Appendix A

EIS Chapter Appendices

Appendix A.1 Options Screening Process

Once all the options that addressed the scoping issues were identified in Section 2.4.2, it was necessary to screen them to reduce the large number of options and sub-options initially identified to a more manageable number that still provided a reasonable range from which to identify full project alternatives. This detailed and time-consuming process is described below.

First, objective screening evaluation criteria were developed for each issue (Section A.1.1). Then, each option was screened against those criteria to determine which options best addressed the issues (Section A.1.2).

A. 1.1 Screening Evaluation Criteria and Metrics

This section describes how the 17 scoping issues and their evaluation criteria identified in Section 2.4.1 (Scoping Issues Identification) were expanded to provide specific metrics (measurements) to be used to screen the options developed in Section 2.4.2 (Options Development).

Metrics Identification

Fundamental to the options screening process is evaluation of each issue criterion to identify an objective range of impacts caused by one or more options. These impacts should reflect the concerns of the public and the agencies. The metrics identified for each criterion varied. Some reflected a specific regulatory standard or limit, such as air quality or water quality standards, that provide a very objective metric. Exceeding those limits might represent an unacceptable impact on the resource and therefore could result in screening out that option. Other metrics were not as well defined and therefore were more subjective. These were identified by using best professional judgment.

The metrics identified for each criterion were applied in the screening process described below in Section A.1.2 (Options Screening) to eliminate options that would not meet acceptable environmental, technical, or economic standards, or options that provided no obvious advantage to other, more environmentally acceptable options that would be retained for detailed analysis in the Environmental Impact Statement (EIS).

Note: Because “impacts” can be both positive and negative, in this document the term “impacts” is construed to mean negative impacts while the term “benefits” is construed to mean positive impacts.

Issue 1. Surface and Groundwater Quality

Criterion Maintenance of existing water quality in the affected drainages to fully protect all designated uses (such as aquatic life, drinking water, and industrial use).

All discharged waters would be expected to be in compliance with toxicity criteria and numerical water quality standards as defined by the federal National Pollutant Discharge Elimination System (NPDES) permit, underground injection control (UIC) permit, and state discharge permit(s) or certifications of federal permit(s). Therefore, the discharges from each option were evaluated for either meeting or failing to meet those regulatory requirements by using the following evaluation criteria:

- No or low impact – No or very low likelihood that a discharge would exceed permit standards.
- Moderate impact – Occasional non-compliance would be possible.
- High impact – Substantial risk of not obtaining a discharge permit, and if obtained, compliance reliability would be low.

For those releases from the project that are not covered by a discharge permit with specific numeric limits, a more general set of evaluation criteria was used. These criteria would apply to situations such as accidental or unplanned releases (e.g., fuel or chemical spills) and stormwater runoff. The following metrics were applied:

- No or low impact – No planned release or low likelihood of occurrence; if an accidental release or spill occurs, the potential for impacts to environment or public interests would be negligible. Low likelihood of stormwater runoff that would be inconsistent with the goals of the stormwater NPDES permit.
- Moderate impact – There is a risk of accidental release, or a release has a low likelihood of occurrence but the impacts could be substantial. Moderate likelihood of stormwater runoff that would be inconsistent with the goals of the storm water NPDES permit.
- High impact – A high potential for accidental release exists, and the severity of the release would be high. High likelihood of storm water runoff that would be inconsistent with the goals of the stormwater NPDES permit.

Issue 2. Wetlands

Criterion Siting, construction, and management of components to avoid, minimize, and mitigate impacts on wetlands.

This criterion addresses wetlands impacts and the degree to which they can be avoided, minimized, and compensated according to the regulatory definition of mitigation in the Clean Water Act Section 404(b)(1) guidelines. Because a project must meet the 404(b)(1) guidelines, expected failure of an option to meet these guidelines was considered a fatal flaw and resulted in that option being dropped from further consideration.

The metrics are based on the level of expected direct and indirect impacts, and whether they can be mitigated within the context of the U.S. Army Corps of Engineers (COE) permitting process.

- No or low impact – No or few direct or indirect impacts to wetlands expected.
- Moderate impact – More than a few direct or indirect impacts to wetlands could not be avoided.
- High impact – Substantial direct or indirect impacts to wetlands expected.

Issue 3. Fish and Aquatic Habitat

Criterion Minimize impacts to fish and aquatic habitat.

This criterion addresses impacts to fish and aquatic habitat. Two types of impacts are considered – direct and indirect. Direct impacts are those that directly affect fish and aquatic habitat (elimination or reduction in availability of habitat from construction activities, physical or chemical barrier[s] to movements, bioaccumulation of metals, or unexpected changes from project system failures). Indirect impacts would be from human activities due to improved access and project development.

The metrics are based on these direct, indirect, and movement impacts:

- No or low impact – No or few direct or indirect impacts to fish or habitat. Impacts would be localized and affect few individuals of any one species.
- Moderate impact – More than a few direct or indirect impacts to fish or habitat. Impacts might be localized, affecting a large number of individuals of one or more species, or might be greater than local, affecting the major drainages containing project facilities.
- High impact – Substantial direct or indirect impacts to fish or habitat. Impacts likely could extend beyond the major drainages containing project facilities and affect a large number of individuals of one or more species.

Issue 4. Wildlife

Criterion Minimize impacts to wildlife and habitat.

This criterion addresses impacts to wildlife itself as well as to wildlife habitat. Two types of impacts are considered – direct and indirect. Direct impacts are those that directly affect animals (e.g., collisions with vehicles or power lines and physical barrier to movements) and habitat (direct elimination of habitat by construction of project facilities such as the airstrip, road, mill and camp, and dry-stack tailings pile). Indirect impacts are the effective loss of habitat through avoidance because of human contact and associated mining activities and noise.

The metrics are based on these direct and indirect impacts:

- No or low impact – No or few direct or indirect impacts to wildlife or habitat. Impacts would be localized in nature.
- Moderate impact – More than a few direct or indirect impacts to wildlife or habitat. Impacts would be greater than local in nature, but likely would not extend beyond the major drainages containing project facilities.
- High impact – Substantial direct or indirect impacts to wildlife or habitat. Impacts likely could extend beyond the major drainages containing project facilities.

Issue 5. Air Quality

Criterion Minimize impacts to existing air quality.

Air impacts may be temporary, such as fugitive dust related to construction or periodic operational activities, or long lasting, such as continuous releases of emissions from power plants. The primary air quality metrics related to development are the Alaska Ambient Air Quality Standards (AAAQS), which are the same as the National Ambient Air Quality Standards (NAAQS), and Prevention of Significant Deterioration (PSD) increments for a Class II area. These metrics represent threshold maxima that cannot be exceeded under specific permit requirements for the project area.

Those project options that are associated with these emissions provide predictable threshold values, and the criteria metrics are either “Exceeds Criterion” or “Does Not Exceed Criterion.” Exceeding the criterion was considered a fatal flaw and resulted in not including that option in a future alternative.

Other air quality releases, such as fugitive dust or other emissions that affect soils, vegetation, or visibility, may not have specific thresholds. The metric for fugitive dust assigned to each component option includes:

- No or low impact – No impact from fugitive emissions or minimal potential of routine occurrences.
- Moderate impact – Periodic fugitive releases, such as during construction or, if recurring, limited to areas adjacent to the project facilities. Visible during periods of highest activity or high winds; localized accumulations may affect vegetation immediately adjacent to or on facility property.
- High impact – Continuous or long-term releases that create a substantial visibility nuisance or affect the public or natural resources.

Issue 6. Noise

Criterion Minimize noise impacts to residents, recreationists, wildlife, and others.

The impacts of noise are related to project construction activities, which are temporary, and operational activities, which may be periodic or long term. The most substantial noise impacts directly related to mining, such as blasting and mine operations, would occur underground and likely would not affect this criterion. Activities such as handling of development rock or operation of a power plant would produce varying noise impacts during different stages from project development through operation. Milling operations would occur above ground, as would trucking of tailings to the dry-stack tailing pile. Mine supplies and personnel during construction and operation periodically would traverse an all-season road, winter road, or arrive by air.

These noise impacts generally are not regulated at a threshold level, but may result in impacts that have environmental or societal impacts. Where applicable, the following metrics apply to these options:

- No or low impact – No noise, a low level of noise produced, or noise occurs in an area where there are no receptors to be affected by the noise.
- Moderate impact – Moderate levels of noise produced, but either the noise occurrence is not continuous or it occurs in areas where there are few receptors likely to be affected.
- High impact – The potential for recurring noise has unacceptable impacts to residents, recreationists wildlife, or others.

Issue 7. Safety

Criterion Minimize safety issues for workers and members of the public.

This criterion addresses safety in the context of workers as well as members of the public who could come into contact with project-related activities such as a winter or all-season road. Safety issues related to workers in the mine, in the mill, and at other project facilities are not considered because they would be covered by specific Mining and Safety Health Administration (MSHA) regulations, which are beyond the scope of this EIS.

The metrics used are necessarily general in nature because safety issues vary widely among the various project components. For example, specific safety issues related to project use (supply trucks) as well as public use (all-terrain vehicles and snow machines) of a winter road would differ from the nonpublic safety issues related to workers at a staging area loading and unloading trucks in the dark and cold of mid-winter to move a year's worth of supplies across a winter road. The metrics are:

- No or low impact - No or low likelihood of injury to workers or members of the public.
- Moderate impact – Moderate likelihood of injury to workers or members of the public.
- High impact – High likelihood of injury to workers or members of the public.

Issue 8. Reclamation

Criterion Components designed and sited to promote successful reclamation.

This criterion addresses the return of exploration, developed, and mined areas to a stabilized condition to ensure long-term protection of land and water resources in a manner compatible with the selected post-project land use.

The metrics identified are based on the likelihood of successful reclamation from the perspective of component design, construction, operation, and closure, and of protection of post-project water quality. No metric with a moderate impact level was used because reclamation was considered to be a threshold criterion with no basis for only meeting the criterion part way. The metrics are:

- No or low impact – Lower likelihood of unsuccessful reclamation with a corresponding increased potential for minimizing impacts to water quality and/or an increased potential to achieve a post-mining land use consistent with the Tanana Basin Area Plan (TBAP).
- High impact – Higher likelihood of unsuccessful reclamation with a corresponding increased potential for unacceptable impacts to water quality and/or a decreased potential to achieve a post-mining land use consistent with the TBAP.

Issue 9. New Industrial and Commercial Uses

Criterion Infrastructure for new industrial and commercial uses consistent with the management intent, guidelines, and land use designations of the adopted Tanana Basin Area Plan and the Tanana Valley State Forest Management Plan.

The State of Alaska's TBAP provides for multiple uses in the general project area, including industrial and commercial uses. Examples include mining, timber harvesting, agriculture, trapping, mushing, and guiding. Article VIII, § 1 of the Alaska Constitution states, "It is the policy of the State to encourage the settlement of its land and the development of its resources by making them available for maximum use consistent with the public interest." This charge is reflected in the State of Alaska land planning process and land management and permitting policies, and in the State of Alaska's active involvement of the public and Tribes in these multiple land uses.

The State's Tanana Valley State Forest (TVSF) was established as one of the first units of the Alaska state forest system. The primary purpose of state forests is multiple use management that provides for the production, utilization, and replenishment of timber resources while promoting personal, commercial, and other beneficial uses of resources.

The TVSF Management Plan (Alaska Department of Natural Resources, 2001b) identifies and prioritizes management activities for lands designated by the Alaska Legislature as the TVSF. This plan also sets policy on how the ADNR should review proposals for use of state forest land by the public, industry, and other governmental agencies. Because the Management Plan is designed to promote multiple use, it establishes rules and guidelines aimed at allowing various land uses to occur with minimal conflict.

The metrics identified are based on the type, mode, design, siting, management, and disposition of infrastructure for the Pogo Mine that could be used for other industrial and commercial uses, including other mines in the same area, consistent with the TBAP and the TVSF Management Plan. Access type includes that for personnel/supplies (road) as well as electric power (cleared right-of-way). Access mode includes ground (all-season road and winter road) and air access. Design includes width and robustness of an all-season or winter road and sizing and load of a power line. Management includes whether the infrastructure would be available to users other than the Applicant during or after the life of the Pogo project. Disposition includes whether the infrastructure would remain after the life of the Pogo project or would be removed or otherwise altered. The metrics are:

- No or low impact – Infrastructure type, design, siting, management, and disposition very favorable to other industrial or commercial uses.
- Moderate impact – Infrastructure type, design, siting, management, and disposition moderately favorable to other industrial or commercial uses.
- High impact – Infrastructure type, design, siting, management, and disposition not favorable to other industrial or commercial uses.

Issue 10. Recreational Resources and Uses

Criterion Access for recreational uses consistent with the management intent, guidelines, and land use designations of the adopted Tanana Basin Area Plan and the Tanana Valley State Forest Management Plan.

This criterion addresses use of presently remote areas for recreational purposes such as hunting, trapping, fishing, floating, hiking, boating, sightseeing, berry picking, cross-country skiing, mushing, and snow machining.

The metrics identified are based largely on the mode, design, siting, management, and disposition of the access infrastructure for the Pogo Mine that could be used for recreational uses. Access type includes that for personnel/supplies (road) as well as electric power (cleared right-of-way). Access mode includes ground (all-season road and winter road) and air access. Design includes width and surface of an all-season or winter road. Management includes whether a road or airstrip would or would not be available to recreational users during or after the life of the Pogo project. Disposition includes whether a road or airstrip would remain after the life of the Pogo project or would be removed or otherwise altered. The metrics are:

- No or low impact – Infrastructure type, design, siting, management, and disposition very favorable to increased recreational access.
- Moderate impact – Infrastructure type, design, siting, management, and disposition moderately favorable to increased recreational access.
- High impact – Infrastructure type, design, siting, management, and disposition not favorable to increased recreational access.

Issue 11. Existing Privately Owned Lands and Existing Recreational and Commercial Uses

Criterion Minimize impacts to existing privately owned lands and existing recreational and commercial uses consistent with the management intent, guidelines, and land use designations of the Tanana Basin Area Plan and the Tanana Valley State Forest Management Plan.

This criterion addresses existing privately owned lands, residences, and cabins; existing recreational uses such as hunting, fishing, trapping, boating, mushing, and snow machining; and existing commercial uses such as trap lines and sled dog expeditions. Increased recreation and industrial and commercial uses could have impacts on existing privately owned lands and existing recreational and commercial uses.

The metrics identified are based on the level of increased industrial, commercial, and recreational uses in areas with remote private land ownership and existing recreational and commercial uses:

- No or low impact – No or limited increase in industrial, commercial, and recreational uses.
- Moderate impact – Moderate increase in industrial, commercial, and recreational uses.
- High impact – High increase in industrial, commercial, and recreational uses.

Issue 12. Subsistence and Traditional Uses

Criterion Minimize impacts to subsistence and traditional resource uses currently occurring within the affected area.

This criterion addresses subsistence uses, which are defined under state law as “the noncommercial, customary and traditional uses of wild, renewable resources by a resident domiciled in a rural area of the state for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation, for the making and selling of handicraft articles out of nonedible by-products of fish and wildlife resources taken for personal or family consumption, and for the customary trade, barter, or sharing for personal or family consumption” (Alaska Statutes 16.05.940[32]). Examples of subsistence uses in this area include hunting, fishing, trapping, drinking water, wood gathering, and berry picking. (Some existing commercial and recreational activities also currently use these same resources.) Activities that might affect the availability of subsistence and traditionally used resources, access to them, or competition for them could have impacts on subsistence and traditional uses.

The metrics identified are based on potential changes in subsistence resource availability, access to those resources, and competition for those resources:

- No or low impact – No or limited change in availability of, access to, or competition for traditional subsistence resources.
- Moderate impact – Moderate change in availability of, access to, or competition for traditional subsistence resources.
- High impact – Major change in availability of, access to, or competition for traditional subsistence resources.

Issue 13. Cultural Resources

Criterion Avoid impacts to cultural resources.

This criterion addresses cultural resources, whether and where they exist, their cultural importance, and whether they would be affected by the project. Criteria used in determining importance of an archaeological site or historic property are the same as used in determining eligibility for listing on the National Register of Historic Places (Code of Federal Regulations, Title 36, Part 800, Subpart B [Section 106 process]). With respect to this project, the general criterion pertaining to eligibility is stated as "[those sites] that have yielded, or may be likely to yield, information important in prehistory and history."

The metrics identified are based on whether, for project site locations and transportation corridors, cultural resources have been identified, whether those resources have been determined eligible for listing on the National Register, and whether the resources would be damaged or destroyed by construction or operation of the project. The metrics are:

- No Impact – No cultural resources are located within the area affected by the undertaking and/or there are no properties listed on, or eligible for listing on, the National Register of Historic Places.
- High Impact – Properties listed on, or eligible for listing on, the National Register of Historic Places are located within the area affected by the undertaking resulting in an adverse effect to those properties.

Issue 14. Socioeconomics

Criterion Minimize social and quality of life impacts and maximize economic benefits to potentially affected communities.

The only project component options likely to have measurable socioeconomic consequences concern access to the mine site. The type, management, and disposition options for the two primary ground access options (all-season road or winter-only road, and associated air transport) could have different socioeconomic impacts and/or benefits in the Delta area. In part, the issue concerns where the mine workforce would reside. With the winter road option, crews would rotate on a 2-week-on, 2-week-off shift basis, presumably with many employees commuting from outside the Delta area and perhaps outside the Interior. With the all-season road option, crews would rotate on a 4-days-on and 4-days-off basis. This more frequent rotation could encourage more local residents to work at the mine and could induce nonresident workers to settle in the Delta area rather than commute from Fairbanks or elsewhere.

Too much population growth, however, could generate an increase in infrastructure demands (e.g., housing, education, and public safety), causing economic burdens on local government and Tribes. The effects of an increase of local workers and their families must be assessed on population growth, resident employment and commerce, housing, schools and other public facilities, local government and Tribal finances, health and social services, and the overall quality of life of local residents.

Other aspects of the project with potential socioeconomic impacts to local residents and Tribal resources also must be evaluated, including intermittent and final mine closure and the design, management, and eventual disposition of project facilities and access systems.

The all-season road option could affect other resource development in the area. If the road were open to the public and/or other industrial or commercial users, it could facilitate economic and population growth in the Delta area. These impacts could extend well beyond the life of the mine if an all-season road were permanently left open for public, industrial, and commercial access rather than removed and reclaimed.

The winter-only road option could increase the risk of unplanned closure of the mine if in some years warm weather were to make maintenance of a winter road impossible for the required time period. If mine resupply were constrained and the mine forced to temporarily close, this inability to maintain operations could lead to layoffs and loss of income for local residents.

The metrics consider local employment, population growth and infrastructure demands, long-term economic benefits if access were to be maintained, and the probability of an unplanned, temporary mine closure:

- No or low impact – High local labor participation and local settlement of nonlocal labor. No or low population growth and infrastructure demands. Long-term, unrestricted access maintained. Low probability of an unplanned, temporary mine closure.
- Moderate impact – Moderate local labor participation and local settlement of nonresident workers. Moderate population growth and infrastructure demands. Long-term, restricted access maintained. Moderate probability of an unplanned, temporary mine closure.
- High impact – Little or no local labor participation in the mine workforce or local settlement of nonresident workers. High population growth and infrastructure demands. No long-term access maintained. High probability of an unplanned, temporary mine closure.

Issue 15. Cumulative Impacts

Criterion Assess the cumulative impacts from this and other past, present, and potential developments in the area.

The cumulative impacts included in this criterion include those that are direct or indirect in concert with other past, present, or reasonably foreseeable projects. The assumption is that measurable impacts, while acceptable for this project, might not be acceptable when combined with the impacts of other projects whether implemented in the past, present, or future.

The metrics are quite subjective because cumulative project impacts are very difficult to estimate until the options of interest have been considered. These assumptions would need to be clearly defined when each value is assigned. The metrics are:

- No or low impact – No cumulative impacts, either because the impacts would be benign or the option was independent of activities of other projects.

- Moderate impact – The options, in concert with similar or other components of other projects, may produce definite environmental impacts. Typically, this would include options that affect nonrenewable resources, such as air, water supply, water quality, or infrastructure demands. Any such impacts are amenable to mitigation, although the costs of mitigation may be high.
- High impact –Compounding impacts would result from other existing projects or would be known to have a direct impact on the development of a future project that, in concert with this impact, would produce unacceptable impacts. Any such impacts are not amenable to mitigation and are unacceptable from the perspective of at least one of the stakeholder groups (public, agencies, or project investors).

Issue 16. Technical Feasibility

Criterion Minimize chances of system failure by incorporating technically feasible and operationally efficient component design, siting, and mitigating measures.

The technical feasibility of various project components must be addressed. If components become too complex or use uncertain technology, an increased risk of failure could result. Some items of specific concern are adequate system capacity and availability; the water collection, transport, and discharge system; dry tailings pile stability; recycle tailings pond (RTP) water diversion and dam failure; and adequacy of access for project materials and supplies.

Certain components for development and operation of a mining project may have technical constraints that affect the ability to implement those components. For example, topography, resource limitations, spatial relationships of one component to another, temporal relationships, or engineering knowledge for a specific option may influence the acceptability of that particular option or approach for meeting the project objectives. Issues of importance to this criterion consider the ability of a specific option to meet these challenges.

The metrics identified are based on the technical feasibility of specific options and the potential risk associated with component siting, design, operational efficiency, and mitigation:

- No or low impact – No specific engineering challenges related to meeting technical requirements.
- Moderate impact – Technically feasible, but the requirements represent a substantial challenge. Engineering and operational requirements have not been fully tested. The option evaluated may also face risks to completion as a result of unknown estimates of technical or regulatory acceptance until additional information is collected. Risk of delay or not meeting objectives is moderate.
- High impact – Substantial unknowns with respect to engineering feasibility. High risk associated with not being able to comply with technical or regulatory requirements.

Issue 17. Economic Feasibility

Criterion Consider the cost effectiveness of technically feasible and operationally efficient component design, siting, and reclamation.

If project costs exceed reasonable or practical limits, economic feasibility could become an issue. Every industrial project includes among its stakeholders those who have an investment interest in the financial success of the project. When specific conditions for meeting technical constraints, environmental restrictions, and project requirements are met, these stakeholders have specific profit expectations to make the project feasible. If meeting the other criteria included in this evaluation means that the project would not meet those financial expectations, then that option may not be feasible for economic or financial reasons.

The metrics identified are based on the engineering and ancillary costs of project development and operation and the environmental mitigation and other costs that may be required to develop an acceptable and approved project. The metrics are:

- No or low impact – No substantive additional cost required to meet technical or regulatory requirements.
- Moderate impact – Substantial costs required to meet technical or regulatory requirements.
- High impact – Extraordinary costs required to meet technical or regulatory requirements.

A. 1.2 Options Screening

This section describes the process by which the options and sub-options identified in Section 2.4.2 (Options Development) were screened with the evaluation criteria described in Section A.1.1 (Screening Evaluation Criteria and Metrics) based on the issues identified during scoping. The purpose of screening was to reduce the large number of options and sub-options initially identified to a more manageable number that still provided a reasonable range from which to identify full project alternatives.

Evaluation Criteria Not Used for Screening

Of the 17 evaluation criteria identified during scoping, 15 were considered relevant for options screening, 1 was considered partially adequate, and 1 was considered inadequate. The partially adequate criterion was socioeconomics. The inadequate criterion, cumulative impacts, was not used during options screening because it did not possess metrics that realistically would differentiate between options. The reasons these criteria were not used, or were only partially used for options screening, are discussed immediately below. All 17 criteria, however, including socioeconomics and cumulative impacts, were used for the detailed impacts analysis of alternatives in Chapter 4.

Socioeconomic Resources Most socioeconomic issues require data collection and analysis that are not available during the screening process. Many of these issues also have complex offsetting or mitigating characteristics that are more appropriately considered during the more detailed evaluation of alternatives that occurs later in the EIS process. Also, it would not be possible to differentiate among particular options for most of the socioeconomic issues because their impacts result from the project as a whole and not from one specific component option versus another.

For the Pogo Mine project, however, options for one component, mine access, could have measurable socioeconomic consequences. The type, management, and disposition options for the two primary access options (all-season road, and winter-only access with an air access complement) could have different socioeconomic impacts and/or benefits in the Delta area. In part, the issue concerns where the mine workforce would reside. With the winter-only access option, crews could rotate on a 2-week-on, 2-week-off shift basis, presumably with many employees commuting from outside the Delta area and perhaps outside the Interior. With the all-season road option, crews would rotate on a 4-days-on and 4-days-off basis. This more frequent rotation could encourage more local residents to work at the mine and could induce nonresident workers to settle in the Delta area rather than commute from Fairbanks or elsewhere.

Too much population growth, however, could generate an increase in infrastructure demands (e.g., housing, education, and public safety), causing an economic burden on local government.

The all-season road option also could affect other resource development in the area. If the road were open to the public and/or other new industrial or commercial uses, it could facilitate economic and population growth in the Delta area. These impacts could extend well beyond the life of the mine if an all-season road were permanently left open for public, industrial, and commercial access rather than removed and reclaimed.

A winter-only access option could increase the risk of unplanned closure of the mine if in some years warm weather were to make maintenance of a winter-only access option impossible for the required time period. If mine resupply were constrained and the mine forced to temporarily close, this interruption of operations could lead to layoffs and loss of income for local residents.

Thus, because some specific options could have socioeconomic impacts, they were screened from the socioeconomic perspective.

Cumulative Impacts After applying the metrics for this criterion to the options, it was determined that the cumulative impacts criterion was not an appropriate criterion for use in screening evaluation because the cumulative impacts of individual component options could not be realistically assessed. Rather, cumulative impacts appeared to be related more to the project as a whole. Therefore, individual options were not screened against this criterion, and cumulative impacts are discussed for each issue in Chapter 4.

Options Screening

This section describes the methods and results of applying the evaluation criteria metrics to screen each option and sub-option for all 15 project components. Screening was done by an interdisciplinary group consisting of the third-party EIS team and agency resource specialists. Values of low, moderate, and high, developed for each criterion as described above, were assigned to each issue criterion. Individual options and sub-options then either were dropped from further consideration or retained for detailed impact analysis in Chapter 4 (Environmental Consequences).

Screening was done in a three-step process.

First, a fatal flaw analysis was completed. In the second step, values were assigned based on the impact of each option and sub-option on each issue criterion. In the third step, a weight-of-evidence analysis was used to determine whether an option should be retained for detailed analysis.

For the fatal flaw analysis, a fatal flaw was defined as a condition in which an option could not meet a specific, measurable performance threshold required to obtain a particular permit or to meet a particular project objective. An example would be being able to meet a specific discharge standard for an NPDES permit. Another example would be lack of geotechnical conditions adequate to receive approval to construct a tailings disposal facility or a mill facility.

In the second step, each option and sub-option for each of the project components was compared to the metrics for each of the 16 evaluation criteria. This comparison resulted in the assignment of low, moderate, and high impact values. In some comparisons, measurements were largely qualitative; in other cases, it was possible to quantify potential impacts.

If an option received a value of moderate or high for a particular issue criterion, the option was re-evaluated based on the use of reasonable measures to mitigate potential impacts. If it was determined that such mitigation measures would lower the impacts, the option was assigned a lower impact value.

In the third step, an option then was evaluated from an overall weight-of-evidence perspective; that is, on the basis of whether in its entirety an option was rated as being more favorable (lower level of impact) or less favorable (higher level of impact) than other options for the same component. If this comparison demonstrated that there was a more favorable option that afforded no environmental disadvantage, that more favorable option was retained and the others eliminated, unless a less favorable option possessed a particular environmental advantage for at least one issue criterion.

Because NEPA regulations require that an Applicant's proposed project be evaluated as a distinct alternative in the EIS, the options that constitute the Applicant's proposed project were automatically retained for detailed analyses as a separate project alternative (Alternative 2, Applicant's Proposed Project).

For each option and sub-option, the following sections discuss the evaluations and decisions made based on potential impacts associated with each of the 16 issue criteria. The discussions focus on options that received moderate or high values for a particular impact or that were otherwise important in determining whether an option was dropped from further consideration or retained for detailed analyses. Thus, if a particular evaluation metric did not differentiate impacts between options for a component, or if a low value was assigned, it generally is not discussed.

Summary options screening matrix The summary options screening matrix at the end of this appendix lists all components, options, and sub-options developed in Section 2.4.2 (Options Development), and presents the high (H), moderate (M) and low (L) impact ratings produced during the screening process for each of the 16 screening criteria. These screening ratings are referenced extensively in the remainder of this appendix as the screening process for each project component is described. Frequent reference to the matrix will assist a reader in following the options screening discussion.

Summary Options Screening Matrix

It is important that the reader understand that this summary options screening matrix is NOT a summary of the impacts described in Chapter 4 (Environmental Consequences). It is a summary of the impact ratings that were assigned, very early in the EIS process, to decide which options would be carried forward for detailed analysis, and which options would be dropped from further consideration. While most of the impact ratings in this matrix agree with those described in Chapter 4, during detailed impacts analysis several of the impacts in this matrix were determined to be greater or smaller than originally believed almost 2 years earlier. These findings are not surprising because during that period considerably more information became available on which to base impacts determinations. Thus, this matrix represents a “snapshot” of the screening analysis process early in the EIS process. It’s primary value is in understanding why particular options were dropped and why others were carried forward for detailed analysis at that time.

Milling Process

Three options for this component were identified:

1. Whole ore cyanidation
2. Gravity / flotation / cyanide vat leach
3. Gravity/ flotation / ship concentrate off site

- For four criteria (water quality, fish, wildlife, and reclamation) the whole ore cyanidation option (Option 1) was considered less favorable than the gravity / flotation / cyanide vat leach option (Option 2). This was because this option would result in all tailings in the dry stack having been exposed to cyanide. Despite having gone through a cyanide destruction process, there still would be some cyanide left in the tailings.

  No advantage was determined for any criterion for the whole ore cyanidation option (1) compared to the gravity / flotation / cyanide vat leach option (2), except for economic feasibility.

  From the economic feasibility perspective, the whole ore cyanidation option (1) would provide approximately 1 to 2 percent greater gold recovery than the gravity / flotation / cyanide vat leach option (2); however, all tailings would be exposed to cyanide, including those to be deposited in the dry-stack tailings pile on the surface. This increased environmental risk was recognized by the Applicant, and consequently the Applicant proposed the gravity / flotation / cyanide vat leach option (2) for environmental reasons, despite the lower gold recovery. Thus, the gravity / flotation / cyanide vat leach option (2) was retained for alternatives analysis while the *whole ore cyanidation option (1) was dropped from further consideration*.

- The gravity / flotation / ship concentrate off site option (3) would require an all-season road to transport the concentrate to a processing facility somewhere off site, either within or outside Alaska. The use of seasonal winter access, or flying out concentrate, would not be economic.

  Two major factors were analyzed in screening this option: economic feasibility and relative environmental impacts. These factors are closely related and are discussed below. The remainder of this mill process section discusses the gravity / flotation / ship concentrate off site option (3) (Teck-Pogo Inc., 2001b).

  - Regular concentrate From the economic feasibility perspective, the concentrate produced by the gravity / flotation / cyanide vat leach mill process would constitute approximately 10 percent by weight of the processed ore, or approximately 250 tons per day (tpd) at the initial ore volume of 2,500 tpd (91,250 tons per year). This volume would require approximately 3,380 trucks per year for transport off site. (Pogo does not benefit from a proximity to tidewater as do the Red Dog and Greens Creek mines in Alaska, which ship concentrate off site by marine transportation.)

    Estimated concentrate shipping costs would range from $140 to $240 per ton (see following discussion for high-grade concentrate shipping costs), or approximately $13 million to $22 million per year. These concentrate transport costs alone would constitute approximately 13 to 22 percent of projected annual gross project revenues of approximately $100 million. *Thus, off-site shipment of a regular concentrate would make the project uneconomic and it was not considered further.*

  - High-grade concentrate By modifying the mill process, however, it would be possible to produce a higher grade of concentrate that would reduce the tonnage to be shipped off site from approximately 10 percent by weight of processed ore to approximately 3 percent (27,375 tons per year). This mill process would reduce gold recovery by approximately 2 percent. The high-grade concentrate, however, would contain approximately 5 percent by weight of arsenic that could require special handling, shipment, and disposal procedures. This scenario would reduce the number of trucks by 70 percent to 1,015 per year. The issue of where to ship the high-grade concentrate then arises.

  - Unspecified Alaska facility This option requires identification of a suitable location for processing and permanent storage of the concentrate tailings within Alaska. This process would raise the same environmental and economic issues that are already being addressed at the Pogo Mine site. While it might be technically and politically feasible to permit, construct, and operate an independent concentrate processing and tailings disposal facility elsewhere in Alaska, it would appear to be more environmentally responsible to deposit the tailings underground in the same location from which they came. Hauling concentrate from the Pogo Mine to some other Alaska processing site, and then hauling the concentrate tailings back to Pogo for deposition in the mine, would not make economic sense, and would increase the probability of handling or transportation accidents, especially in winter. Also, there is no reason to expect that operating risks from leaching the concentrate would be any greater at the Pogo Mine than at another Alaska site. Thus, processing and disposal at another Alaska site was not considered further.

Two options Outside Alaska were reviewed for processing high-grade concentrate: shipping to a new leaching facility in British Columbia or to existing smelters.

- British Columbia facility   An existing Teck-Cominco site at Afton, B.C., was used as a hypothetical case for cost estimation for a leaching facility. It is located near the rail system in a historic mining area where a tailings facility could be permitted more readily and where there might be some infrastructure available to support construction and operation of a new concentrate leaching facility.

  Transporting the concentrate directly to Afton by truck (approximately 2,000 miles) in 1.5- to 2.0-ton Supersacks appeared to be the most environmentally feasible method and would minimize concentrate losses compared to bulk container or bulk truck/rail combinations. In order to optimize the economics under this option, it was assumed that cement and grinding balls necessary to support the mine would be procured in B.C. and backhauled to Pogo on the same trucks. The transport costs were estimated at $140 per ton, or $3.8 million per year. Including the 2 percent gold recovery loss to achieve the high-grade concentrate, this option would cost approximately 6 percent of gross revenues.

- Existing smelters   The high arsenic content of the concentrate would limit the number of smelters in the world that would accept the concentrate for refining. These smelters would accept the product, but would impose a net smelter penalty of approximately 2 percent. Two smelters that could process Pogo high-grade concentrate were considered: Noranda in Quebec and Dowa in Japan.

- Transporting to Noranda, Quebec, was evaluated under three scenarios: 1) Supersacks inside shipping containers via truck to Valdez, then barge to Seattle, rail to Montreal, and truck to Noranda; 2) as in 1 above, except all truck from Seattle to Noranda; and 3) Supersacks trucked to Fairbanks, loaded into rail boxcars, then shipped by rail, barge, and finally by rail to Noranda. These transport costs were estimated at $240 to $340 per ton.

- Transporting to Dowa in Japan was evaluated under two scenarios: 1) Supersacks trucked to Valdez, barged to Stewart, B.C., and loaded on top of concentrate from another mine on an ocean freighter already bound for Japan; and 2) Supersacks inside shipping containers, trucked to Valdez, barged to Vancouver or Seattle, and then shipped independently to Japan. The transport costs were estimated at $200 to $210 per ton.

  Under the cheapest smelter option of $200 per ton, transportation costs would be approximately $5.5 million per year. Including the 2 percent gold recovery loss to achieve the high-grade concentrate, and the 2 percent smelter arsenic penalty, the least expensive smelter option would cost approximately 9.5 percent of gross revenues.

Environmental considerations   The major environmental benefit of shipping concentrate off site would be elimination of risk from cyanide leached tailings being placed underground, and the related reduced potential for acid rock drainage and metals leaching. There would be some additional environmental benefits in that there would be a reduced need to transport reagents to the mine site, including 200 tons of cyanide annually. This reduced transport need would equate to approximately 8 trucks per year that would not be required for cyanide transport, and an additional approximately 125 trucks that would not be required to transport the lime and other reagents used in leaching, gold recovery, and cyanide destruction. These approximately 133 fewer trucks would compare to the approximately 1,015 additional trucks that would be required for shipping concentrate off site, for a net increase of approximately 880 trucks per year. This increased truck volume could cause a substantial impact on the existing Shaw Creek Road if this Richardson Highway egress sub-option were selected. Also, the size of the above-ground dry-stack tailing pile would be reduced approximately 4 percent in volume.

These project area benefits, however, would result in impacts to other areas. They would result in an unknown level of impacts elsewhere along the transportation route to, and at, a processing facility, such as additional road traffic (more than 1,000 trucks per year on the Alaska Highway to southern B.C.), spill risk, the same cyanide processing risk, and the impacts of constructing and operating leaching and tailings disposal facilities.

Another environmental factor to consider when evaluating off-site concentrate shipment is the risk associated with handling many shipments of the fine, dry, concentrate with high arsenic content across thousands of miles via several different modes of transport, and the handling risks and procedures at each transfer point.

Applying the non-economic evaluation criteria only to the project area (i.e., ignoring environmental impacts outside the project area discussed above), all five criteria for which a differential impact was determined (wildlife, noise, safety, existing private lands and recreational uses, and subsistence) rated the off-site option as being less favorable than the gravity / flotation / cyanide vat leach option (2).

Economic considerations The direct economic impact to the project from off-site concentrate processing would be between approximately 6 and 9.5 percent of annual gross revenues. While potentially manageable, this cost would have an adverse impact on the viability of the project. The degree of impact cannot be determined with reasonable certainty because it is largely tied to the future price of gold, which is a highly variable commodity. The project would not be able to weather fluctuations in the gold market, however, as well as it could if it did not have to bear these added costs. Disruptive periods of temporary closure would be more likely during gold price declines, thereby directly affecting local workers. Temporary shutdowns that might involve environmental management issues would be more likely during the mine life. The ability of the project to address other issues that might arise during the mine life could be compromised. Also, a major Alaska issue of long standing has been local value-added processing of raw natural resources rather than shipping them out of state. Off-site processing would export jobs from Alaska.

Summary Shipping a high-grade concentrate off site for processing would have the advantage of eliminating the on-site risk from cyanide leaching of the underground tailings, and would reduce the reagents needed for that process and for cyanide destruction. It would, however, require an all-season road and a net increase of approximately 880 truck trips per year, or an increase of approximately 40 percent more trips than for the on-site processing scenario. It would cause an unknown level of impacts elsewhere along the transportation route to, and at, a processing facility (additional traffic, spill risk, the same cyanide processing risk, and impacts of a tailings disposal facility). Five evaluation criteria rated this option as less favorable than on-site concentrate processing.

The direct economic impact to the project would be between approximately 6 and 9.5 percent of annual gross revenues, which would have an adverse but unknown impact on the viability of the project because of the highly variable price of gold. If the added cost caused temporary closures, workers would be affected, and environmental management issues could arise.

It would appear, therefore, that an argument for off-site processing can only be made if the underground mine at the Pogo Mine site is not considered to be the most environmentally responsible site to place the tailings, and if the processing of concentrate at the Pogo Mine site is considered to present a risk high enough to offset the economic and other environmental impacts of off-site processing. The Applicant, however, has proposed a mill process that minimizes the use of cyanide, uses a long-proven cyanide destruction process, and would place all tailings that do contact cyanide back underground in the mine workings from which the ore originally came. All of these processing activities would be done with a state-of-the-art facility. The Fort Knox Mine near Fairbanks, which processes approximately 15 times more ore with a cyanide leaching system than would the Pogo Mine, has operated without incident for 6 years. Fort Knox uses whole ore cyanidation and processes approximately 40,000 tpd through a sulfur dioxide and air cyanide destruction process. The Pogo Mine would first use flotation to produce a smaller volume of concentrate (approximately 250 tpd) and then would process the concentrate through the sulfur dioxide and air process.

There appears to be no reason, therefore, to conclude that on-site processing of concentrate would have greater environmental impacts than processing off site. *Thus, there appeared to be no substantial environmental advantages from off-site processing, and this option was not carried forward for alternatives analysis.*

Tailings Disposal

Because the tailings disposal component, and the following mill and camp location component, were inextricably linked to the location of the ore body, and to each other, screening required a coordinated analysis of all three components. Because the location of the ore body is fixed, environmental and technical factors somewhat limited the scope of the screening analysis. A more detailed discussion of the technical aspect of the screening analysis for the tailings disposal and mill site and camp components may be found in Metz (2000). An abbreviated discussion follows.

The tailings disposal component had two subcomponents: type of disposal and disposal location.

Disposal type This subcomponent had three options:

1. Underground as a paste backfill in the mine
2. Surface dry-stack disposal / RTP using dewatered tailings
3. Traditional surface disposal of wet tailings behind an impoundment structure

In addition to the obvious advantages of reducing the volume of tailings to be disposed of on the surface, placing the sulphide-containing concentrates underground where acid rock drainage and metals leaching could be better controlled, and providing needed structural support in the mine to allow continued mining, *underground disposal was retained because it was the Applicant's preferred option.*

Analysis of traditional options for wet tailings disposal and dry-stack tailings disposal indicated that each method possessed certain advantages and disadvantages, and that both methods could be feasible from environmental, technical, and economic perspectives. It was determined that the characteristics of the physical location of a given disposal option, however, would be the most important factor in determining which disposal type options would be retained for further analysis. The following discussions of the subcomponent for tailings disposal location and the component for mill and camp location, therefore, frequently reference the interdependency of these components.

- The surface dry stack / RTP option had four sub-options for a tailings facility liner:
    1. Lined dry stack
    2. Lined RTP
    3. Unlined dry stack
    4. Unlined RTP

Because technical data were not available during the screening process to determine whether a liner would be needed, *all four sub-options were carried forward for detailed analysis of alternatives.*

The *traditional options for wet tailings placement was not retained for further analysis* because, as discussed below under disposal location, the locations for this option either were technically deficient, or locations for a surface dry stack / RTP option were superior for other reasons.

Disposal location Thirteen options for tailings disposal sites in the mine vicinity were identified for this subcomponent, as well as one generic off-site location outside the project area (Figure 2.4-1). In addition, a separate tunnel option under the Goodpaster River that might address concerns with surface tailings transfer to a tailings disposal site on the west side of the Goodpaster was identified.

Seven sites were on the west side of the Goodpaster River, proximate to a “lower mill and camp site” located approximately 1 mile west-southwest of the ore body. Six sites were on the east side of the Goodpaster, proximate to an “upper mill and camp site” located over the ore body. A third location for the mill and camp site was on the valley floor near the existing development camp where Pogo Creek enters the Goodpaster River. All tailings disposal sites were within 5 miles of the Pogo ore body.

From a wetlands perspective, there was no site that reasonably could be considered for tailings disposal within a radius of five miles of the ore body that did not include wetlands. Sites beyond that distance were not investigated because in addition to technical and economic considerations, the length of roads that would have been necessary to access such sites would have themselves impacted substantial areas of wetlands and likely required one or more additional stream crossings and impacts to other drainages.

- Each of the seven disposal sites west of the Goodpaster River was rejected from a technical feasibility perspective as having seriously difficult foundation conditions for dam design, more difficult access problems from the mill complex, or higher risk as determined from the consequences of a failure of the tailing delivery system. The lower mill and camp site associated with these disposal options, as discussed below, also suffered on geotechnical grounds. Also, developing a disposal site and mill and camp complex west of the river would dramatically spread project facilities to both sides of the valley, substantially increasing impacts to many other resources.

- An option related to, but separate from, the disposal location component was whether a tunnel under the Goodpaster River for moving either ore or tailings from the mine to a mill or tailings disposal site on the west side of the river might address some of the impacts associated with a surface crossing of the river, and thereby make analysis of the west side mill or tailings disposal sites more favorable. Even ignoring the technical deficiencies described above for the west side disposal sites, and those below for the west side and valley bottom mill and camp sites, the tunnel option still was dropped from further consideration. Not only did it fail to demonstrate any more favorable advantages for any of the issue criteria, but the water inflow to the tunnel would very substantially increase water management problems and result in a considerable increase in the volume of mine water that would have to be discharged. *This substantial increase in discharge was considered a fatal flaw.*

- Six sites were located on the east side of the Goodpaster River (Figure 2.4-1).
  - Site 1 was located approximately 5,000 feet (ft) from the ore body at the head of Liese Creek Valley. The site met all requirements for both conventional slurry and paste/dry-stack systems for tailings disposal, but showed a higher potential as a site for the use of the paste/dry-stack system. The only technical concern at this site was the construction of a water diversion system on the south side of the creek valley where talus deposits exist on the upper slopes.
  - Site 6A was located on lower West Creek approximately 18,000 ft from the ore body. *It was rejected largely on technical grounds* due to the presence of potentially unstable permafrost and foundation problems. Additionally, the site presented difficult access, high spill risk, a large rainfall catchment area, and substantial problems associated with the construction and operation of an adequate diversion system for surface runoff.
  - Site 6B was located on upper West Creek approximately 17,000 ft from the ore body. *It was rejected because of difficult access from the upper process site and potential concerns with seepage control and seismic stability*.
  - Site 6C was located near the head of West Creek approximately 16,000 ft from the upper mill and camp site. The site met all requirements for systems of both conventional slurry and dry-stack tailings disposal, but showed a higher potential as a site for use of the paste/dry-stack system. The concerns identified for this site included a somewhat difficult access and a relatively high spillage risk. Still, this site produced the highest overall technical score for all sites evaluated.
  - Site 9 was located in Sonora Creek approximately 25,000 ft from the ore body. This site was similar to Site 6C and was technically acceptable, but had more difficult access and a high spillage risk due to the much greater distance from the ore body.
  - Site 10, at the Tabletop location above and east of Liese Creek Valley, was approximately 9,000 ft from the ore body. In addition to being predominantly wetlands, it contained a *technical fatal flaw and was rejected* because of insufficient storage volume. It also possessed poor aesthetics (visual impacts) as well as a high spillage risk.

Thus, three sites on the east side of the Goodpaster River were considered technically feasible for tailings disposal: 1 (Liese Creek Valley), 6C (upper West Creek), and 9 (Sonora Creek). Sites 6C and 9 were relatively similar technically, with neither being technically more favorable than the other. Site 9, however, was 9,000 ft farther from the ore body. This site would be more difficult to access, be a considerable distance to pump tailing slurry, and substantially increase the overall project's footprint. Also, traditional wet-tailings disposal did not appear to offer any more favorable advantage over dry-stack disposal. *Thus, because no advantage was seen for Site 9 over Site 6C, the former was dropped from further consideration*.

Sites 1 and 6C then were screened in detail by using the issue screening criteria. For all but three criteria, there were no reasonable differences between the options. For three criteria (water quality, wildlife, and existing recreational activities), Site 6C was judged less favorable. From the water quality perspective, this site would introduce impacts to an additional drainage not otherwise affected by the project. For the wildlife criterion, it would increase substantially the mine area facilities' footprint and affect another drainage. From the perspective of recreational users, this site would be substantially more visible than Site 1 from much longer stretches of the Goodpaster River. In addition, Site 6C would require approximately 3.5 miles of access road that would create more surface disturbance and risk of spillage during hauling. For its part, Site 6C itself did not possess any clearly more favorable advantages over Site 1, which was much closer to the ore body. *Thus, Site 6C was dropped from further consideration*, and *Site 1 was retained for detailed alternatives analysis*.

The final disposal option was at an unknown location outside the project area. This option was discussed above in conjunction with the mill process option of shipping concentrate off site, and was *dropped from further consideration*.

Mill and Camp Location

Six sites for this component were identified (Figure 2.4-1):

1. On the Goodpaster River valley floor immediately west of the ore body below the existing 1525 Portal (Site 1)
2. In the saddle on upper Pogo Ridge southeast of the ore body (Site 3) (there was no site 2)
3. On Pogo Ridge almost immediately above the ore body (Site 4)
4. On the west side of the Goodpaster River somewhat more than 1 mile west-southwest of the ore body (Site 5)
5. In Liese Creek Valley (Site 6)
6. A generic location outside the project area

From an operational and construction point of view, it is preferable that the mill and tailings disposal sites be remote from environmentally sensitive areas, close to the mine and to each other, and of sound geotechnical foundations. An important screening factor for this component, therefore, was the selection of suitable tailings disposal sites. As discussed earlier, all *seven disposal sites on the west side of the Goodpaster River were rejected on technical grounds*. Also, geotechnical drilling at mill and camp Site 5 west of the river confirmed the presence of a deep deposit of ice-rich silt that would cause adverse foundation conditions. Thus*, mill and camp Site 5 on the west side of the river was dropped from further consideration*.

The most complex issue to overcome in process plant siting is the use of paste backfill in the mine as both part of the mine development plan and to reduce surface disposal volumes of tailings. The high density of paste backfill makes it difficult to pump a paste backfill over horizontal distances exceeding several thousand feet, and usually precludes pumping to higher elevations. Design criteria for paste backfill systems usually include location of the paste backfill plant a substantial vertical distance above the mine being filled in order to provide natural gravitational head to assist in paste tailings distribution. Thus, Sites 3, 4, and 6, each above the ore body, had a substantial technical advantage over Option 1 on the Goodpaster Valley floor.

The Goodpaster Valley floor Site 1, however, offered lower project capital costs because it would use the existing exploration adit and there would be no need to construct other shafts. Use of this site, however, would require hauling or pumping ore and/or tailings either across the Goodpaster River to the technically less favorable west side disposal sites or up to the head of Liese Creek Valley (tailings) and a point above the ore body (paste backfill). Shaft access from a site above the ore body, however, would avoid a river crossing, or the need to haul ore and pump tailings to an elevation well above the ore body. In addition, Site 1 had higher impacts for several issue criteria because of its valley floor location (water quality, wetlands, fish, wildlife, reclamation, existing recreational uses, and technical feasibility). Also, this option did not offer any more favorable advantages with respect to any of the issue criteria other than possible economic feasibility. Thus, *mill and camp Site 1 was dropped from further consideration.*

Three mill and camp sites (3, 4, and 6) were located at a higher elevation than the ore body (Figure 2.4-1). Site 4 was immediately adjacent the edge of the ore body. This proximity would provide a clear advantage for minimizing ore and tailings hauling distances. From a water quality perspective, however, Site 4 was at a distinct disadvantage. A road up Liese Creek to access Site 4, which would be higher than the RTP and the tailings dry stack, would substantially increase the area that would drain to the RTP. Additionally, the drainage area between Site 4 and Liese Creek would contribute to the overall drainage area. Modeling showed that precipitation and snowmelt from this drainage area, coupled with fluctuations of the water level in the RTP could, under certain conditions, cause the RTP to overtop its dam and discharge untreated water directly into Liese Creek (Teck-Pogo Inc., 2001d). While such an event is always a possibility, the modeling showed this type of discharge could happen as frequently as once a year. *This possibility was unacceptable from a regulatory perspective; therefore, Site 4 was dropped from further consideration.*

Site 3 on upper Pogo Ridge was approximately 7,000 ft from the ore body. When compared to Site 6 in Liese Creek, both sites were rated the same for all screening criteria except two. For wildlife, Site 3 was considered to have a greater impact because it would expand the project footprint by over a mile, while for recreational use, Site 3 was considered to have a greater impact because it would be more visible to Goodpaster River recreational users. Also, Site 6 was substantially closer to the ore body and therefore would minimize the combined underground/surface haulage and conveying distances from the ore body to the mill, as well as the haul distance to the dry stack tailings pile. In addition, Site 6 would require substantially shorter and more direct return water lines from the RTP, lowering both the cost and risk of water transport, and it would allow for shorter freshwater supply lines. It also would limit impacts only to the Liese Creek drainage. Site 3 did not offer any such clear advantages for any criterion. *Thus, Site 3 was dropped from further consideration, and Site 6 was retained for detailed alternatives analysis.*

The sixth mill site option was at an unknown location outside the project area. *This option was discussed and eliminated above in conjunction with the mill process option of shipping concentrate off site.*

Development Rock Disposal

Two options for this component were identified:

1. Encapsulate mineralized development rock in the dry stack tailings pile in upper Liese Creek Valley (Figure 2.3-1e)
2. Use nonmineralized development rock as construction material for roads, pads, and the RPT dam, or encapsulate it also in the dry-stack tailings pile.

All screening criteria considered both options to have no or low impacts. Both were the Applicant's options; therefore, *both were retained for detailed alternatives analysis*. No other options for this component were identified.

Gravel Source

Two options for this component were identified.

1. Existing or new gravel pits on the Goodpaster Valley floor an in Liese Creek Valley would be used. An existing gravel pit below the 1525 Portal would be expanded (Figure 2.3-1a), with new gravel pits developed at the 3,000-ft airstrip (Figure 2.3-1b) and adjacent to the access road on the west side of the Goodpaster River (Figure 2.3-1). Three material sites would be developed in Liese Creek Valley (Figures 2.3-1b and 2.3-1e).
2. In the second option, nonmineralized development rock that otherwise would be encapsulated in the dry tailings stack would be crushed to produce gravel.

Option 1 was rated as no or low impact for all but two criteria. For both wetlands and wildlife, it was rated as having greater impacts. The second option was rated as no or low impact for all criteria except economic feasibility, for which it was rated as a high impact.

Both options were retained for alternatives analysis. The first because it was the Applicant's proposed option, and the second because it offered advantages for two criteria because it would provide a gravel source from otherwise unused development rock and would not require expanding existing, or developing new, borrow sites.

Construction Camp Location

Only the Applicant's proposed option was identified. This option would place the 200-person construction camp for approximately 2 years at the site of the existing exploration camp below the 1525 Portal in the Goodpaster Valley (Figure 2.3-1a). For all screening criteria, this option was considered to have no or low impacts. *This option was retained for alternatives analysis*.

Laydown Areas

Two options for this component were considered.

1. In the first, permanent laydown areas would be built on the Goodpaster Valley floor below the 1525 Portal (Figure 2.3-1a) and adjacent to the airstrip (Figure 2.3-1b). A smaller permanent laydown area also would be built at the mill site in Liese Creek Valley (Figure 2.3-1c). After construction, the site below the 1525

Portal and airstrip laydown site would be reduced in size to accommodate the lowered operational phase needs.

2. In the second option, an expanded laydown area for operations would be built at the mill site in Liese Creek Valley, and the 1525 Portal and airstrip laydown areas on the Goodpaster Valley floor would be fully reclaimed after construction.

Analysis showed only one criterion for which there was a difference between the options. From the technical perspective, the steep nature of Liese Creek Valley would make creating a large laydown area at the mill difficult, requiring excavation of a substantial volume of material from the valley side. Because of the steepness of Liese Creek Valley, the fact that the necessary construction of the temporary laydown areas on the Goodpaster Valley floor already would have caused surface disturbance, and because these laydown areas would be reduced in size after construction to meet the lowered space requirements of the operational phase, *the second option was dropped from further consideration, and the first option was carried forward for analysis* in Chapter 4.

Power Supply

Two options for this component were identified:

1. Power line
2. On-site generation

For eight of the ten criteria for which differential impacts were identified between these two options (water quality, fish, wildlife, noise, new industrial and commercial uses, recreational resources and uses, subsistence, and socioeconomics), the power line option was deemed to have fewer impacts. For two criteria (wetlands and existing privately owned lands and recreational activities), however, the power line option was expected to produce greater impacts because of the need for a power line. *Both options, therefore, were retained for detailed alternatives analysis*; the first because it was the Applicant's preferred option, and the second because it offered a more favorable advantage for two of the issue criteria.

Water Supply

This component had two subcomponents: industrial water supply and domestic water supply.

Industrial water supply Four options were identified for this subcomponent:

1. Mine drainage
2. RTP
3. Wells
4. Goodpaster River

The use of one source of water over another would not in itself have a direct impact on ground water or surface water quality because all discharges would have to meet water quality standards. By using the poorer quality water sources first in the mill process, however, there would be less need to treat the poorest quality water to meet discharge standards. The Applicant's strategy, thus, was not an either/or situation, but rather a hierarchy of use for industrial purposes.

For all screening criteria except one, the use of water from any of the four water source options was considered to have no or low impact. From the fish and aquatic habitat criterion perspective, potential for dewatering the Goodpaster River during the winter months in a low-flow year and entrapment of fry would be possibilities, although the latter could be mitigated by proper design. From the other perspective, the Goodpaster River option did not appear to offer any more favorable advantages over the other three options, which were judged adequate to supply the project's water needs. *Thus, the Goodpaster River was dropped from further consideration as an industrial water supply source*.

Domestic water supply Two options were identified for this subcomponent:

1. Wells
2. Goodpaster River

Screening for this subcomponent produced identical results as for the industrial water supply subcomponent above. For all screening criteria except one, the use of water from the Goodpaster River was considered to have a no or low impact. From the fish and aquatic habitat criterion perspective, however, potential would exist for dewatering during the winter months in a low-flow year. Wells in alluvial gravels, historically, are able to supply up to several hundred gallons per minute and offer reliable year-round service without flood, icing, sediment, fish entrapment, or biological problems. Use of the Goodpaster River option did not appear to offer any more favorable advantages over the use of wells. *Thus, the Goodpaster River option was dropped from further consideration as a domestic water supply source*.

Water Discharge

This component had two temporal phases: the project's development phase and the operations phase.

Development phase This phase had three discharge options for treated wastewater:

1. Underground injection wells
2. Direct discharge to the Goodpaster River
3. Off-river treatment works

For all screening criteria except two, treated water discharge to either a cased, bored well or to the Goodpaster River was considered to have no or low impact. From the fish and aquatic habitat criterion perspective, the Goodpaster River option would pose a greater risk to aquatic resources due to the possibility of process upsets and facility failures. There also could be bioaccumulation of trace metals in fish and other aquatic organisms. From the technical feasibility perspective, however, there were outstanding issues about an increase in discharge volume to an underground well during development, and at what point such an increased volume would in effect become a *de facto* direct discharge to the Goodpaster River.

For all but three screening criteria, water discharge from an off-river treatment works was considered to have no or low impacts. For the wetlands and wildlife criteria, this option was considered to have moderate impacts because of habitat disturbance on the valley floor. For the fish and aquatic habitat criterion, this option was considered to have a low to moderate impact because of the risk of failure during extreme winter conditions, which would coincide with low flows in the Goodpaster River. This option, however, could address the regulatory concerns associated with the underground injection and direct discharge to the Goodpaster options. Thus, because each discharge option offered an advantage over the other, *all three options were retained for alternatives analysis*.

Operations phase This phase had two subcomponents:

1. Excess industrial wastewater discharge from the RTP
2. Domestic wastewater discharge

Industrial wastewater (from RTP) This subcomponent had five options for treated wastewater discharge: discharge into constructed wetlands at the existing borrow pit below the 1525 Portal in the Goodpaster Valley; discharge to an engineered soil absorption system (SAS); underground injection to a bored / cased well; treatment and direct discharge to the Goodpaster River; and an off-river treatment works.

- Constructed wetlands For all screening criteria, except one, this option was considered to have no or low impacts. For the technical feasibility criterion, while evidence from some mining operations shows these systems offer good attenuation capabilities, it takes time to establish wetland systems, they are not proven in interior Alaska climates, and it is more difficult to demonstrate attenuation capabilities with these systems then for an engineered SAS that can be designed and constructed to given specifications and tested in the laboratory. For these reasons, and because it did not offer any clear advantage over the SAS option, this option was *not retained for further consideration*.

- Soil absorption system For all screening criteria, this option was considered to have no or low impacts. Given the same treatment plant and same water discharge as the underground injection option, an SAS would offer treatment for ammonia, nitrate, and cyanide if any were present, and even some metals removal. A compliance issue exists, however, because the Applicant has applied for an NPDES permit and not a UIC permit. Because discharges under NPDES are usually measured after all treatment, how discharge monitoring under an NPDES permit would occur with an SAS has not been determined. Because this was the Applicant's preferred option, it was *retained for further analysis*.

    - Soil absorption system location The SAS option had three sub-options for location: in the Goodpaster Valley adjacent to the airstrip (Figure 2.3-1b), in middle Liese Creek Valley, and in the saddle above and southeast of the mill site on Pogo Ridge accessed by a spur road. Geotechnical drilling at the middle Liese Creek Valley site revealed discontinuous permafrost in poorly drained soils; therefore, *this sub-option was dropped from further consideration.*

      For all screening criteria, except one, the Goodpaster Valley sub-option was considered to have no or low impacts. For the wildlife criterion, this sub-option was considered to have moderate impacts because of higher value wetlands and habitat on the valley floor than at the higher elevation in the saddle on Pogo Ridge. For all screening criteria, except one, the saddle above and southeast of the mill site on Pogo Ridge was considered to have low or no impacts. Only for the technical feasibility criterion choice was considered to have a moderate impact because of a less predictable hydrogeologic regime. *Thus, both remaining sub-options were retained for alternatives analysis;* the former because it was the Applicant's proposal, and the latter because it offered advantages for the wetlands and wildlife criteria.

- Underground injection wells This option would discharge underground into a bored / cased well (Figure 2.3-1a). For all screening criteria, except one, this option was considered to have no or low impact. For the technical feasibility criterion, the impact was considered to be moderate because the option offered no potential for attenuation, and there was a question concerning the ability of the well to absorb the potential quantity of water. Because a UIC permit would require monitoring of the discharge prior to injection, this option could address the monitoring compliance issue described above for the soil absorption option. *This option was retained for further analysis* because it was the Applicant's preferred option.

- Direct discharge to Goodpaster River   For all screening criteria except one, water discharge under this option scenario was considered to have no or low impacts (Figure 2.3-1a). From the fish and aquatic habitat criterion perspective, the Goodpaster River option would pose a greater risk to aquatic resources due to the possibility of process upsets and facility failures. The proposed discharge location, however, is not in a spawning area. There also could be bioaccumulation of trace metals in fish and other aquatic organisms. Also, there is a regulatory compliance risk to the company. The discharge location would not be in a spawning area, but water quality standards prohibit mixing zones in spawning areas. Permitting a direct discharge to surface waters, however, is a management method with which EPA's NPDES program is very familiar, compared to the Applicant's proposed SAS. To maintain maximum flexibility, therefore, *this option was retained for further analysis*.

- Off-river treatment works   For all but two screening criteria, water discharge under this option was considered to have no or low impacts. For the wildlife criterion, this option was considered to have moderate impacts because of habitat disturbance on the valley floor. For the fish and aquatic habitat criterion, this option scenario was considered to have a low to moderate impact because of the risk of failure during extreme winter conditions that would coincide with low flows in the Goodpaster River. This option, however, could address the regulatory concerns associated with the SAS and options with direct discharge to the Goodpaster by obviating the point of compliance and mixing zone near spawning habitat issues, respectively. Thus, *this option was retained for further analysis*.

Domestic wastewater   This subcomponent would use a package treatment plant with two discharge options: treatment and discharge to an underground drain field or treatment and direct discharge to the Goodpaster River.

- Underground discharge   For all but one of the criteria, the generic use of an underground drain field rated no or low impacts. For the water quality criterion, the impact was rated high because of a substantial risk of not obtaining a discharge permit because the effluent would not meet water quality standards before discharge to the drain field.

  This option had two sub-options for location of the drain field:

  - Discharge from the permanent Liese Creek Valley camp and mill to a permanent drain field on the Goodpaster River Valley floor near the mouth of Liese Creek, and

  - Discharge of effluent to a temporary drain field on the south-facing side-slope below the camp in Liese Creek Valley. Then, during operations, treated effluent would be piped through the mine to the permanent drain field on the Goodpaster Valley floor, which was originally built for temporary use by the construction camp during the development phase.

  For all criteria except two, the first sub-option rated no or low impacts. For wetlands and wildlife, however, the valley location was considered to have a moderate impact because of higher value wetlands and habitat on the valley floor than at the temporary drain field site at higher elevation adjacent to the mill and camp in Liese Creek Valley.

The second sub-option was rated for all criteria as having no or low impact because the previously installed drain field at the construction camp below the 1525 Portal would be used on a permanent basis during operations, rather then having to construct a new drain field on the valley floor, as in the first option, or to continue use of the temporary drain field in more marginal soils adjacent to the Liese Creek camp. Thus, the second sub-option was considered superior to the first.

- Discharge to Goodpaster River For all screening criteria except one, water discharge under this option scenario was considered to have no or low impacts. From the fish and aquatic habitat criterion perspective, impacts were rated locally moderate because of potential treatment facility failures. The discharge, however, would contain conventional pollutants with a low probability of bioaccumulation of trace metals.

  In final analysis, because of the substantial risk of not obtaining a discharge permit for the option of underground drain field discharge, and because package treatment technology is well understood and reliable in proper conditions, the *underground discharge option was dropped from further consideration* and the *treatment and direct discharge to the Goodpaster River option was retained for further analysis*.

Fuel Supply and Storage

This component had two subcomponents: fuel supply and fuel storage. For both subcomponents, the screening evaluation focused primarily on the risk of spills and the severity of their impacts. This focus on spills was important because the risk of spills from hauling large quantities of fuel was a key factor in evaluation of the project's access type and route discussed later.

Supply route This subcomponent had three options: all-season road access, winter-only access, and air access.

- All-season road versus winter-only access (winter road or trail) While inextricably related to the surface access component discussed later, the all-season and winter-only access fuel supply route options were evaluated from the perspective of just how fuel would be supplied to the mine site. In other words, any impacts attributed to an all-season or winter-only access option that were not directly related to transport of fuel were ignored. For all eight issue criteria for which differential impacts were identified between these two options (water quality, wetlands, fish, wildlife, noise, safety, new industrial and commercial uses, and technical feasibility), greater impacts were found from use of a winter-only access option for fuel supply. The primary basis of concern for four of the criteria (water quality, wetlands, fish, and wildlife) was the substantially increased risk of a fuel spill occurring in or near a waterway, considering the routes of the winter-only access options, and the severe daylight and temperature constraints that exist in winter.

  From the perspective of the noise criterion, the intensive 8- to 10-week fuel haul would have greater impacts than a year-round resupply effort. For the safety criterion, the winter-only access option was considered to have high impacts due to the increased likelihood of accidents because of extreme cold and darkness. From the perspective of the new industrial and commercial uses criterion, winter-only access would not be as useable as an all-season road, and technical feasibility impacts were considered greater because of the difficulties of moving a large volume of fuel during a short period in very low temperatures and light conditions. Thus, the winter-only access fuel supply option was judged to be substantially less favorable than the all-season road option.

All-season road routes From the perspective of specific route sub-options for the all-season road, differential impacts were identified between the Shaw Creek Hillside and the South Ridge routes for three criteria: wetlands, fish and wildlife. In all cases, the Shaw Creek Hillside route was considered to have potential for greater impacts because it crosses more waterways and generally more important wildlife habitat than does the South Ridge route.

Winter-only access routes From the perspective of specific winter-only access route sub-options, differential impacts were identified between the Shaw Creek Flats and the Goodpaster Valley routes for five criteria: water quality, wetlands, fish, wildlife, and technical feasibility.

In all cases the Goodpaster Valley route was considered to have potential for greater impacts because it makes nine crossings of the Goodpaster River while the Shaw Creek Flats route only makes two crossings of Shaw Creek and one of the Goodpaster.

From the perspective of the first four of those five criteria, the primary issue was the increased risk of a spill occurring on or near a waterway. From the perspective of technical feasibility, the construction and maintenance of a winter ice road or perennial winter trail and ice bridges are difficult, especially if unpredictable weather and snow conditions are a factor. Thus, because the Goodpaster River route would have nine crossings, versus only three for the Shaw Creek Flats option, the former was considered to have a higher impact.

- Air access Screening for the air fuel supply option showed no or low impacts for all but four criteria. Moderate impacts were predicted for the noise, safety, and technical criteria while a high impact was predicted for the economic feasibility criterion.

Because the subcomponent for the fuel supply route is dependent on the entire project access system that is ultimately selected, *none of these three fuel supply sub-options discussed above could be dropped on the basis of this analysis alone*. This fuel supply subcomponent, however, is a very important part of the overall project access component, and the results of this screening analysis described immediately above weighed heavily in the overall screening analysis of project access described later.

Storage location This subcomponent had two options:

1. The first would construct temporary diesel storage tanks on the Goodpaster Valley floor below the existing 1525 Portal (Figure 2.3-1a) and adjacent to the airstrip (Figure 2.3-1b). Smaller, permanent fuel storage would be built at the mill in Liese Creek Valley (Figure 2.3-1c), and at the mouth of the 1525 Portal above the valley floor (Figure 2.3-1a). After the construction phase, all diesel storage would be removed from the Goodpaster Valley floor.
2. The second option would be the same, except there would be no permanent diesel storage at the mouth of the 1525 Portal above the valley floor.

Potential impacts from this component were related to the temporary fuel storage on the valley floor for the approximately 2 years of construction. Because such temporary fuel storage would occur with both options, the issue for this component was only whether a permanent, 5,000-gallon diesel fuel storage tank would be maintained during operations at the mouth of the existing 1525 Portal in addition to the permanent fuel storage facilities at the mill. This relatively small storage tank, which would be inside a bermed, lined pit immediately adjacent to other equipment on the pad at the mouth of the 1525 Portal, would be approximately 200 ft above, and 1,400 ft from, the Goodpaster River. For all resources, permanently maintaining a storage tank at this location was considered to have no or low impacts. Because this was the Applicant's preferred option, and because the second option did not offer any advantages, *the first option was carried forward for alternatives analysis*.

Surface Access

This component had four subcomponents: type of access, access route, management of that access, and ultimate disposition of the access system at mine closure.

Type This subcomponent had three options: all-season road, winter-only access, and a railroad.

- 1 & 2 All-season road and winter-only access Generically screening the all-season and winter-only access options was difficult because impacts varied across evaluation criteria depending on which of the other subcomponent options (route, management, and disposition) were considered. Generally, however, an all-season road was considered to have fewer impacts than winter-only access. The discussions below for the other surface access subcomponents (route, management, and disposition) describe these impacts.

  Eight screening criteria (water quality, fish, noise, safety, new industrial and commercial uses, socioeconomics, technical feasibility, and economic feasibility) showed generally greater impacts for a winter-only access option while five criteria (wetlands, wildlife, reclamation, existing residents and recreational users, and subsistence) showed generally greater impacts for the all-season road option.

  For the technical feasibility and economic criteria in particular, a winter-only access option was considered of high impact because of the possibility that during at least one winter over the expected mine life weather conditions would not permit a winter access window of sufficient duration to allow transport of all required materials, fuel, and supplies to the mine site. Because the winter-only access option was rated more favorable for the five criteria mentioned, however, *the winter-only access option was retained for detailed analysis of alternatives, in addition to the Applicant's proposed all-season road*.

- 3. Railroad A rail system would be technically feasible and could provide adequate surface access for the Pogo Mine project as well as for some other potential industrial and commercial resource uses. Such a system, however, would not provide long-term public access to the area. This absence of public access can be viewed as positive or negative based on issues raised during scoping. It certainly would allow for restricting public access. For most criteria, a rail system rated little differently from the all-season road option.

  Railroads by their nature have severe grade limitations. Thus, from the existing transportation infrastructure near the Richardson Highway, the only reasonable route would be up the Goodpaster Valley. From the perspective of the wetlands issue, a

Goodpaster Valley route would affect more area than would the all-season or winter-only access options. A Goodpaster Valley route also would affect existing land uses. The TBAP says that access should avoid the corridor (7D1) unless no feasible and prudent alternative exists. A railroad right-of-way would require a special exception to the TBAP.

From the perspective of economic feasibility, the costs and logistical problems of dealing with a rail system not connected to an existing rail center (e.g., the Alaska Railroad) would be very substantial. The maintenance facility (locomotive and cars), loading and unloading facilities, roadbed maintenance crews, and transfer facilities for equipment, personnel, and supplies would require more land than other transportation options and a large capital investment.

Railroads are efficient at moving large volumes over long distances. The small-scale transportation needs of the Pogo Mine project (average of five to seven trucks per day, plus periodic personnel change-outs), and the short, approximately 50-mile system length, could not support the capital investment and operating cost of a rail transportation system.

Analysis showed that a railroad option offered no substantial advantage over other mitigated options while being very expensive to construct and operate. Thus, *the railroad access option was dropped from further consideration*.

Route The two remaining surface access type options (all-season road and winter-only access) had five route options between them.

- All-season road The all-season road option had three route sub-options: Shaw Creek Hillside, South Ridge, and Dean Cummings Crossing.

  - 1 & 2 Shaw Creek Hillside and South Ridge Screening of the Shaw Creek Hillside and South Ridge route sub-options (Figure 2.4-3) showed that for three criteria (wetlands, fish, and wildlife), lower impacts were expected for the South Ridge route. Thus, because the Shaw Creek Hillside route was the Applicant's preferred sub-option, and because the South Ridge route offered an environmental advantage for three criteria, *both route options were retained for alternatives analysis*.

    Richardson Highway egress The Shaw Creek Hillside sub-option had four route choices for initial egress from the Richardson Highway at the beginning of the route: the existing Shaw Creek Road / Rosa route, Pipeline, Keystone, and Tenderfoot (Figure 2.4-4).

    - Existing Shaw Creek Road/Rosa This route was considered to have moderate impacts for four criteria (wetlands, fish, noise, and safety). *It was retained for further analysis* because it was the Applicant's proposed option.

    - Pipeline This route was considered to have moderate impacts for the fish and safety criteria, but a high technical feasibility impact. There is an existing "underpass" of TAPS at an appropriate location for this route, but it is too low to provide clearance for standard highway trucks. The road would have to be lowered at this point with a carefully engineered excavation under Alyeska Pipeline Service Company supervision. The existing bridge on the TAPS work pad could not support projected project loads and would have to be reconstructed. The major reason for the high impact rating, however, was because this route would follow the work pad for a distance of approximately 4 miles immediately adjacent to the elevated pipeline. This route would be dangerous, and Alyeska likely would strongly oppose this option, especially given that there are other options. The single biggest accidental threat to TAPS security is from large vehicles colliding with the above ground pipeline. Thus, *this option was dropped from further consideration*.

- Keystone This route was considered to have moderate impacts for three criteria (fish, wildlife, and technical feasibility) and a high impact for wetlands. From a fish perspective, this route would involve a new crossing of Shaw Creek, and for wildlife, this route would traverse prime waterfowl habitat and affect nesting trumpeter swans. From a technical perspective, this route would have to pass under the same elevated portion of TAPS as would the Pipeline route. The high impact to wetlands would occur because the route would traverse approximately 3.5 miles of primarily wetlands, requiring a large rock or gravel fill that would necessitate high maintenance. Because of these impacts, and because this route did not offer any clear advantage not already offered by the two other retained choices, *it was dropped from further consideration*.
- Tenderfoot This route, which would be similar to the Shaw Creek Road / Rosa route except that it would avoid the existing Shaw Creek Road, had the same impact ratings as the Shaw Creek Road / Rosa route, except for four criteria. It was rated a high impact for economic feasibility because it would require building an entirely new access road. It rated as having lower impacts for fish, noise, and safety criteria, the latter two because it would avoid passing homes along the existing Shaw Creek Road. Because the low fish, noise, and safety ratings offered advantages over the Shaw Creek Road / Rosa route, *this route was retained for alternatives analysis*.

✦ 3. Dean Cummings Crossing This sub-option would be approximately 64 to 70 miles in length. It would begin approximately 28 miles east of Delta Junction where the Alaska Highway crosses the Gerstle River (not shown in Figure 2.4-3). The route would follow New Cummings Road northwest to the vicinity of Dean Cummings Junction where it would cross the Tanana River. From this point the route was not well defined, but would pass close to Healy Lake and then up the Healy River and into the Goodpaster drainage. It would require a major bridge across the Tanana, and between five and eight other bridges depending on the route.

Impacts to subsistence use, fish, wildlife, and wetlands likely would be substantially greater than for either of the other two route options. In addition, being between 33 to 45 percent longer, this option would be substantially more costly than the other options. This route would cross lands privately owned by the Village of Healy Lake, which has stated its strong opposition to any all-season road into the area. Thus*, this sub-option was dropped from further consideration.*

- Winter-only access The winter-only access option had two route sub-options (Figure 2.4-3):

1. Shaw Creek Flats
2. Goodpaster Valley

All six evaluation criteria for which differential impacts were identified between these sub-options (water quality, wetlands, fish, wildlife, existing privately-owned lands and existing recreational and commercial uses, and subsistence) showed greater impacts for the Goodpaster Valley route than for the Shaw Creek Flats route.

For three criteria (water quality, fish, and wildlife), the major concern was the risk of fuel spills, as discussed earlier under the fuel supply component. The Goodpaster Valley route would have nine ice bridge crossings of the Goodpaster River versus a maximum of two over Shaw Creek and one over the Goodpaster River for the Shaw Creek Flats route. It also would cross more Conservation Priority Index lands than the Shaw Creek Flats route.

From a wetlands perspective, the Goodpaster Valley route would require more riverine habitat disturbance. For the existing privately owned lands and recreational activities criterion, the Goodpaster Valley route would affect a substantially higher number of owners/users, and it would be closer to Healy Lake's major subsistence use area. For no criterion did the Goodpaster Valley route offer an advantage. Thus, while this route would be used for the first 2 years of mine development, and possibly longer, as an ongoing route for winter surface access to the Pogo mine site, *the Goodpaster Valley option was dropped from further consideration and only the Shaw Creek Flats winter-only access option was carried forward* for alternatives analysis.

✦ The Shaw Creek Flats route had two sub-options.

  The first was a winter access route for approximately 25 miles up the bottom of the Shaw Creek Valley, requiring a new route for approximately the last 10 miles, to an approximately 18-mile all-season road over the divide to the Goodpaster River Valley.

  The second was a shorter, approximately 15-mile winter access route on existing trails that would meet a similar but approximately 30.5-mile all-season road south of Gilles Creek.

All six evaluation criteria for which differential impacts were identified between these sub-options (water quality, wetlands, fish, new industrial and commercial uses, technical feasibility, and economic feasibility) showed greater impacts for the sub-option of constructing an annual winter access all the way up the bottom of Shaw Creek Valley. For no criterion did this sub-option offer an advantage; thus, *it was dropped from further consideration and the second option was carried forward for detailed analysis*.

Management This surface access subcomponent had three elements: design, use, and location of the security gate.

1. Design The all-season and winter-only access design options each had two sub-options.

✦ All-season road ─ one lane with turnouts, or two lanes For all but two criteria, no differential impacts between the options were identified. For the safety and new industrial and commercial uses criteria, however, the two-lane design was considered more favorable. The single-lane option showed no advantage for any of the criteria. Thus*, only the two-lane option, as proposed by the Applicant, was carried forward for alternatives analysis*.

✦ Winter-only access ─ a traditional snow and ice road, or a perennial winter trail A traditional snow and ice road surface would be built on top of the vegetation while a perennial winter trail design would entail developing a route with a flat surface that sometimes involved small cuts and fills and partial removal of surface organics.

For all but two criteria, no differential impacts between these sub-options were identified. For the wetlands criterion, greater impacts were expected for the perennial winter trail sub-option because of greater surface disturbance. For the economic feasibility criterion, greater impacts were expected for the traditional winter-only access, which would be more costly to construct each year. The potential for too short an annual resupply window for winter-only access is considered by the Applicant to be a fatal flaw for the traditional winter-only access sub-option. Because the perennial winter trail standards sub-option potentially offers a method for increasing the length of the use window for winter-only access during warmer, low-snow winters, however, *both sub-options were retained and carried forward for alternatives analysis*.

2. Use This element had three options for use during mine operations: use by the Pogo project only, use by the Pogo project as well as other industrial and commercial users, and use by everyone.

While for the majority of criteria, restricting use only to the Pogo project was the more favorable option, for three criteria (new industrial and commercial uses, recreational resources and uses, and socioeconomics) each of the other two options was more favorable. Thus, *all three options were carried forward for alternatives analysis*.

3. Security gate location Two locations for a security gate were considered; near the end of the existing Shaw Creek Road, and at Gilles Creek approximately 23 miles up the Shaw Creek Valley from the end of the existing Shaw Creek Road.

Both locations were retained for alternatives analysis; the former because it was the Applicant's proposed location, and the latter because it was more responsive to the TVSF management guidelines.

Disposition This surface access subcomponent, applicable only if there were to be an all-season road, had three options:

1. Removal and reclamation
2. Conversion to a recreational trail
3. Leaving the road open following closure of the Pogo project

- Analysis of the conversion to a recreational trail option showed there was not enough information at present to adequately screen it. For example, would motorized vehicles be allowed on the trail? Also, there appeared to be no reason at this time to analyze just one road disposition option that would not become effective for more than a decade, during which conditions could change. In addition, by analyzing the other road disposition options to remove and reclaim the road, as well as leaving the road open at the end of the Pogo project, the impacts analysis would cover a range of options that would include a recreational trail. Thus, *the recreational trail option was dropped from further consideration.*

- The majority of criteria rated removal and reclamation of the road as more favorable than leaving the road open. For six criteria (reclamation, industrial and commercial uses, recreational uses, socioeconomics, technical feasibility, and economic feasibility), however, leaving the road open following closure of the Pogo project was more favorable. Thus, *both these options were carried forward for alternatives analysis*.

The option to leave the road open had two sub-options:

- Use by industrial and commercial users
- Use by everyone

Each option was rated as being more favorable than the other for at least one criterion. Thus, *both sub-options were carried forward for alternatives analysis*.

Air Access

This component had three subcomponents: type of access, management of that access, and ultimate disposition of the access system at mine closure.

Type This subcomponent had three options: an air-only option, air access as a complement to surface access, and no air complement to surface access.

1. Air-only This option was considered for five criteria (safety, new industrial and commercial uses, socioeconomics, technical feasibility, and economic feasibility) to have high impacts, and by two (noise and existing land ownership and recreational uses) to have moderate impacts. Winter-only access still would have to be constructed up the Goodpaster winter trail for two or three consecutive seasons in order to mobilize and demobilize the equipment and supplies necessary to construct the 5,000-ft airstrip at Tabletop and the mine, and to supply the initial inventory. After construction, access would be predominantly by air, but winter-only access still would be necessary periodically for items too large to be transported by air.

   From a technical feasibility perspective, this option would not provide the required reliability for a 24-hour-per-day, 7-day-per-week mining operation that would run for 12 years. Wind data collected at the Tabletop airstrip site indicated strong prevailing winds at approximately 90° to the alignment of the airstrip (ABR Inc., 2001). These crosswinds, combined with unpredictable gusts and turbulence near the ridge tops, could render the strip unavailable or unsafe for considerable periods of time. The data indicated that the crosswinds at the Tabletop location would exceed published Federal Aviation Administration (FAA) guidelines for normal airstrip construction and operation (Teck-Pogo Inc., 2001a).

   Based on daily weather and logistical site records related to air access availability during 2000 at the existing Pogo airstrip in the Goodpaster River Valley, access was restricted 21 percent of the time either part of the day or all day by weather conditions, either at the Pogo Mine site or at Delta. The reliability of an air access system associated with a 5,000-ft airstrip at the Tabletop site very likely would be somewhat worse.

   First, the 21 percent restricted availability figure for the existing Pogo airstrip was based on single-engine Cessna 206 and twin-engine SkyVan aircraft. These aircraft are relatively small and can often fly up the Goodpaster Valley in weather conditions that would not be possible with the DC-6 or C-130 aircraft that would use the Tabletop site. Small aircraft can start up the valley in marginal weather and, while prepared to turn around if necessary, often can make it through to the site. These marginal days were not logged in the site records as part of the 21 percent restricted days, and they would increase that figure because larger aircraft could not risk beginning a trip until weather conditions were certain.

Second, the Tabletop site has substantially worse weather conditions than the existing lower airstrip in the valley. Visibility restrictions resulting from frequent low cloud ceilings at the 3,500-ft site elevation would add an additional element of uncertainty and unavailability. The site is often in the clouds and would be unusable on many days that the smaller aircraft could make it into the lower airstrip.

Third, the high winds and turbulence experienced by the aircraft at the 3,000- to 4,000-ft elevation are often subdued near the Goodpaster Valley floor. The crosswind and turbulence component at the Tabletop site would additionally restrict use of the airstrip, even on some clear days.

Based on Year 2000 records and the reasons discussed above, it appears that availability of a Tabletop airstrip would be lower than for one in the Goodpaster Valley. While it is difficult to estimate actual availability of a Tabletop airstrip, it is possible that the elevation, wind, and visibility issues could combine to render the airstrip unavailable between 25 and 30 percent of the time. Such restrictions would cause substantial disruptions to many aspects of mine operations, including crew changes and critical component resupply.

From a safety perspective, an air-only option would be inherently less safe than a ground access option for many of the same reasons discussed above for technical feasibility. Given those restrictions, and because the Tabletop site would not meet FAA safety guidelines, it is doubtful a prudent operator would accept the liability and business risks associated with operating such an airstrip.

From an economic feasibility perspective, this option would be substantially more costly than a ground access option. Analysis showed that costs of transportation by air would be approximately $400 per ton, or three times greater compared with approximately $127 per ton for surface transportation with an all-season road. This higher cost would result in a difference of approximately $8.3 million annually. The cost of transporting personnel by air would result in an additional $0.7 million dollars. Together, the air-only option would have annual costs of approximately $9 million, or approximately 9 percent of the gross annual revenue expected of $100 million expected for the project (Teck-Pogo Inc., 2002a). This expense would place an economic burden on the project that would not be conducive to long-term project stability.

There would be other related increased costs for an air-only option. Without surface access, the cost of constructing a power line would increase between approximately $1 million and $4.7 million, depending on whether it were built in summer or winter. And, the costs for constructing a winter road for additional years would be in excess of $1 million. Also, there would be inevitable additional costs from weather-related delays in personnel shift changes, at approximately $55,000 per day.

Other indirect costs would include additional power line maintenance, which would be more difficult without support of an adjacent surface access route. There would be management complexities associated with an air-only option that are difficult to quantify, but that would ultimately cause inefficiencies and increased costs. Inventory management would be intensive because all incoming loads would have to be broken down from highway loads and rehandled at least three extra times, increasing risk of damage, spills, and other losses. During construction, if major mine components were not available to make the brief time window for use of the winter road, there would either be project delays or complex workarounds required that would add costs and risk to the project.

For the new industrial and commercial uses criterion, the air-only option was found to be less favorable than a ground access option, as it was for the socioeconomic criterion, because ground access would have a more favorable influence on additional economic development in the project area.

Also, an air-only option would reduce opportunities for local, stable, year-round employment. An all-season road option would allow a 4-day-on, 4-day-off shift during which workers would be able to be home every 4 days. Given the high transport costs and the lack of a predictable flight schedule, a 4-day-on, 4-day-off shift would not be used under the air-only option. A 2-week-on, 2-week-off shift would be used. Thus, workers would have less frequent contact with their families. And, the longer rotation would allow workers to live far from their place of employment, thereby reducing the beneficial socioeconomic impact on the Delta area.

From an overall screening perspective, the third-party EIS team recommended the air-only option be dropped from further consideration for the following reasons: this option would still require periodic, ongoing use of a Goodpaster winter-only access; it could not provide a reliable and safe transportation system needed to support mine operations; the costs of flying almost all fuel and materials to the site would place a serious economic burden on the project; and local socioeconomic benefits would be lost.

Following their review of this recommendation, the agencies and Tribes requested a more detailed analysis of this option so that the agencies could specifically make a better informed decision on whether to retain the option for additional analysis. In response, the Applicant produced a more detailed evaluation of an air-only option (Teck-Pogo Inc., 2001a), which the third-party contractor was tasked to review, in addition to other available information (Michael Baker Jr., 2001). Following analysis of these documents, EPA (2001b), COE (2001), and ADNR (2001a) each determined that *an air-only option was not reasonable and practicable and was not responsive to the purpose and need. Therefore, it was dropped from further consideration*.

2. Air complement to surface access This option had two sub-options: a 3,000-ft airstrip in the Goodpaster Valley (with the all-season road option) and a 5,000-ft airstrip at Tabletop (with the winter-only access option). Based on the concerns discussed immediately above for the 5,000-ft airstrip, this sub-option was dropped, and *only the 3,000-ft airstrip was retained for alternatives analysis*.

3. No air complement to surface access This option was judged to have low impacts for all criteria except two. For the safety criterion, having only ground access was judged less favorable than having the flexibility of an air component, and from the perspective of new industrial and commercial uses, having no air complement to ground access was considered to have a high impact.

   From a strictly practical perspective, however, this option did not make sense. First, there is an existing airstrip at the site that has been used for many years; therefore, a new airstrip would not introduce air access where there has been none before. Second, under the winter-only access option, there would have to be a permanent airstrip someplace to move workers and supplies to and from the site during the approximately 44 weeks when the winter-only access would not be in operation. For the all-season road option, the only option where the no complement to ground access option could apply, a 3000-ft airstrip would have to be available at least for the first year of construction to move workers and supplies to and from the site until the road was completed. Thus, this option would necessitate abandoning use of an existing 3,000-ft airstrip and require all personnel and supplies to move via the all-season road, when completed. Continued use of the existing 1,500-ft airstrip would not be possible because the road bridge across the Goodpaster River would actually cross the southern end of the existing airstrip, making it unusable within approximately 1 month from start of project construction.

   Alternatively, under the all-season road option, aircraft would use the airstrip approximately two to four times per week. This air traffic would be a small addition to other, non-Pogo flights in the area, especially in a state where small planes are common. Also, even though the Pogo Mine project would have an all-season road, maintaining an airstrip for safety purposes is very important in isolated communities, especially because the trip just to the Richardson Highway would be more than 50 miles. Thus*, having no airstrip was not considered practical and it was dropped from further consideration*.

Management This subcomponent had three options, use by:

1. Pogo project only
2. Pogo and other industrial and commercial users
3. Everyone

Although for the majority of criteria, restricting use only to the Pogo project was the more favorable option, for three criteria (new industrial and commercial uses, reclamation, and socioeconomics), each of the other two options was more favorable. Thus*, all three options were carried forward for alternatives analysis*.

Disposition This subcomponent had two options: removal and reclamation of the airstrip and leaving it open following closure and reclamation of the Pogo project.

1. Removal and reclamation The majority of criteria rated this option as having no or low impacts. For four criteria (reclamation, new industrial and commercial uses, recreational users, and economic feasibility), this option was considered to have high impacts, and for the socioeconomic criterion, it was considered to have moderate impacts. These five criteria favored leaving the airstrip open. Thus*, both options were carried forward for alternatives analysis*

2. Leave airstrip open This option had two sub-options:

- ✦ Use only by industrial and commercial users
- ✦ Use by everyone

The majority of criteria considered these sub-options to have similar impacts. For the fish, safety, existing recreational uses, and subsistence criteria, the sub-option of use by everyone was considered as having greater impacts, while for the recreational resources and uses criterion, the sub-option of open only to industrial and commercial users was considered as having a high impact. Thus, because each sub-option provided an advantage for at least one criterion, *both sub-options were carried forward for alternatives analysis.*

Power Line Route

This component had two subcomponents, one with two power line route options, and one with one route option (Figure 2.4-3):

1. An all-season road route

- Shaw Creek Hillside
- South Ridge

2. A winter-only access route

- Shaw Creek Hillside

Note: for the option of Shaw Creek Flats winter-only access, the power line in the lower Shaw Creek drainage would follow the power line route along the Shaw Creek Hillside all-season road route and would not be located in the flats near the winter road or perennial winter trail in the valley bottom.

For all evaluation criteria, no differences between the options were identified at the screening level, with most impacts related to the type of ground access (all-season road versus winter only access) that the power line options would follow. Because the Goodpaster Valley winter-only access option was dropped from further consideration, as described earlier, *only the Shaw Creek Hillside and South Ridge power line route options were retained for alternatives analysis.*

Conclusion

As a result of the options screening process, 44 options and 13 sub-options for the 15 project components were retained for detailed alternatives analysis in Chapter 4 (Environmental Consequences). How those options and sub-options were used to form the formal project alternatives is described in Section 2.5 (Action Alternatives Identification).

Summary Options Screening Matrix

This matrix contains all of the components, options, and sub-options developed in Section 2.4.2 (Options Development) down its left side and each of the 16 screening criteria identified in Section A.1.1 (Screening Evaluation and Metrics) listed across the top. The body of the matrix presents the high (**H**), moderate (**M**), and low (**L**) impact ratings produced during the screening process for each option/sub-option and each criterion. These screening ratings are referenced extensively in Section A.1.2 (Options Screening).

Note: It is important that the reader understand that this screening matrix is NOT a summary of the impacts described in Chapter 4 (Environmental Consequences). It is a summary of the impact ratings that were assigned, early in the EIS process, to decide which options would be carried forward for detailed analysis, and which options would be dropped from further consideration.

While most of the impact ratings in this matrix agree with those described in Chapter 4, during detailed impacts analysis several of the impacts in this matrix were determined to be greater or smaller than originally believed almost 2 years earlier. This finding is not surprising because during that period considerably more information became available on which to base impact determinations.

Thus, this matrix represents a “snapshot” of the screening analysis process early in the EIS process. Its primary value is in understanding why particular options were dropped and why others were carried forward for detailed analysis at that time.

Component / Option / Sub-option	W Q	Wet	Fish	Wildl	Air Q	Noise	Safety	Recl’m	Indust	Rec	Exist	Cult	Subsis	Socio	Tech	$$
Milling Process																
▶ Whole ore cyanidation[1]	M	L	M	M	L	L	L	H	L	L	L	L	L	L	L	L
▶ Gravity / flotation / cyanide vat leach[2]	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M
▶ Gravity/flotation/ship concentrate off site	L	L	L	M	L	M	M	L	L	L	H	L	H	L	L	H
Tailings Disposal																
Type																
▶ Underground paste backfill	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
▶ Tailing facility liner	L	M	L	L	L	L	L	L	L	L	M	L	L	L	L	L
✦Lined dry stack	N/A[3]	L	L	L	L	L	L	N/A	L	L	L	L	L	L	N/A	M
✦Lined RTP	N/A	L	L	L	L	L	L	N/A	L	L	L	L	L	L	N/A	M
✦Unlined dry stack	N/A	L	M	L	L	L	L	N/A	L	L	L	L	L	L	N/A	L
✦Unlined RTP	N/A	L	L	L	L	L	L	N/A	L	L	L	L	L	L	N/A	L
▶ Traditional surface wet tailings																

1 Shaded rows are options or sub-options that were dropped from further consideration.
2 Underline – Applicant’s preferred option.
3 N/A – Data not available at time of screening.
4 There was no Site # 2.

Summary Options Screening Matrix

High (H), Moderate (M), and Low (L) Impact Ratings

Component / Option / Sub-option	W Q	Wet	Fish	Wildl	Air Q	Noise	Safety	Recl'm	Indust	Rec	Exist	Cult	Subsis	Socio	Tech	$$
Location																
▶ West side of Goodpaster River																
✦# 2 Traditional wet tailings																
✦# 3 Traditional wet tailings																
✦# 4A Dry stack																
✦# 4B Dry stack																
✦# 5 Dry stack																
✦# 7 Traditional wet tailings																
✦# 8 Traditional wet tailings																
✦West side of Goodpaster via tunnel																
▶ East side of Goodpaster River																
✦# 1 Liese Creek dry stack	L	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
✦# 6A Lower West Creek wet tails																
✦# 6B Upper West Creek wet tails																
✦# 6C West Creek dry stack	M	M	L	M	L	L	L	L	L	L	M	L	L	L	L	L
✦# 9 Sonora Creek wet tailings																
✦# 10 Tabletop dry stack																
▶ Off site (outside the project area)																
Mill and Camp Location																
▶ Below 1525 Portal in valley (Site #1)	M	H	M	M	L	L	L	H	L	L	H	L	L	L	M	L
▶ Upper Pogo Ridge (Saddle, Site #3) [4]	L	M	L	M	L	L	L	L	L	L	M	L	L	L	L	L
▶ Pogo Ridge (Site # 4)	H	M	L	L	L	L	L	L	L	L	M	L	L	L	L	L
▶ West side of G-paster River (Site #5)																
▶ Liese Creek Valley (Site #6)	L	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
▶ Off site (outside the project area)																

[1] Shaded rows are options or sub-options that were dropped from further consideration.
[2] Underline – Applicant's preferred option.
[3] N/A – Data not available at time of screening.
[4] There was no Site # 2.

Summary Options Screening Matrix

High (H), Moderate (M), and Low (L) Impact Ratings

Component / Option / Sub-option	W Q	Wet	Fish	Wildl	Air Q	Noise	Safety	Recl'm	Indust	Rec	Exist	Cult	Subsis	Socio	Tech	$$
Development Rock Disposal																
▶ Liese Creek																
✦Mineralized/encapsulated in dry stack	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
✦Nonmineralized (stack & dam constr.)	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Gravel Source																
▶ New gravel pits in Goodpaster Valley	L	M	L	M	L	L	L	L	L	L	L	L	L	L	L	L
▶ Crush nonmineralized development rock	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H
Construction Camp Location																
▶ Below 1525 Portal in G-paster Valley	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Laydown Area																
▶ Permanent below portal, airstrip, mill	L	H	M	M	L	L	L	L	L	L	M	L	L	L	L	L
▶ Temp: portal and airstrip; perm. at mill	L	H	M	M	L	L	L	L	L	L	M	L	L	L	H	L
Power Supply																
▶ Power line	L	M	L	L	L	L	L	L	L	L	H	L	L	L	L	L
▶ On-site generation	M	L	M	M	L	M	L	L	H	M	L	L	M	M	L	L
Water Supply																
Industrial																
▶ Mine drainage	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
▶ RTP	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
▶ Wells	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
▶ Goodpaster River	L	L	M	L	L	L	L	L	L	L	L	L	L	L	L	L
Domestic																
▶ Wells	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
▶ Goodpaster River	L	L	M	L	L	L	L	L	L	L	L	L	L	L	L	L

[1] Shaded rows are options or sub-options that were dropped from further consideration.
[2] Underline – Applicant's preferred option.
[3] N/A – Data not available at time of screening.
[4] There was no Site # 2.

Summary Options Screening Matrix

High (H), Moderate (M), and Low (L) Impact Ratings

Component / Option / Sub-option	W Q	Wet	Fish	Wildl	Air Q	Noise	Safety	Recl'm	Indust	Rec	Exist	Cult	Subsis	Socio	Tech	$$
Water Discharge																
Development Phase																
▶ Underground injection wells	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	L
▶ Discharge to Goodpaster	L	L	M	L	L	L	L	L	L	L	L	L	L	L	L	L
▶ Off-river treatment works	L	M	M	M	L	L	L	L	L	L	L	L	L	L	L	L
Operations Phase																
▶ Industrial wastewater (from RTP)																
✦Constructed wetlands at borrow pit	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	L
✦Soil absorption system	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
⏩ Goodpaster Valley near airstrip	L	L	L	M	L	L	L	L	L	L	L	L	L	L	L	L
⏩ Middle Liese Creek Valley																
⏩ Saddle above & SE of Pogo Ridge	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	L
✦Underground injection wells	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	L
✦Discharge to Goodpaster River	L	L	M	L	L	L	L	L	L	L	L	L	L	L	L	L
✦Off-river treatment works	L	L	M	M	L	L	L	L	L	L	L	L	L	L	L	L
▶ Domestic wastewater																
✦Underground drain field	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
⏩ G-paster Valley mouth of Liese Ck	L	M	L	M	L	L	L	L	L	L	L	L	L	L	L	L
⏩ Temp Liese Ck, perm. portal camp	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
✦Discharge to Goodpaster River	L	L	M	L	L	L	L	L	L	L	L	L	L	L	L	L
Fuel Supply and Storage																
Supply Route																
▶ All-season road	L	L	L/M	L/M	L	L	L/M	L	L	L	L	L	L	L	L	L
✦Shaw Creek Hillside	L	M	M	M	L	L	L	L	L	L	L	L	L	L	L	L
✦South Ridge	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

1 Shaded rows are options or sub-options that were dropped from further consideration.
2 Underline – Applicant's preferred option.
3 N/A – Data not available at time of screening.
4 There was no Site # 2.

Summary Options Screening Matrix

High (H), Moderate (M), and Low (L) Impact Ratings

Component / Option / Sub-option	W Q	Wet	Fish	Wildl	Air Q	Noise	Safety	Recl'm	Indust	Rec	Exist	Cult	Subsis	Socio	Tech	$$
▶ Winter-only access	M/H	M	M/H	M/H	L	M	H	L	H	L	L	L	L	L	M	L
✦Shaw Creek Flats	M	L	M	M	L	M	M	L	H	L	L	L	L	L	M	L
✦Goodpaster River Valley	H	M	H	H	L	M	M	L	H	L	L	L	L	L	H	L
✦Air	L	L	L	L	L	M	M	L	L	L	L	L	L	L	M	H
Storage Location																
▶ Temp below portal and at airstrip; perm at portal mouth and Liese Creek mill	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
▶ Temp below portal and at airstrip; perm only at Liese Creek mill	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Surface Access																
Type																
▶ All-season road	L	H	L	M	L	L	L	H	L	L	H	L	M	L	L	L
▶ Winter-only access	M	M	H	L	L	M	M	L	M	L	M	L	L	H	H	H
▶ Railroad	L	H	L	M	L	L	L	L	L	M	H	L	L	L	L	H
Route																
▶ All-season road																
✦Shaw Creek Hillside	L	H	M	M	L	L	L	H	L	L	H	L	L	L	L	L
Initial egress from Richardson Hwy																
▸▸ Existing Shaw Creek Road/Rosa	L	M	M	L	L	M	M	L	L	L	L	L	L	L	L	L
▸▸ Pipeline	L	L	M	L	L	L	M	L	L	L	L	L	L	L	H	L
▸▸ Keystone	L	H	M	M	L	L	L	L	L	L	L	L	L	L	M	L
▸▸ Tenderfoot	L	M	L	L	L	L	L	L	L	L	L	L	L	L	L	H
✦South Ridge	L	M	L	L	L	L	L	H	L	L	H	L	M	L	L	L
✦Dean Cummings Crossing																

[1] Shaded rows are options or sub-options that were dropped from further consideration.
[2] Underline – Applicant's preferred option.
[3] N/A – Data not available at time of screening.
[4] There was no Site # 2.

Summary Options Screening Matrix

High (H), Moderate (M), and Low (L) Impact Ratings

Component / Option / Sub-option	W Q	Wet	Fish	Wildl	Air Q	Noise	Safety	Recl'm	Indust	Rec	Exist	Cult	Subsis	Socio	Tech	$$
▶ Winter-only access																
✦ Shaw Creek Flats	M	M	M	M	L	M	M	L	M	L	M	L	L	L	L	L
⏩ To head of Shaw Creek Valley	M	M	M	L	L	L	L	L	M	L	L	L	L	L	H	H
⏩ To south of Gilles Creek	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	M
✦ Goodpaster Valley	H	H	H	H	L	M	M	L	M	L	H	L	M	L	L	L
Management																
▶ Access design																
✦ All-season road																
⏩ One lane with periodic pullouts	L	L	L	L	L	L	M	H	M	L	L	L	L	L	L	L
⏩ Two lane with no pullouts	L	L	L	L	L	L	L	H	L	L	L	L	L	L	L	L
✦ Winter-only access																
⏩ Traditional winter road standards	L	M	L	L	L	L	M	L	L	L	L	L	L	L	L	M
⏩ Perennial winter trail standards	L	H	L	L	L	L	M	L	L	L	L	L	L	L	L	L
▶ Use Road open (versus closed) to:																
✦ Pogo project use only	L	L	L	L	L	L	L	L	H	H	L	L	L	M	L	L
✦ Pogo and industrial / commercial	L	M	L	M	L	M	M	L	L	H	M	L	M	L	L	L
✦ Everyone	L	H	M	H	L	M	H	L	L	L	H	L	H	L	L	L
Disposition																
▶ Remove and reclaim	L	L	L	L	L	L	L	H	H	H	L	L	L	M	M	H
▶ Leave road open (versus closed) to:																
✦ Industrial / commercial	L	H	M	M	L	M	M	L	L	H	M	L	M	L	L	L
✦ Everyone	L	H	M	H	L	M	H	L	L	L	H	L	H	L	L	L

[1] Shaded rows are options or sub-options that were dropped from further consideration.
[2] Underline – Applicant's preferred option.
[3] N/A – Data not available at time of screening.
[4] There was no Site # 2.

Summary Options Screening Matrix

High (H), Moderate (M), and Low (L) Impact Ratings

Component / Option / Sub-option	W Q	Wet	Fish	Wildl	Air Q	Noise	Safety	Recl'm	Indust	Rec	Exist	Cult	Subsis	Socio	Tech	$$
Air Access																
Type																
▶ Air-only option	L	L	L	L	L	M	H	L	H	M	L	L	L	H	H	H
▶ As complement to surface access																
✦<u>3,000-ft airstrip in G-paster Valley</u>	L	H	M	M	L	L	M	L	M	L	M	L	L	L	L	L
✦5,000-ft airstrip at Tabletop	L	M	L	L	L	M	H	L	L	L	M	L	L	L	L	M
▶ No air complement to surface access	L	L	L	L	L	L	M	L	H	L	L	L	L	L	L	L
Management																
▶ Airstrip open (versus closed) to:																
✦<u>Pogo project use only</u>	L	L	L	L	L	L	L	L	H	H	L	L	L	M	L	L
✦Pogo and other industrial / comm.	L	M	L	M	L	M	M	L	L	H	M	L	M	L	L	L
✦Everyone	L	M	M	M	L	M	H	L	L	L	H	L	H	L	L	L
Disposition																
▶ <u>Remove and reclaim</u>	L	L	L	L	L	L	L	H	H	H	L	L	L	M	L	H
▶ Leave strip open (versus closed) to:	L	L	L	M	L	M	L	L	L	L	M	L	M	L	L	L
✦Industrial / commercial resources	L	L	L	M	L	M	M	L	L	H	M	L	M	L	L	L
✦Open for everyone	L	L	M	M	L	M	H	L	L	L	H	L	H	L	L	L
Power Line Route																
▶ All-season road																
✦<u>Shaw Creek Hillside</u>	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
✦South Ridge	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
▶ Winter-only access																
✦Shaw Creek Hillside	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
✦Goodpaster Valley	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L

[1] Shaded rows are options or sub-options that were dropped from further consideration.
[2] Underline – Applicant's preferred option.
[3] N/A – Data not available at time of screening.
[4] There was no Site # 2.

Appendix A.2

Additional Noise Information

This appendix contains more specific information about noise and vibration regulations and guidelines used for the Pogo Mine noise technical analysis.

Sound Propagation Characteristics

The following provides general information on the potential effects of certain factors on sound attenuation.

- Existing Structures: Existing structures can reduce noise by physically blocking the sound transmission, and in some circumstances, can cause an increase in noise levels if the sound is reflected off the structure and transmitted to a nearby receiver location.

- Topography: Topography includes existing hills, berms, and other surface features between the noise source and receiver location. As with structures, topography has the potential to reduce or increase sound, depending on the geometry of the area.

- Foliage: Foliage, if dense, can provide slight reductions in noise levels. The Federal Highway Administration (FHWA) provides for up to a 3 decibel A-weighted (dBA) reduction in traffic noise for locations with at least 30 feet of dense foliage that contains leaves year-round.

- Ground Cover: The ground cover between the receiver and the noise source can have a significant effect on noise transmission. For example, sound will travel very well across reflective surfaces such as water and pavement, but can be attenuated when the ground cover is field grass, lawns, or loose soil. Appropriate ground coverage was used in the analysis, including powder snow, granular snow, and field grass.

- Atmospheric Conditions: Atmospheric conditions that can have an effect on the transmission of noise include wind, temperature, humidity, and precipitation.

Noise Regulations and Guidelines

FHWA Traffic Noise Criteria

The traffic noise impact criteria for federal funded road and highway projects are taken from Title 23, Part 772, of the Code of Federal Regulations (CFR), *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, FHWA, Washington, D.C. The criterion applicable for residences, churches, schools, recreational uses, and similar areas is an exterior hourly equivalent sound level (L_{eq}) from the project that approaches or exceeds 67 dBA. The criterion applicable for other developed lands, such as commercial and industrial uses, is an exterior L_{eq} that approaches or exceeds 72 dBA. In addition to the absolute levels of 67 dBA for residential and 72 dBA for commercial, the FHWA also considers a traffic noise impact to occur if "future noise levels substantially exceed the existing noise levels." Most states consider a 10-dBA increase over the existing noise levels sufficient to identify the increase as a *substantial increase impact*. No criterion exists for underdeveloped lands or construction noise. A summary of the FHWA noise regulations is contained in Table A.2-1.

Table A.2-1 FHWA Roadway Noise Abatement Criteria

Land Use Category		Hourly L_{eq} (dBA)
Type A:	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose	57 (exterior)
Type B:	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals	67 (exterior)
Type C:	Developed lands, properties, or activities not included in the above categories	72 (exterior)
Type D:	Undeveloped land	—
Type E:	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums	52 (interior)

U.S. Environmental Protection Agency Noise Guidelines

Table A.2-2 contains the U.S. Environmental Protection Agency (EPA) standards that can be used as a guideline for expected community reaction to a noise increase above existing ambient levels.

Table A.2-2 EPA Guidelines for Expected Noise Impact

Increase over Existing Level	Expected Community Reaction
0 - 5 dBA	Few complaints if gradual increase
5 - 10 dBA	More complaints, especially conflicts with sleeping hours
Over 10 dBA	Substantial number of complaints

Blasting Noise and Noise Level Descriptors

Evaluation of blast noise was performed by using the C-weighting scale. For short-term and impulsive noises, such as surface blasting, the C-weighted filter is normally used. The C-weighted filter helps to account for the short time period and low-frequency content characteristic of blasting. Measurements taken with the C-weighting filter are denoted dBC. Table A.2-3 provides information on blasting, blast levels in dBC, and community response based on the number and relative sound level of the blast.

Table A.2-3 EPA Limits on Number of Blasts for Different Blast Levels

Blast Level in dBC	Permissible Daily Number
Above 125	0
123 - 125	1
121 - 122	2
120	3
119	4
118	5
117	6
116	8
115	10
114	12
113	16
112	20
111	25
110	32
109	40
108	51
107	64
106	80
105	100

Vibration Impact Criteria

Vibration from mining-related activities, such as mechanical digging, rock breaking, and vehicle traffic are only expected to be perceptible within a few hundred feet of the activity, and no impacts are expected. However, criteria were developed for the project to ensure that there would not be any vibration-related impacts. The vibration criteria are derived from the U.S. Department of Transportation guidelines for the evaluation of impacts due to vibration. The criteria are given in Table A.2-4. The criteria given in Table A.2-4 are not applicable to blasting due to the short duration and lower frequency associated with blasts. Vibration levels from general operation and traffic do not have the same level of annoyance as the vibration produced from blasting.

The safe blasting vibration criterion is given in terms of particle velocity in inches-per-second at the frequency where most blasting energy is normally located (approximately 40 hertz)

(U.S. Department of Interior, 1971). The level of vibration considered the threshold of the "safe blasting criteria" is 2.0 inches per second.

Table A.2-4 General Vibration Peak Particle Velocity Guidelines

Velocity (in./sec)	Effects on Humans	Effects on Buildings
0 to 0.01	Imperceptible by people – no intrusion	Vibrations unlikely to cause damage of any type
0.04 to 0.08	Threshold of perception – possibility of intrusion	Vibrations unlikely to cause damage of any type
0.15	Vibrations perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.64	Level at which continuous vibrations begin to annoy people	Virtually no risk of "architectural" damage to normal buildings
1.27	Vibrations annoying to people in buildings (This agrees with the levels established for people standing on bridges and subjected to relatively short periods of vibrations.)	Threshold at which there is a risk of "architectural" damage to normal dwellings – houses with plastered ceilings and walls.
2.54 to 3.81	Vibrations considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges	Vibrations at a greater level than normally expected from traffic, but would cause "architectural" damage and possible minor structural damage

Reference Cited and Additional References

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Appendix A.3

Conservation Priority Index

This appendix contains more specific information about the Conservation Priority Index discussed in Section 3.14.1. The following description is based on Jorgenson *et al* (2000), and the reader is referred to that study for greater detail.

Although maps of the habitat use patterns of single species can be quite useful, developers and land managers must integrate such information across all of the biological resources of an area. To this end, Jorgenson *et al* (2000) used a geographical information system (GIS) containing habitat information for 32 key species and species groups in the Pogo Mine project area to develop six integrated indices of habitat value based on the habitat values shown in Table A.3-1. These indices were:

- Rare or sensitive species
- Rare species
- Harvested species
- Overall use (32 species)
- Habitat rareness
- Conservation priority habitats

Jorgenson *et al* (2000) suggested that the index of conservation priority was the single most useful metric for identifying priority habitats for protection from habitat-altering activities.

The Conservation Priority Index combined habitat rareness with habitat use, with emphasis on use by rare species, and values ranged from 1.41 to 2.71. (Human modified habitats were assigned a conservation priority of 0) (Table A.3-1). Figure 3.10-1 shows the geographic distribution of the wildlife habitat classes within the Pogo project area. High priority rankings were calculated for cliff, riverine broadleaf forest, riverine mixed forest, lowland meadow, lowland broadleaf forest, and lakes and ponds because these habitats were uncommon, important to rare species, or had overall high value for wildlife. In contrast, low priority rankings were calculated for alpine dwarf scrub, subalpine needleleaf woodland, upland tall scrub, and lowland low scrub because these habitats had either low use or were relatively abundant habitats. When values of the Conservation Priority Index were categorized into high, medium, and low, high priority areas covered 5 percent of the Pogo project area, medium priority areas covered 70 percent, and low priority areas covered 25 percent (Figure 3.14-1).

Table A.3-1 Rankings of habitat use for selected species in the Pogo project area, Alaska.

Ranking of habitat use for selected wildlife species in the Pogo project area, Alaska. Use ranks are 0 = none/negligible, 1 = low, 2 = medium, 3 = high, 4 = essential. Data quality is characterized by font type: bold = data-supported, regular = partially data supported, italic = judgmental.

	Area		Habitat Value Indices: Birds																					Habitat Value Indices: Mammals											Integrated Habitat Value Indices					
Habitat Type	acres	% cover	Trumpeter swan	Northern pintail	Harlequin duck	Bald eagle	Northern goshawk	Peregrine falcon	Spruce grouse	Ruffed grouse	Willow ptarmigan	Common snipe	Hairy woodpecker	Olive-sided	Hammond's	Black-capped	Gray-cheeked	Varied thrush	Bohemian	Yellow-rumped	Townsend's	Lincoln's sparrow	Dark-eyed junco	Moose	Caribou	Black bear	Brown bear	Lynx	Marten	River otter	Beaver	Snowshoe hare	Microtine rodents[a]	Shrews[b]	Rare or Sensitive Species	Rare Species	Harvested Species	Overall Use (all 32 species)	Habitat Rareness	Conservation Priority Habitats
Rivers and Streams	29,698	4.3	1	1	4	4	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	0	4	4	0.54	0.63	1	1.88
Riverine Barrens	3,278	0.5	0	2	0	1	1	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2	1	2	0	1	0	1	1	1	1	1	3	2	0.92	0.59	3	1.86
Riverine Scrub	3,435	0.5	0	3	0	1	1	2	1	2	1	2	1	1	1	2	1	2	1	1	0	2	2	3	1	3	1	2	0	1	1	3	2	1	6	2	1.69	1.41	3	2.14
Riverine Broadleaf Forest	3,123	0.4	0	1	0	3	3	1	2	1	0	1	3	1	2	3	3	3	1	2	1	1	2	3	1	2	1	2	0	1	1	2	1	1	8	3	1.31	1.53	3	2.51
Riverine Mixed Forest	10,590	1.5	0	1	2	4	2	1	3	1	0	1	3	1	2	1	2	2	2	3	2	1	2	2	1	2	1	2	2	1	1	2	1	1	7	4	1.46	1.63	2	2.54
Riverine Needleleaf Forest	15,362	2.2	0	1	3	2	2	1	3	1	0	1	2	2	2	2	1	2	2	3	2	1	2	1	1	2	1	1	3	1	1	1	1	1	9	2	1.31	1.53	2	1.84
Lakes and Ponds	2,327	0.3	4	3	1	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	4	0	0	0	2	2	1.00	0.72	4	2.24
Lowland Meadow	1,515	0.2	3	2	1	2	0	2	0	0	1	2	0	1	0	0	0	0	0	0	0	3	1	2	1	1	1	1	2	2	2	1	3	3	4	2	1.23	1.16	4	2.39
Lowland Low Scrub	24,404	3.5	1	1	0	0	1	1	1	1	1	3	1	0	0	1	2	0	2	1	0	3	2	2	1	2	1	2	0	1	1	2	3	2	4	2	1.23	1.22	1	1.41
Lowland Broadleaf Forest	11,400	1.6	0	3	0	0	2	1	1	2	0	3	2	1	1	2	3	2	1	2	1	3	1	3	1	3	1	2	2	1	1	3	3	3	8	3	1.77	1.69	2	2.23
Lowland Needleleaf Forest	114,312	16.4	0	1	0	0	2	1	2	1	0	2	2	3	3	2	3	2	3	3	2	3	3	2	2	3	1	2	3	1	1	2	2	2	8	3	1.62	1.84	0	1.61
Bluff Meadow	114	< 0.1	0	0	0	0	0	2	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	1	1	0	1	1	0	0	0	0	1	1	1	2	0.38	0.38	4	2.13
Upland Tall Scrub	10,520	1.5	0	0	0	0	1	1	1	1	2	1	1	1	1	1	1	2	2	2	1	2	2	3	1	1	2	2	1	1	1	2	3	3	10	1	1.38	1.34	2	1.45
Upland Needleleaf Woodland	22,719	3.3	0	0	0	0	1	1	1	1	2	0	0	3	0	1	1	0	0	1	0	0	1	2	2	2	2	2	3	0	0	2	2	1	2	3	1.46	0.97	1	1.66
Upland Broadleaf Forest	69,243	10.0	0	0	0	0	3	1	2	2	1	0	2	1	3	3	2	2	2	3	2	1	3	2	1	3	2	3	0	1	1	2	2	2	9	2	1.54	1.63	1	1.54
Upland Mixed Forest	176,888	25.4	0	0	0	0	3	1	3	3	1	1	1	3	3	3	2	3	3	3	3	1	3	1	1	2	2	3	0	1	1	2	3	2	9	3	1.54	1.81	0	1.60
Upland Needleleaf Forest	81,844	11.8	0	0	0	0	1	1	2	2	1	0	2	1	2	2	1	2	3	2	3	1	2	1	2	2	2	2	1	1	1	2	2	2	9	3	1.46	1.44	0	1.48
Upland North-facing Needleleaf Forest	51,469	7.4	0	0	0	0	1	1	2	2	1	0	1	3	2	2	2	1	2	1	2	1	2	1	2	2	3	1	1	0	0	1	1	2	5	3	1.23	1.25	1	1.75
Cliff	73	< 0.1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0.00	0.13	4	2.71
Alpine Meadow	4,445	0.6	0	0	0	0	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	0	3	0	3	0	1	0	0	0	1	1	0	1	0.69	0.44	3	1.48
Subalpine Needleleaf Woodland	37,919	5.5	0	0	0	0	0	2	1	0	3	1	0	0	0	0	0	1	0	1	0	1	1	2	3	2	3	2	2	0	0	1	2	2	2	2	1.46	0.94	1	1.31
Alpine Dwarf Scrub	13,048	1.9	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	1	1	0	0	0	2	1	1	1	0.77	0.44	2	1.15
Human Modified	3,531	0.5	0	0	0	1	1	1	1	2	1	0	0	1	1	1	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1	2	1	1	1	0.46	0.56	3	0[c]

[a] *Clethrionomys rutilus*; *Microtus oeconomus*, *M. pennsylvanicus*, *M. xanthognathus*, *M. miurus*, *M. longicaudus*; *Synaptomys borealis*; *Lemmus trimucronatus*; *Zapus hudsonius*.
[b] *Sorex cinereus*, *S. hoyi*, *S. monticolus*, *S. tundrensis*.
[c] Human modified habitats were assigned a Conservation Priority index of 0.