A.	Supply deliveries to Comet Beach early in construction phase, after which deliveries to and ore concentrate transport from Slate Creek Cove. Numbers of barges same as Alternative A.	Same as Alternative B.	Same as Alternative B.

Summary of Potential Impacts of Each Alternative by Resource (continued)

Resource	Impact	Alternative A	Alternative A1	Alternative B	Alternative C	Alternative D
Transportation (continued)	Employee transportation	Two to three trips Monday through Friday during operations (12 trips total).	Same as Alternative A.	Five shuttle boat trips daily (M–F) between Slate Creek Cove and Cascade Point. Three round trips on weekends.	Three to five shuttle boat trips daily between Slate Creek Cove and Echo Cove. Three round trips on weekends.	Same as Alternative B.
	Vehicle trips/ accident risk	10,500 vehicle trips annually; accident probability 6.3 percent per year.	9,668 vehicle trips annually; accident probability 5.8 percent per year.	5,350 vehicle trips on access road annually; accident probability 9 percent per year.	Same as Alternative B.	Same as Alternative B.
	Fuel release due to accident	Risk of 5,000-gallon spill: 0.036 percent per year	Risk of 5,000-gallon spill: 0.013 percent per year	Risk of fuel truck accident at mine site: less than 0.04 percent per year; potential for fuel release and volume of spill very limit because of isotainer use.	Same as Alternative B	Same as Alternative B.