U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management

Spokane District Office
1103 N. Fancher
Spokane, Washington 99212

November 1994

Record of Decision
Lamefoot Mine
Environmental Impact Statement
Supplement
to the Kettle River
Key Project Expansion

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Spokane District Office
1103 N. Fancher
Spokane, Washington 99212-1275

IN REPLY REFER TO

(509) 536-1200

WMP130 89-019B
3809 (135)

Dear Reader:

Attached is the Record of Decision (ROD) for the Final Lamefoot Mine Environmental Impact Statement Supplement (EISS) to the Kettle River Key Project Expansion FEIS.

Over 200 copies of the Draft and Final EISS were mailed out to the general public and other interested parties. In addition, one public meeting was held during the comment period. Over all, a total of 23 individual responses were received. These comments were printed in their entirety along with BLM's responses in the Final EISS.

This ROD will be available for a 30 day appeal period. If you believe that this decision is in error you should follow the procedures outlined on form (1842-1) attached to this document. Any comments you may have should be directed to me, Ann Aldrich Border Resource Area Manager, Spokane District, 1103 North Fancher, Spokane, WA 99212-1275. Thank you for your involvement.

Sincerely yours,

Ann B. Aldrich
Border Resource Area Manager

U. S. Department of the Interior
Bureau of Land Management

Record of Decision

for

Lamefoot Mine Environmental Impact Statement Supplement to the Kettle River Key Project Expansion

(OR135-05-01)

Prepared By:
Department of the Interior
Bureau of Land Management
Spokane District
Border Resource Area
Spokane, Washington

I. INTRODUCTION

This Record of Decision (ROD) documents the selection of the Bureau of Land Management's (BLM) Preferred Alternative for the Lamefoot Gold Mine Project located in Northern Ferry County, Washington. The alternatives considered in the Final Environmental Impact Statement Supplement (EISS) are summarized in this document. The rationale for selecting the Preferred Alternative, which is also the Environmentally Preferred Alternative, is described in Part VI.

Echo Bay began an exploration program at the Lamefoot site in 1989 on both private and federal land. The underground phase of the exploration program extended through April, 1994, and additional exploration will continue concurrent with mining. A Notice of Operations for exploration was initially submitted to the BLM in September of 1989 for surface drilling and road construction on public land. Several modifications were made to that notice, and in November 1991, Echo Bay submitted a Plan of Operations to conduct surface and underground exploration that would exceed five acres of disturbance on land managed by the BLM. Pursuant to the National Environmental Policy Act (NEPA), and 42 U.S.C., an environmental assessment for the exploration phase was completed in June, 1992, and the Plan of Operations for exploration activities was approved by the BLM on July 28, 1992. One condition of the approval was that Echo Bay submit a plan modification if exploration indicated that mining might be feasible. Echo Bay submitted the modified Plan of Operations for mining in April 1993, and supplemental information in July 1993. At that time it was determined that an Environmental Impact Statement would be necessary to evaluate the impact of Echo Bay's proposal for full scale mining.

In developing the proposed action, Echo Bay held informal meetings and independently consulted with local landowners and county officials during 1992 and 1993 to identify issues and concerns in the Republic and Curlew Lake vicinities.

A Draft EISS (DEISS) was prepared and released to the public on March 11, 1994. The FEISS is the culmination of over two years of public involvement, data collection and analysis. Ferry County participated in the NEPA process as a cooperating agency.

II. SUMMARY OF ALTERNATIVES EVALUATED INCLUDING: (The Proposed Action, the Preferred Alternative, and the Environmentally Preferred Alternative)

Alternatives considered for the EISS for the Lamefoot project are summarized in Table 1. The alternatives were developed from documents on the proposed action, agency comments, public comments, experiences at other mining projects, and a review of the technical literature. The alternatives were evaluated based on engineering, environmental, and economic factors. Some alternatives were then eliminated. Technical feasibility and technical effectiveness were included in the engineering evaluation. As a result of public comment on the draft EISS and additional analysis of the existing information by BLM, it was determined that additional data was needed to adequately analyze the project. BLM believes this information is needed to verify the conclusions identified in the impact analysis regarding full development of the mine as described in Echo Bay's Proposed Action. Echo Bay was unable to supply this information and in response to public comment BLM developed an alternative to full development. This alternative was included in the Final EISS and involves limiting development of the mine from that originally proposed by Echo Bay to mining only that portion of the ore bodies located above the projected post closure water table of 2,750 feet mean sea level (msl). Subsequent to analysis of this alternative, Echo Bay requested that BLM consider authorizing development of the ore body under Zone #3 down to the 2,741 foot msl elevation, since this is the lowest level of the inclined floor of an existing exploratory access opening. These alternatives are described in detail in the FEISS as Alternatives 5 & 6, respectively. The environmental evaluation considered potential impacts to air, water, and soil (land disturbance), with consideration of subsequent impacts to vegetation, wildlife, and the human environment. Relative cost and affordability were included in the economic evaluation.

Included alternatives are generally acceptable based on technical feasibility, environmental, and economic factors. Eliminated alternatives are generally unacceptable based on at least one of the factors. Table 1 provides a brief description on why some alternatives were eliminated and others included in the evaluation documented in the EISS.

TABLE 1

ALTERNATIVES CONSIDERED FOR LAMEFOOT EISS

Category	Alternative	Included/Eliminated for Detailed Analysis	Reasons for Inclusion or Elimination
Mining Method	A) Open Pit	Eliminated	Extensive surface disturbance and potential noise, wetlands, and visual impacts. Also, some potential for impacts to air and water quality.
	B) Open Stope Mining without Backfilling	Eliminated	Extensive surface subsidence possible. Increased potential for water degradation through access to the underground workings. Also, a safety hazard to workers.
	C) Open Stope Mining with Pillars	Eliminated	Inefficient utilization of resources due to incomplete resource extraction. Surface subsidence possible. Water degradation in underground workings possible.
	D) Open Stope Mining with Backfill	Included	Viable and efficient means of resource extraction. Reduced potential for surface subsidence, water degradation, and visual impacts.
	E) Limited Mine Development - 2,750' Level	Included	Viable means of resource extraction. Reduced potential for water degradation.
	F) Limited Mine Development - 2,741' Level	Included	Viable means of resource extraction that incorporates the existing workings in Zone 3. Reduces potential for water degradation.
Backfill Access Method	A) Ramp access from Wolfe Camp Road Crossing	Included	Viable and effective means of backfill access.
	B) Drop Pass and Access Ramp without Wolfe Camp Road Crossing	Included	Viable and effective means of backfill access.
	C) Sub-County Road Access for Backfill	Included	Viable and effective means of backfill access.

TABLE 1
(Concluded)

Category	Alternative	Included/Eliminated for Detailed Analysis	Reasons for Inclusion or Elimination
Ore Transportation Routes	A) Newly-Constructed, Dedicated Haul Road	Eliminated	Extensive new surface disturbance. Likely unpaved, with potential for high particulate emissions and noise near residences. Route crosses both public and private lands.
	B) Existing Highway 21 and Fish Hatchery Road	Included	Short route along existing road alignment. Partially paved. Three miles would require upgrading.
	C) Highway 21 and Old Kettle Falls Road (formerly Cooke Mountain Road)	Included	Mostly paved route with least disturbance to local residents; requires no upgrading.
Waste Rock Disposal	A) Onsite Above Ground	Eliminated	Associated with open pit mining method; eliminated for same reasons.
	B) Onsite Below Ground	Included	Waste rock disposal with limited offsite impacts. Most appropriate for open stope with backfill, underground mining method. Involves temporary surface waste rock storage.
Milling and Tailings Disposal	A) Key Mill and Kettle River Tailings Facility	Included	Makes use of permitted facilities; existing, efficient means of milling and waste disposal; minimizes surface disturbance and impacts to other resources.
	B) Other Sites	Eliminated	Requires new construction, and involves unnecessary impacts to resources; additional surface disturbance.

A. PROPOSED ACTION

The proposed Lamefoot Mine project consists of extracting ore by a long hole open stoping mining technique from 6 Zones down to approximately 2200 feet msl. The ore would be loaded into underground trucks and transported to the surface where it would be hauled to the Key Mill via state and county roads. The ore would be processed by the conventional carbon-in-leach method. The processed ore would be stored at an existing tailings impoundment located on private land.

Waste rock would be deposited in temporary waste storage piles at the Lamefoot site. During operations and upon completion of the commercial mining phase, the waste rock would be hauled underground and used as backfill to provide ground support and mitigate potential for acid formation. Additional backfill would be quarried from a site adjacent to the mine in the Wolfe Camp drainage, and hauled across Wolfe Camp Road to the mine workings.

Reclamation plans for the project include the use of topsoil and fertilization if necessary, to revegetate areas of surface disturbance. In the interim, until the protective vegetative cover becomes established, measures for erosion and sediment control would be undertaken until completion of mining activities. The long term objective for managing the land would be to return it to wildlife habitat.

B. ALTERNATIVES TO THE PROPOSED ACTION

Alternative 1 - No Action

The No Action Alternative, under which Echo Bay would not receive approval to develop the Lamefoot Project, and would be required to carry out reclamation in accordance with the conditions specified in the approved Exploration Plan of Operations. Surface disturbance associated with the exploration/development program and existing surface facilities would not be increased.

Alternative 2 - Alternate Drop Pass Backfill Access Method

Alternative 2 is an alternate method for introducing backfill materials to the underground workings. Drop passes at the base of the Wolfe Camp quarry backfill borrow area would allow underground access to the workings without crossing the Wolfe Camp Road. Front end loaders would dump backfill materials into the drop pass, by a grated loading chute, and into a truck. Following truck loading, backfill materials would be hauled via an access ramp to the underground workings and placed as described in the Proposed Action.

Alternative 3 - Alternate Ore Transportation Route

Alternative 3 is an alternate ore transportation route utilizing Highway 21 and the Fish Hatchery Road. This route would provide a shorter haul distance than the proposed Old Kettle Falls Road (formerly the Cooke Mountain Road) route.

Alternative 4 - Alternate Sub-County Road Access for Backfill

Alternative 4 is the second alternative method for introducing backfill materials from the quarry located on the west side of the Wolfe Camp drainage to the underground mine workings on the east side of the valley. This alternative would allow trucks travelling between the Wolfe Camp quarry and the mine to pass under the Wolfe Camp road and enter the mine directly from an adit in the east valley wall.

Alternative 5 - Limited Mining Alternative - 2,750 Foot Level (Preferred Alternative)

In response to public comments received on the draft EISS, the BLM has developed a limited mining alternative for incorporation and analysis in the FEISS. This alternative supplements the existing proposed mining alternative in the FEISS, and is designed to prevent unnecessary or undue degradation to the water quality at the mining site. The limited mining alternative is intended to minimize potential water quality impacts by limiting mining to elevations above the post-closure water table predicted to be at 2,750 feet elevation. Mining methods and reclamation would occur as described in the Proposed Action. (This is the Environmentally Preferable Alternative.) This is the **Selected Alternative**, which is described in detail in section IV.

Alternative 6 - Limited Mining Alternative - 2,741 Foot Level
Alternative 6 is a mining alternative that is the same design as Alternative 5 except it incorporates the existing floor elevation of Zone 3 at the 2,741 foot level.

III. DECISION

This Record of Decision (ROD) authorizes the development of the Lamefoot Mine as described in the Lamefoot Mine Environmental Impact Statement Supplement (EISS) under Alternative number 5 (The Preferred Alternative) but modified to permit widening of the existing workings of the 2745 North Drift laterally to the full width of the ore body in Zone 3 (estimated maximum width of 60 feet). To minimize new exposures of potentially reactive material, the floor of the stope for the base of Zone 3 shall be inclined and kept to the same grade as the existing workings (See Section IV. M 9.)

In order to verify existing information and prior to considering any future plan modifications, Echo Bay will be required to conduct or develop studies relative to geology, geochemistry, groundwater, surface water, acid generation characterization, and other similar matters. These studies would be utilized to supplement existing information gathered during the course of the analysis of Echo Bay's Proposed Action. If the additional data gained and subsequent environmental analysis substantiates the predicted low impacts of full mining as Echo Bay initially proposed, additional plan modifications will be considered focusing towards full development. If the additional information contradicts the original findings, then additional environmental analysis may be necessary in the form of an environmental assessment or a supplement to the existing environmental impact statement.

Here after this alternative will be known as the Selected Alternative. A detailed description of this alternative is outlined in the next section.

IV. SELECTED ALTERNATIVE

A. General

This ROD authorizes the development and commercial mining phases and the additional surface exploration to explore for the continuation of gold mineralization, conditioned upon Echo Bay complying with the following:

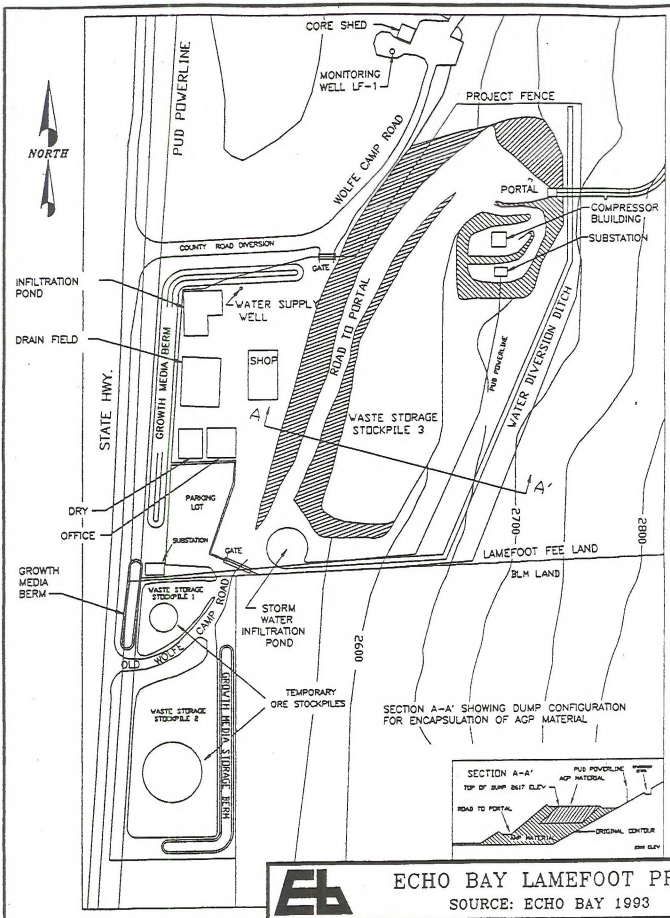
Mining shall be limited to elevations above the post-closure water table which has been interpreted to be at 2750 feet. No mining will be allowed below an elevation of 2750 feet;except as modified by this decision. Ore zones that can be mined above this elevation include all of zone 2 and a portion of zones 3 and 4 (Figure 1). Echo Bay shall establish brass cap survey points marking the location of the 2750 foot elevation level on access routes and mining zones.

Use of existing workings below the 2750 foot level and one new portal will be allowed for access for hauling of ore, waste rock, and backfill and for drilling activities to collect hydrologic and geochemical data.

The proposed mining will be accomplished by a long hole open stoping mining technique. This method entails drilling blast holes between existing mining levels within the ore body, and blasting the rock so that it may be accessed from lower levels. The ore will then be loaded into underground trucks for transport to the surface. Highway trucks will haul the ore by state and county roads to the processing facility.

The ore will be processed by the conventional carbon-in-leach method at Echo Bay's existing Key Mill. Process tailings (after extraction of gold) will be permanently stored in a zero-discharge, lined tailings facility. The current tailings impoundment is located on private land, and is scheduled and permitted for enlargement in 1993 through 1995 under authorization from the State. Process waters are treated in a cyanide destruction circuit before discharge to the tailings pond and subsequent recycling for use in the milling circuit.

Waste rock from underground development will be deposited by underground trucks in temporary waste storage stockpiles at the Lamefoot site (Figure 2). Waste rock shall be placed on limestone pads to prevent acid rock drainage. Most of



ECHO BAY LAMEFOOT PROJECT

SOURCE: ECHO BAY 1993

ECHO BAY MINERAL CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON

FACILITY LAYOUT

DATE: APRIL 1993 | SCALE: 1" = 200' | FIG. NO. 2

LFDUMP1

the waste rock in the surface stockpile (about 160,000 tons) generated during both the commercial mining phase and the exploration phase shall be hauled underground before or upon completion of mining in individual areas, and used as backfill, to provide ground support. About 100,000 tons of limestone will remain on the surface for use in recontouring the portal area. The existing buildings will be dismantled and the office/shop site and other surface disturbance shall be revegetated upon completion of mining or earlier as feasible. Drill roads and pads from previous and future surface exploration programs shall be reclaimed.

Mined-out areas within the Lamefoot underground workings shall be backfilled with rock as required to prevent subsidence. Rock shall be obtained from the temporary waste rock stockpiles and from the borrow area west of the proposed backfill portal and north of the main portal. Wolfe Camp Road shall be relocated to an alignment through this quarry excavation at the end of the mine life (Figures 3 and 4).

No additional surface disturbance from mining on public land is anticipated, but there will be additional surface disturbance associated with exploration drilling activities from surface locations. The surface disturbance associated with new exploration activity will probably be less than five acres and shall be conducted in the same fashion as the original exploration on public lands.

B. Project Schedule

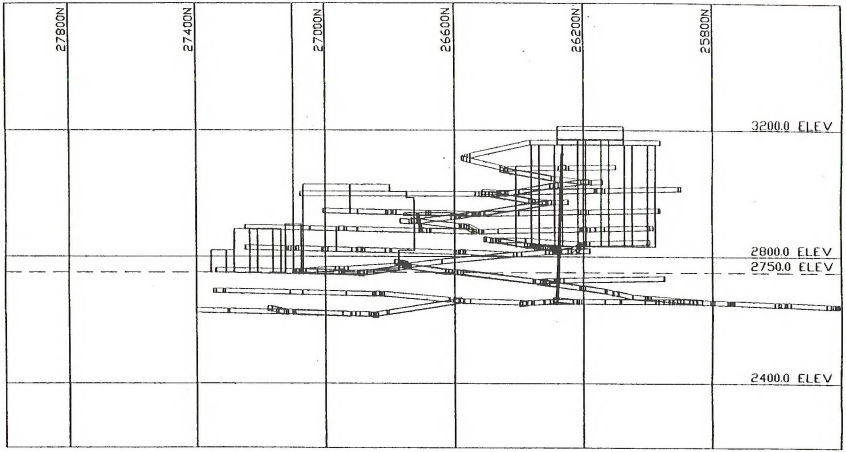
Commercial production will commence at the Lamefoot Mine upon completion of the exploration/development program. Initially, one mining area will be chosen for stoping (commercial production). Others will follow as feasibility allows. It may take several weeks following startup of commercial mining for full production capacity to be realized.

Six ore zones have been delineated within the Lamefoot orebody. Only a portion of the orebody will be mined under the Selected Alternative. The locations of Zones 1 through 4 are shown on Figure 5. Zones 5 and 6 are not yet as well defined as Zones 1 through 4. Available information on Zone 5 indicates that this portion of the orebody is located adjacent and parallel to Zone 4, approximately 100 feet west of the Zone 4 hanging wall. Current estimates indicate that Zone 5 may extend from 27,000 feet north to 27,400 feet north on the base survey grid between elevations 2400 and 2680 feet. Zone 6 is located beneath Zone 4. Current estimates indicate that Zone 6 may extend from 27,000 feet north to 27,400 feet north with a central elevation of approximately 2200 feet. Under the Selected Alternative, mining shall be authorized only for Zone 2 and those portions of Zones 3 and 4 located above the water table. Based on existing information the water table has been interpreted to be at the 2750 foot elevation (Figure 1).

The duration of mining at the Lamefoot deposit will depend upon the mineral reserves recoverable within the zones that will be mined under the Selected Alternative. The mining rate may also be impacted by other factors such as gold price and alternate ore sources. Current reserves are calculated based on a gold price of $350 per ounce. Minable reserves in the Selected Alternative total about 1,750,000 tons (including 100,000 tons of production during the exploration phase). If all of the minable reserves are extracted at a tonnage rate of 1500 tons per day, the duration of the uninterrupted commercial mining phase will be about 2.5 years. The actual mining rate will be determined by the size and geometry of the resource as determined by the exploration program. This rate is expected to be between 1,200 and 2,000 tons per day. The total waste expected to be produced over the life of the Selected Alternative is 260,000 tons during exploration and 173,000 tons during production, for a total of about 433,000 tons. The exact geometry of the underground workings may change, as constructed, therefore, waste volumes will vary based on engineering design.

C. Underground Mining

Underground commercial production at the Lamefoot deposit will consist of two primary methods of material extraction techniques. Access to mining areas and drifting (tunneling) in ore will be accomplished by the use of a jumbo drill and conventional blasting methods. A jumbo drill is a rubber tire mining machine which drills near-horizontal holes in a mining face to be blasted. This method results in drifts which can be driven on the level or on an incline, either up or down, of up to about 15% grade. Most ongoing development of mining areas during the commercial phase will be accomplished by this method.



ECHO BAY LAMEFOOT PROJECT

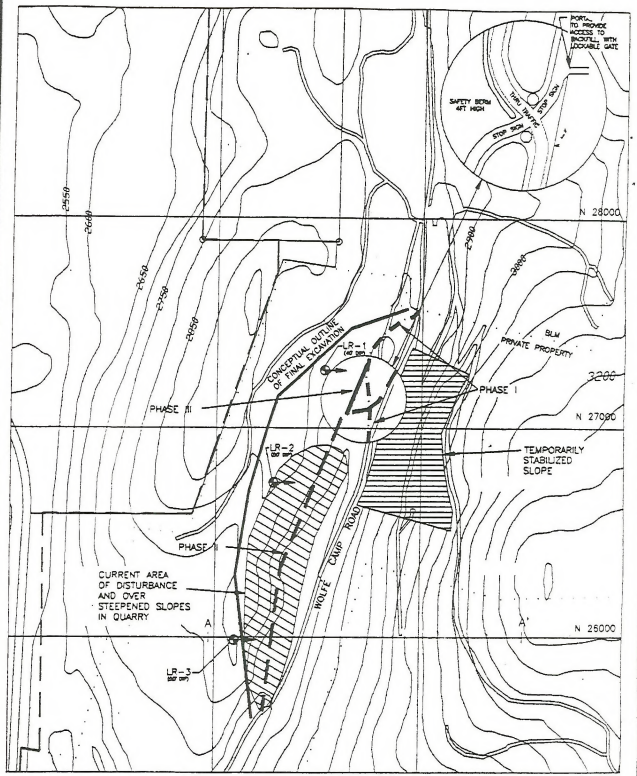
SOURCE: ECHO BAY 1994d

ECHO BAY MINERAL CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON

EXISTING MINE WORKINGS FOR THE LIMITED MINING ALTERNATIVES

DATE: | SCALE: 1" = 500' | FIG NO. 1

LFSEC1



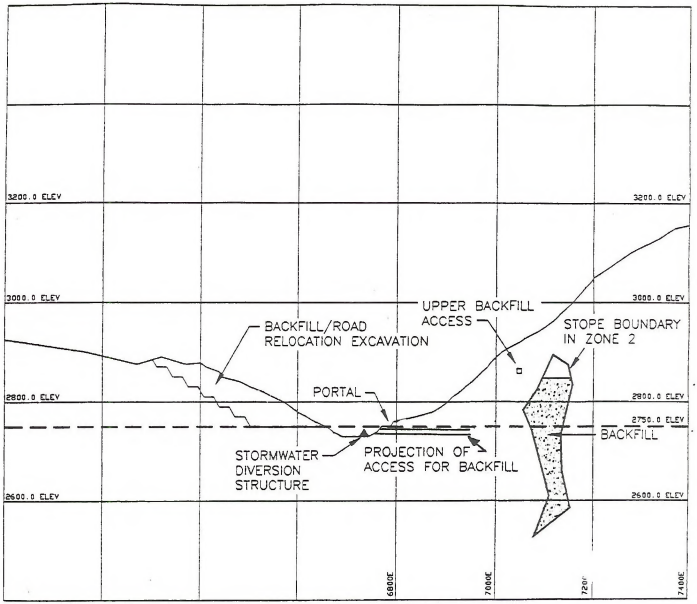
ECHO BAY LAMEFOOT PROJECT

Source: Echo Bay 1993c

ECHO BAY MINERALS CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON

CONCEPTUAL PROPOSED DIVERSION OF WOLFE CAMP ROAD

DATE: APRIL 1993 | SCALE: | FIGURE #: 3



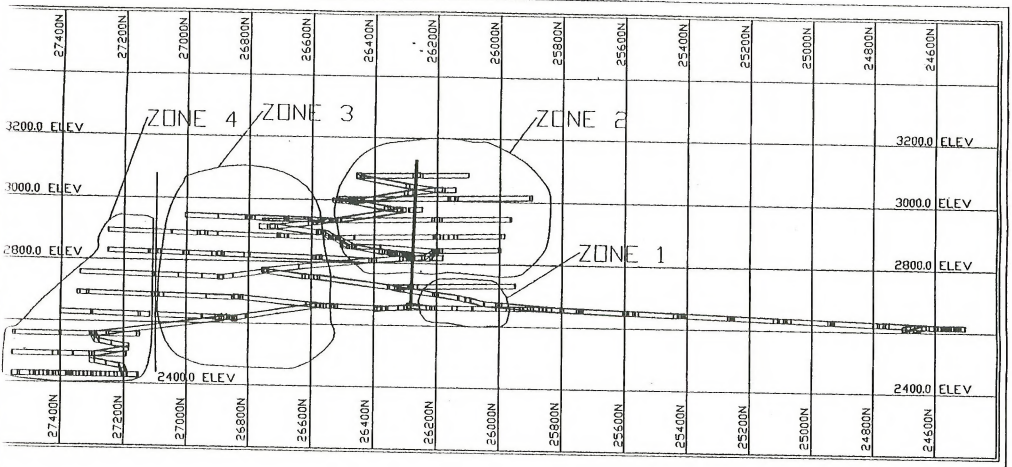
ECHO BAY LAMEFOOT PROJECT

SOURCE: ECHO BAY 1993a

ECHO BAY MINERALS CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON

GENERALIZED CROSS SECTION OF LAMEFOOT AREA SHOWING BACKFILLED STOPE AND ROAD RELOCATION EXCAVATION

DATE | SCALE 1"=200' | FIG. NO. 4



ECHO BAY LAMEFOOT PROJECT

Source: Golder 1993

ECHO BAY MINERALS Co.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON

MINING SEQUENCE
LAMEFOOT PROJECT
LONG SECTION LOOKING EAST

FILE: 2-9A

DATE: NOV 19,93 | SCALE: | FIG. NO. 5

The majority of the ore commercially extracted within the mining areas will be removed by a long hole open stoping technique. This method uses drill holes collared in one ore drift (sublevel) and drilled upwards or downwards toward the adjacent sublevel above or below or toward the ore boundary. These holes will be loaded with explosives. The ore between the levels will be blasted and will fall into a lower level or to the bottom of the active stope, where it will be removed. Drilling for blast holes will be done by a single boom production blast hole drill, an electrically operated machine specifically designed for vertical or angle holes. Draw point locations may vary depending upon the stoping method to be used.

1. Stoping Methods

Stoping methods will be selected based on orebody dimensions and configuration. Echo Bay will use the three stoping methods listed below.

- Transverse stoping
- Longitudinal stoping
- Drift and waste fill

Specific backfilling procedures involving selective placement of backfill shall be used for each stoping method. Backfilling procedures are described in Section G.

Transverse stoping will be used in portions of Zones 2 and 4 where the orebody width is 60 feet or more. Stoping will be completed perpendicular to the strike of the vein, essentially in an east-west direction as depicted on Figure 6.

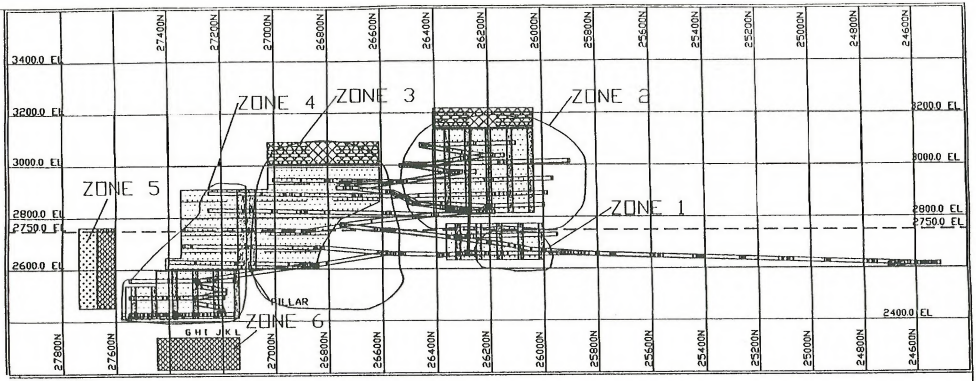
The transverse stoping process starts with development of primary stopes. These stopes will be approximately 24 feet wide and 65 feet high and will start along the 2750 foot elevation level or the base of the orebody, *whichever is higher.* The centerline of each stope will be approximately 70 feet from the centerline of neighboring stope or stopes. The primary stopes will be backfilled with cemented rockfill which will be allowed to cure for approximately 30 days before continued development of the stope through the overlying ore materials. This development sequence will continue until the primary stopes reach the top of the orebody. As the primary stopes advance up through the orebody, the ore in the stope walls will be mined through development of secondary transverse stopes.

The secondary transverse stopes will start at the base of the orebody and proceed upward sequentially in 65-foot increments to the top of the orebody similarly to the primary stopes. Each secondary stope will be approximately 48 feet wide and will be supported on each side by the pillars of cemented rockfill placed previously in the primary stopes. The secondary stopes will be backfilled with uncemented rockfill or waste fill to support the stope walls and form the floor for development of the overlying orebody.

Longitudinal stoping will be used in portions of Zones 3 and 4 where the orebody is typically 60 feet wide or less. Stoping will be completed along the strike of the vein, essentially in a north-south direction as depicted on Figure 6. Each stope will be started at the 2750 foot elevation and will progress upward in 65-foot-high increments until the top of the orebody is reached. The stopes will be backfilled sequentially using uncemented rockfill (or waste fill) to support the stope walls and provide a floor for development of the overlying orebody.

Drift and waste fill methods will be used in portions of the upper Zones 2 and 3 as shown on Figure 6. Drifting will be completed along the strike of the vein, essentially in a north-south direction and will start on top of the previously backfilled stopes. Each drift will be developed to the full width of the orebody over the length of the stoping area. Following backfilling of the preceding drift with uncemented rockfill (or waste fill) to within a few feet of the back (or drift ceiling), another drift will be started over the backfilled drift. This sequence will be repeated until the top of the orebody is reached or surface disturbance criteria prevent further mining.

Although the mining and backfilling plans described in this document have been developed in detail and are final based on available information, some modifications are anticipated during implementation to suit local conditions as



CEMENTED ROCK FILL

WASTE FILL

LONGITUDINAL STOPING

DRIFT AND WASTE FILL

FILE: 2-12-1

ECHO BAY LAMEFOOT PROJECT

Source: Echo Bay 1993

ECHO BAY MINERALS Co.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON

STOPING AND BACKFILLING METHODS
LAMEFOOT PROJECT
LONG SECTION LOOKING EAST

DATE: NOV 19,93	SCALE	FIG. NO. 6

encountered in the field. Any changes in the mining and backfilling plans shall require prior review and written approval by the Authorized Officer, BLM.

2. Drilling and Blasting Procedures

Vertical and angle blast holes in the stope will vary in diameter from 2¼ inches to 6 inches and will be spaced from 5 to 15 feet apart. Water may be used during drilling to cool the drill bit and to wash the drill cuttings from the hole. This water will be obtained from sumps located throughout the mine. No drilling additives will be used with this water.

The holes will be loaded with an ammonium nitrate based explosive such as ANFO (ammonium nitrate-fuel oil), water gel, or emulsion. Stick powder (dynamite) or cast boosters will be used. It is anticipated that emulsion will be the primary explosive material utilized based on ground conditions and the dry rock encountered to date. However, different rock types respond differently to the various explosives depending on lithology, degree of fracturing and alteration. In addition, drill hole sizes, spacing, and patterns also influence the blasting techniques. Blasting compounds and techniques will be adjusted as dictated by these variables. Echo Bay shall conduct experimentation with alternative explosives (see Section E.2.) such as emulsions to minimize nitrates in mine waters. If emulsions are found to be effective for nitrate control, the blasting alternatives will be limited by the use of this type of explosive. Approximately 1/2 lb of emulsion per ton of ore will be required for mining. Non-electric blasting caps will be the detonation devices for the explosives. Care will be taken in the handling of explosive materials to optimize safety of workers and minimize spillage of bulk materials.

Individual slices in the vertical plane of the orebody will be blasted into the open stope. The broken ore will be accessed below at draw points.

After blasting and prior to entry, the mining area will be ventilated to exceed air standards prescribed by the Mine Safety and Health Administration (30 CFR). Exhaust air will be vented from the ventilation raise and the main exhaust crosscut. The ventilation raise was constructed as part of Phase I of the exploration program. The main exhaust crosscut is an existing adit dating from the early part of the century. Water sprays will be used to mitigate particulate emissions in the exhaust. Depending on final configuration of the mining areas, one or more ventilation raises or crosscuts may be needed to provide adequate air flow to the working areas, although Echo Bay does not propose any such facilities at this time.

3. Ore and Waste Transfer Procedures

Broken waste rock will be loaded into low profile diesel-powered underground haul trucks at or near the face (end) of the working headings (drifts), or at draw points for the stopes. Diesel-powered front end loaders with a six yard-rated capacity will be used along with the 26-ton capacity haul trucks. Initially, some of the waste rock will be hauled to the surface and deposited into the waste rock disposal areas as shown on Figure 2. Echo Bay estimates that 95 percent of the waste rock that will be brought to the surface will be present at the end of exploration Phase II. Little waste rock will be brought to the surface during commercial mining as most will be used underground immediately as backfill. Ultimately, most of the waste rock brought to the surface will be transported back underground and used as backfill material.

Stoped ore will be scooped and hauled from draw points at the lowest level of an active stope. In areas to be mined using the transverse stoping method the draw points will be located in the foot wall or hanging wall at the base of each vertical increment. Where longitudinal stoping is proposed the draw points will be located at the end of the working stope and remote controlled machinery will be required to safely excavate the broken ore. The ore will then be hauled to the temporary ore stockpile area shown on Figure 2. Ore will be sorted according to location on the stockpile area so that material from different ownership interests and lease agreements can be segregated and weighed separately.

4. **Backfilling**

To minimize overall surface disturbance on public land and to prevent adverse subsidence of the rock overlying the open stopes, selective backfilling of the void produced during mining shall be done after individual stopes are completed. Rock will be hauled from the surface and dumped into the stope by the use of underground haul trucks. When a mining area's individual stopes are complete, backfill will be obtained from the existing waste dumps or the borrow area. A cement silo will be constructed on the surface and a batch plant will be installed underground for production of cemented backfill.

Two sources of rock will be used as backfill. About 250,000 tons of waste rock placed directly from underground development or from the surface disposal areas constructed during exploration and development will comprise part of the backfill material. Based on an estimated unit weight of 110 pounds per cubic foot (pcf) for backfill, the 250,000 tons of waste rock will form about 167,970 cubic yards of backfill or about 15.4 percent of the required total. The remainder shall come from the borrow area associated with the county road relocation. Figure 4 shows a cross-section through the excavation and a filled stope in Zone 2.

The borrow area location was selected for the following reasons:

- proximity to the underground workings
- minimum visual impact
- existing borrow area site (previously disturbed)
- private property only
- availability of non-acid generating backfill

Additional characterization of backfill materials within the quarry area shall be completed prior to quarry construction to better define the location of potentially acid-generating material. This work shall include surface sampling and drilling and sampling of drill cores for total sulfur content, acid-base accounting (ABA) tests, and whole rock analysis.

Analysis results for total sulfur content, net neutralization potential, and the ratio of neutralization potential to acid generating potential, in conjunction with existing data, shall be contoured and plotted as an overlay for the backfill quarry. Based on this data, the quarry mining plan shall be revised to minimize mining of potentially acid-generating material and to minimize exposures of potentially acid-generating material in the quarry walls.

Echo Bay's revised plan of operations shall include a mining sequence that identifies the minable quantities of material within each mining block within the quarry. Under the Selected Alternative, all mining will be limited to the northern end of the quarry in order to obtain suitable quality materials, unless otherwise approved by the Authorized Officer, BLM.

Materials with a net neutralization potential (NNP) greater than +20 tons calcium carbonate ($CaCO_3$) per 1000 tons [NNP > +20] and a neutralization potential (NP) to acid generating potential (AGP) ratio greater than 3 [NP/AGP > 3] will be considered non-acid generating. Correlation of total sulfur content with NNP and NP/AGP ratios shall also be used to identify and selectively mine non-acid generating materials. Visual estimates of the sulfide content (e.g., percent pyrite) can be used to identify materials which might otherwise meet the above criteria, but have very localized high concentrations of sulfides.

Unless otherwise approved in writing by the Authorized Officer, BLM, only non-acid-generating material from the quarry shall be used as backfill within the mine. Cemented backfill will be constructed exclusively with non-acid-generating backfill from the quarry. In addition, non-acid-generating material from the quarry and non-acid-generating limestone shall be used to create an encapsulation system by selective placement, with a typical minimum thickness of 20 feet adjacent to exposed rock in the walls, floor, and back of each mining zone.

Any potentially acid-producing materials from the quarry and any potentially acid-producing waste generated in zones 2, 3, and 4, along with all existing waste rock stockpile materials, will be allowed only as uncemented backfill following base addition to meet the above mentioned non-acid-generating criteria. These materials will be isolated in cells within

the encapsulation system by placement as layers alternating between layers of non-acid-generating material from the quarry.

All stopes shall be backfilled completely to the back in order to reduce subsidence and water inflow, regardless of the stoping method. For example, this could require using a mobile casting conveyor for the upper part of the final lift or use of a low-mobility slurry.

Some of the backfill used in areas to be developed using transverse stoping will be mixed with cement. Cemented backfill (or cemented rockfill) provides greater support than unconsolidated backfill. The need for cemented backfill will be determined by stope geometry and mining sequencing. The cemented rockfill will be made by mixing sized waste rock (6 inch maximum particle size) with Portland cement, water, a water reducing agent and possibly other suitable additives. Following mixing, the backfill will be hauled by truck and selectively end dumped into the empty stopes. As the backfill level rises within the stopes the fill will be bladed and leveled using a bulldozer to form the working floor for the next stope above.

Uncemented backfill (or waste fill) will be hauled by trucks to the longitudinal stopes and the transverse secondary stopes and selectively end dumped. This fill will be bladed and leveled by a D-4 or D-6 size bulldozer to form the working floor of the next stope above.

Uncemented backfill in the drift and waste fill areas will be hauled by truck and *selectively* dumped and pushed into place using a bulldozer.

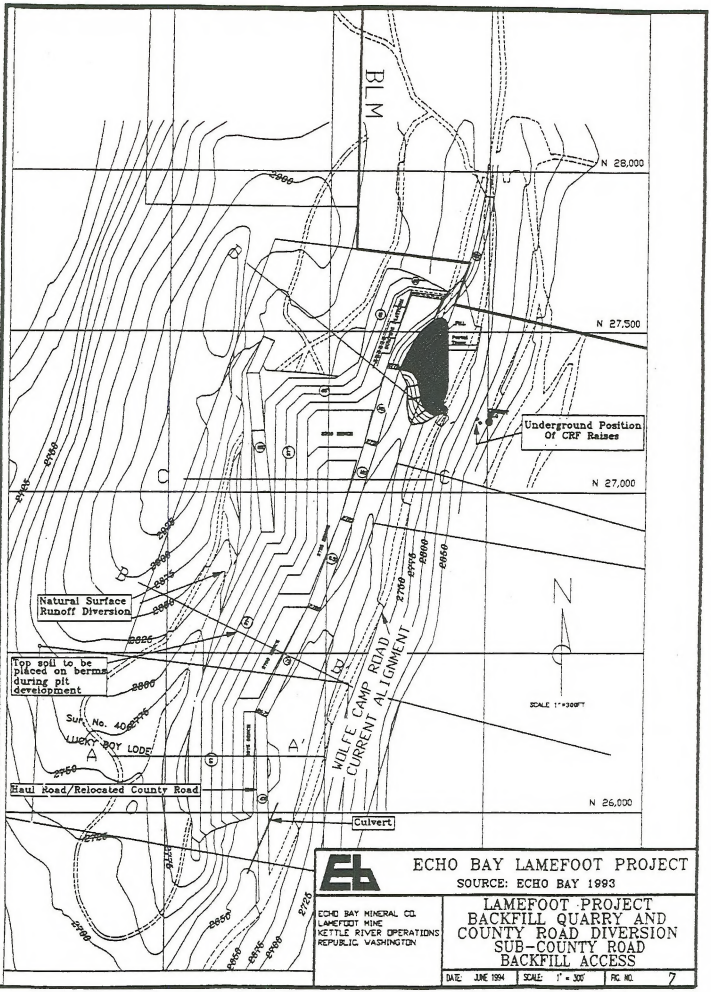
Waste rock sizing is expected to be accomplished primarily through controlled fragmentation during blasting for pit development. Rockfill for uncemented backfill will be screened to remove fragments larger than 24 inches using a 24 inch grizzly. Cemented rockfill will be screened to remove fragments larger than 6 inches using 24 inch and 6 inch grizzlies above the cemented rockfill chute. If additional sizing becomes necessary an underground crusher will be installed in close proximity to the cemented rockfill plant.

The requirements for backfill in the Lamefoot mine will be determined by the total amount of ore mined throughout the mine life. If all current probable and possible reserves are mined out and all mined out areas are filled, approximately 697,000 tons of backfill will be required. The area of potential excavation shown on Figure 7 can provide up to 2.8 million tons. Under the Selected Alternative, only the northern end of the quarry would be mined in order to avoid mining material with potential for acid generation. The approximate area of disturbance would measure 16 acres, including the quarry and a stockpile/staging area. To minimize surface water runoff out of the quarry area, the benches that will be formed by the mining will be constructed to slope gently into the hillside, thus enhancing ponding and infiltration while reducing runoff. A detention berm shall also be constructed to prevent runoff out of the quarry. Figure 4 shows a conceptual location for such a structure. The plan of operations for the Lamefoot mine shall have design details for all aspects of quarry development.

The development of access points for backfill in individual stopes will be determined based on stope geometry defined during the exploration phase. The Selected Alternative, allowing direct access from the borrow excavation, is depicted on Figure 4.

5. Mine Ventilation

Ventilation of the mine will be provided by electric fans. Fans draw air into the portal, and three fans (60 to 100 hp each) will exhaust air from the 6-foot diameter crosscut or ventilation raise (Figure 6). One 250-hp fan will exhaust air from the exhaust crosscut. Air flow and the routing of air to specific areas underground will be facilitated by the use of strategically placed barriers to air flow, and the use of up to six 60- to 125-hp fans to blow air through a ventilation pipe or bag to working areas.


BLM
N 28,000
N 27,500
N 27,000
N 26,000
Underground Position Of CRF Raises
Natural Surface Runoff Diversion
Top soil to be placed on berms during pit development
WOLFE CAMP ROAD / CURRENT ALIGNMENT
Haul Road/Relocated County Road
Culvert
LUCKY BOY LODE
SCALE 1"=300FT
ECHO BAY LAMEFOOT PROJECT
SOURCE: ECHO BAY 1993
ECHO BAY MINERAL CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON
LAMEFOOT PROJECT
BACKFILL QUARRY AND
COUNTY ROAD DIVERSION
SUB-COUNTY ROAD
BACKFILL ACCESS
DATE: JUNE 1994
SCALE: 1" = 300'
FIG NO. 7

CURVPIT2

D. Additional Geochemical Characterization Program for Backfill and Wall Rock

To complement the planned activities described above, Echo Bay shall continue with an ongoing program for further geochemical characterization of quarried backfill, waste rock and wall rock materials during mining. The goal of this program is to provide a database in a timely manner to assist with water quality evaluations and predictions during operations and post-closure.

The program shall include static and kinetic testing as necessary to evaluate the potential for these materials to produce acid rock drainage (ARD). The current kinetic testing program will be completed in early 1995 to further characterize the geochemistry of the ore, waste, and quarry materials. BLM will interpret the post closure concentrations of dissolved constituents in the mine pool using the kinetic test results and other data. This program is a continuation of previous efforts, which include acid-base accounting on limestone wallrock, intrusive wallrock and low-grade ore, kinetic testing of clastic wallrock and kinetic testing of quarried backfill.

Backfill quarry materials shall be sampled at a frequency of at least one sample per 10,000 tons. Given that the quarry materials to be backfilled total approximately 697,000 tons, at least 70 samples will be sampled for acid-production characteristics. The first 50 samples shall be analyzed for Acid Generating Potential (AGP), Acid Neutralizing Potential (ANP), Net Neutralizing Potential (NNP), and Total Sulfur. Such results will allow estimation of the relationship between NNP and Total Sulfur. After this relationship has been estimated, the remaining samples will be analyzed for Total Sulfur (%) only.

Underground waste rock shall be sampled at a frequency of at least one sample per 2,000 tons of waste rock. Since the percentage of waste rock will vary by area, the density of the holes sampled will also need to be adjusted by area. This will result in about 125 samples analyzed for Total Sulfur only (assuming approximately 250,000 tons of underground waste) over the 2.5-year life of the mine, at about 40 samples per year.

Ore and Waste Rock - Following mine closure, sediments from underneath areas where ore and waste rock piles have been stored on the land surface shall be sampled to detect for possible metal, acid, or sulfate contamination of surficial materials.

In conjunction with the testing program, Echo Bay has installed additional groundwater monitoring wells in the vicinity of the orebody and between the orebody and Curlew Lake near the western property boundary. These wells shall be used to monitor flow gradients and water quality in the areas. Locations of the wells were determined in conjunction with Washington Department of Ecology (WDOE) and BLM and are shown on Figures 8 and in the Hydrologic Monitoring Plan. Section E., which follows, provides additional details.

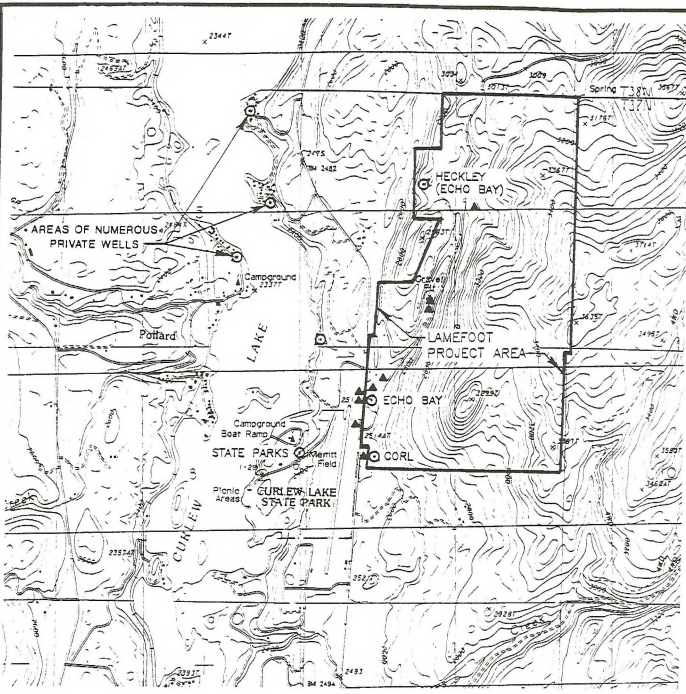
Additional mitigation may be required by State and Federal agencies in connection with the water discharge permits developed following the EISS. During operations, additional mitigation may be required over that already described in this Record of Decision to deal with water quality issues that may arise. This mitigation will be based upon the results of additional monitoring and testing accomplished during operations. These future requirements shall be discussed with and approved by the Authorized Officer, BLM, and where appropriate, by other Federal and State agencies.

E. Water Control, Monitoring, and Treatment

1. Water Handling and Routing in the Mine Workings

Expected water production and use for the proposed Lamefoot Project and other elements of the Kettle River operations are shown on Table 2 and Table 3. Based on these figures, Lamefoot water production is expected to exceed water demand at the mine.

Water inflows to the Lamefoot Mine in particular, which are in excess of mine needs, will be pumped to the infiltration pond for discharge. The water shall be treated prior to discharge to meet WDOE permit standards or if BLM determines



WELLS WITHIN 1/2 MILE OF PROJECT AREA

⊙ WATER WELL ON FILE WITH WASHINGTON D.O.E. LOCATION TO NEAREST 1/4 SECTION AS INDICATED ON WELL LOG.

▲ ECHO BAY MONITORING WELL

0 1000 2000 4000

SCALE IN FEET

ECHO BAY LAMEFOOT PROJECT

SOURCE: ECHO BAY 1994

ECHO BAY MINERAL CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON

WATER WELL INVENTORY MAP

DATE: JUNE 1994 | SCALE: 1" = 2000' | FIG. NO. 16

TABLE 2

PROJECT RELATED WATER PRODUCTION AND USE

Kettle River Project Component	Water Production and Use			
	Average Daily Consumption During Operations (gallons)	Consumption During Startup (gallons per minute)	Expected Range of Production Rate from Mine During Operation (gallons per minute)	On-site Storage Capacity (gallons)
Kettle River Mine	1,000 (from years 1988-1992)	N/A	0 to 15 Current: 0	2,000
Overlook Mine	2,000 (from years 1988-1992	N/A	0 to 10 Current: 0	0
Key East & West Mines	5,000	N/A	0 to 50	5,000
Lamefoot Mine Supply Well	2,000	N/A	0 to 64[a]	0 (small infiltration pond only)
Key Mill and Tailings Facility	70,000	600-700	N/A	5,900
K-2 Exploration	2,000	N/A	N/A	2,000

[a] See Table 4.1-1 of the DEISS for detailed estimates for Lamefoot project.

TABLE 3

MINE INFLOW ESTIMATES[1]

Mine Phase	Inflow from Surface Infiltration	Inflow from Groundwater	Total Inflow
Exploration (current phase of development)	**8.35 AFY** (18.6 acre catchment area x 1.5 ft precipitation x 30% infiltration rate ≈ 8.35 AFY)	**8.35 AFY**	**16.7 AFY** (Based upon observed average inflow of ~10.4 gpm)
Active Mining (to 2400' level)	**18 AFY**[4]	**55 AFY**[2]	**73 AFY**
Active Mining (to 2200' level)	**18 AFY**[4]	**86 AFY**[2]	**104 AFY**
After Closure	**18 AFY**[4]	**0 AFY** (No inflow after mine resaturates to equilibrium)[3]	**18 AFY**
No Action	**6.25 AFY** (assume 75% of exploration infiltration)	**0 AFY**	**6.25 AFY**

Notes:

1 Average annual flows in AFY = Acre Feet per Year; (1 AFY = 0.62 gallons per minute - gpm). Actual flows will vary with seasonal precipitation.

2 Estimated based upon increased hydraulic head in deeper mine workings and assumed bedrock hydraulic conductivity of 0.7 gallons per day/ft^2 (0.09 ft/day) using line sink calculation. Assume inflow is reduced by 50% due to committed mitigation which effectively grouts all points of inflow > 1 gpm.

3 Equilibrium is estimated to be reached when the mine resaturates to the 2750 feet elevation, which would require about 84 acre feet of inflow. This would occur approximately 4.7 years (assuming 18 AFY inflow) after mine closure.

4 Assume surface diversion of run on above mine; 30% infiltration rate on 9.3 acres below (downslope of) diversion, and 100% infiltration rate on 9.3 acres above (upslope of) diversion.

that discharges have exceeded Trigger Levels and caused unnecessary or undue degradation. At present, excess water is routed to a sump at the mine portal and then routed to the infiltration pond site shown on Figure 2. Other underground water will be used for drilling, washdown, and backfill cement mixing operations.

Two initial actions shall be used to reduce potential seepage inflow to the mine. The first consists of grouting of seeping drill holes, faults and/or fractures from the underground workings to reduce direct inflow. The second consists of diverting surface water flow around the area overlying the underground workings to reduce infiltration to the surrounding rock.

In sum, the measures undertaken to handle and route water in the mine workings will include:

(a) Grouting drill holes, fractures, and seeps
(b) Controlling mine infiltration by diverting surface water
(c) Reusing mine water at the cement batch plant
(d) Reusing mine water as makeup water for drilling
(e) Reusing mine water for dust suppression within the mine

a. Underground Grouting Program. Echo Bay shall perform drilling and grouting operations from the underground workings as necessary to reduce water inflow at points of substantial seepage. Grouting shall be performed at locations where the workings intercept faulted or fractured zones of rock with inflows of 1 gpm or more.

All seeps with peak flows projected to exceed one gallon per minute shall be grouted by Echo Bay as close to zero flow as possible, using the Best Available Technology. Examples of best available technology include using high-penetration grouts (e.g., microfine), high-speed centrifugal mixers, and high-sulfate-resistant cement. Pressurized injection of the grout mix into the fractured rock formation will be through drill holes or grout ports at the rock face. The number of drill holes and the quantity of grout to be injected at each location will vary depending upon the rock quality and the relative configuration of the faulted and/or fractured zones and the mine workings. The composition of the grout mixture shall be selected to resist degradation under the geochemical conditions expected to occur in the foundations encountered during mining and post-closure.

Echo Bay shall provide verification by independent, registered professional engineers on the designs, installation, and effectiveness of the grouting program. Echo Bay shall submit the names and qualifications of the proposed engineers to BLM prior to conducting this program, and BLM will notify the Echo Bay whether the engineers are acceptable. These engineers shall be recognized experts in grouting design, and shall review and approve the designs. The engineers shall perform periodic quality control/quality assurance inspections, including witnessing installation and preparation of "as-built" engineering drawings. The engineers shall submit reports to the BLM Authorized Officer within 30 days after completion of each review and inspection. If the engineers identified variations with the approved designs and installation, BLM shall be notified within 24 hours and the construction activities shall cease immediately until written BLM approval is obtained.

b. Surface Water Diversion. Echo Bay shall also reduce the potential for seepage into the underground workings by diverting surface water flows around the overlying hillside. The alignment of the upper exploration road shall be re-constructed into a diversion ditch. The exploration road locations are shown on Figure 2-2. Diversion of surface water flows around areas overlying the underground workings will be expected to reduce infiltration into the workings and seepage into the workings.

To reduce the amount of surface water entering the mine workings, the plan for surface water interception shall be modified to revise the design of Reach 2 Roadside Interception Ditch. The ditch shall be designed to minimize the amount of disturbance, reduce the steepness of the ditch slope and avoid the zone of subsidence hazard. The location and design shall be subject to the prior review and written approval of the Authorized Officer, BLM.

2. Source Control

Echo Bay shall identify source control options within the mine to reduce the levels of nitrate and other analytes in mine water. As discussed in Section C.2., use of low-solubility blasting compounds (water gel and emulsion explosives) will be tested for blasting use, in contrast to the use of ANFO (ammonium nitrate-fuel oil) explosives. Some combination of uses of these materials is expected to reduce nitrate levels during operations. If the combination reduces nitrate levels, its use will be required.

3. Water Quality Detection and Treatment Contingency Program - Hydrologic Monitoring Plan Summary

This section and the next describe Echo Bay's commitments to monitor underground water in the mine workings and at nearby monitoring wells, and to treat water of degraded quality should that become necessary as determined by the Authorized Officer, BLM or other State or Federal agencies. These measures are subject to the review and approval by the WDOE and the Authorized Officer, BLM. The concept for the detection and treatment contingency program is illustrated in Figure 17. The following section further summarizes major points of the detailed Hydrologic Monitoring Plan in the revised Plan of Operations, which provides the basis for the water quality monitoring and detection part of this program. The Hydrologic Monitoring Program will be used to determine the effectiveness of the source control and containment measures.

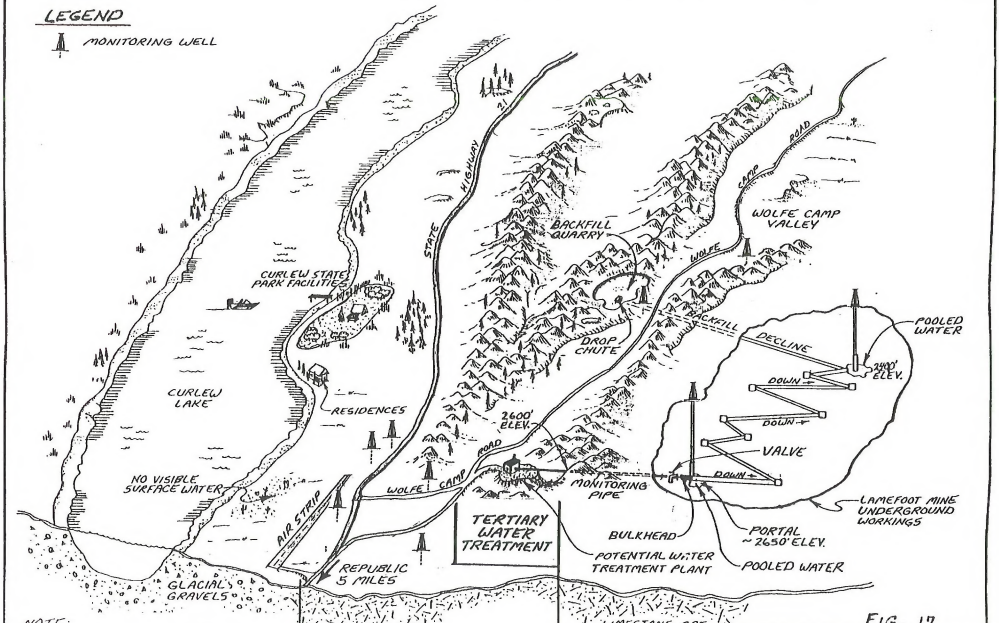
All discharges shall meet State and Federal water quality standards at the project area boundary during operations and following closure. This can be accomplished through source control, water treatment, or a combination of methods. If any standards are exceeded during any one-month monitoring period, Echo Bay shall consult with the Authorized Officer, BLM, to identify appropriate corrective actions. Where BLM determines that corrective action is necessary, Echo Bay shall employ remedial measures, as approved by the Authorized Officer, BLM, within 30 days following the date of approval.

Unnecessary or undue degradation to water quality will be determined based on whether, a) any Trigger Levels are exceeded in any three months, which may or may not be sequential within a twelve month period, b) the source of the degradation can be attributed to the mining operation, and c) the previous corrective measures have been ineffective. If unnecessary or undue degradation occurs and other corrective measures are ineffective, Echo Bay shall consult with the Authorized Officer, BLM. A plan for water treatment facilities may be required within 30 days from the date of written notification by the Authorized Officer, BLM, if BLM determines that these facilities are needed. In determining whether unnecessary or undue degradation has occurred, the Authorized Officer, BLM, may also consult with other state or Federal Agencies.

Where it is determined that unnecessary or undue degradation is caused by excessive nitrate concentrations, Echo Bay shall discontinue using ANFO (ammonium nitrate-fuel oil) explosives immediately following the first month of exceedance. If additional control measures are unable to bring discharge levels within the standards within the next two months, blasting and excavation operations shall cease until the treatment facilities are installed and fully functional, unless otherwise allowed by the Authorized Officer, BLM in writing. If Echo Bay can identify alternative measures to excavate rock and handle discharge water in a manner that will meet the water quality standards without construction of a treatment facility, such methods may be initiated subject to the prior review and written concurrence of the Authorized Officer, BLM.

The Hydrologic Monitoring Plan for the Lamefoot Mine incorporates the relevant monitoring and reporting requirements of the WDOE Waste Water Discharge Permit No. 8033 (i.e. Sections S2, S3, S4, and S7), as well as additional monitoring that has been required as a mitigation measure by the Authorized Officer, BLM.

The Hydrologic Monitoring Plan addresses the monitoring and reporting activities, the monitoring locations and sampling frequencies for mine water discharge, surface water (i.e. springs and wetlands), and groundwater at the mine site, as well as recordkeeping and reporting requirements. The Hydrologic Monitoring Plan includes the following types of items:



NOTE:
NOT TO SCALE, PRECISE LOCATIONS NOT SHOWN. NOT ALL MITIGATION MEASURES ARE SHOWN. SEE SECTION 2.3.5 OF THE FEIS FOR FULL DISCUSSION OF MITIGATION MEASURES AND EXACT WELL LOCATIONS

FIG. 17

CONCEPTUAL DRAWING
POST-CLOSURE UNDERGROUND WATER QUALITY MITIGATION MEASURES
LAMEFOOT MINE PROJECT

- Map of hydrologic monitoring locations (Figure 8)
- Construction specifications for proposed wells
- Aquifer testing procedures
- Monitoring frequency (Tables 4 and 5)
- Sample collection procedures
- Chemical parameters and analytical methods (Tables 6 and 7)
- Periodic interpretation of monitoring data (Section 5)

Standard operating procedures (SOPs) for equipment decontamination, drilling and well installation, aquifer testing, sampling, and documentation are part of the detailed Hydrologic Monitoring Plan to guide field personnel during the implementation of the monitoring program and assure the collection of consistent, reproducible, and defendable data.

The water quality monitoring program by year for the life of the mine and post-closure is depicted graphically on Figures 10 and 11 and described later in this subsection. The requirements of the monitoring program may change over time, depending upon the data obtained and interpretations of the effectiveness of the various monitoring locations, methods and frequencies. The monitoring plan may be modified if the data indicates a need for a change. Any changes in the monitoring program must be reviewed and approved in advance in writing by the Authorized Officer, BLM.

Table 4 presents the frequency for monitoring discharge, water levels, and water quality under the Hydrologic Monitoring Plan. Tables 6 and 7 present the analytes and methods of laboratory analyses for the water samples to be collected. The complete list of parameters shall be analyzed for at least the laboratory sample locations and frequencies shown on Table 4 for the first year of monitoring. The samples shall be collected on a monthly basis for the first six months following the ROD and there after according to the schedule in the Hydrologic Monitoring Plan. During subsequent years of monitoring the complete list shall be analyzed at least once per year or as frequently as later agreed upon, and a "short list" of parameters (as indicated in bold on Tables 6 and 7) shall be analyzed for intervening samples (e.g., quarterly samples).

a. Mine Water. Mine water includes (a) water discharging as underground seepage into the mine, and (b) discharge of this water at the surface from the portal of the mine into the infiltration pond. Monitoring shall consist of quantifying mine water discharge, and measuring field and laboratory water quality.

The amount of underground seepage into the mine shall be monitored by Echo Bay on a monthly basis during operations. Estimates of flow from individual seeps shall be summed to provide an estimate of total inflow to the mine. The monitoring of mine inflows shall be used to identify any substantial (i.e., > 1 gpm) sources of inflow to be grouted for mine water control. All seeps with peak flows projected to exceed one gallon per minute shall be grouted by Echo Bay to zero flow, using the best available technology. Examples of best available technology include using high-penetration grouts (e.g., microfine), high-speed centrifugal mixers, and high-sulfate-resistant cement.

Water quality monitoring shall be conducted to identify whether any specific locations of degraded water quality inflows occur within the mine. Quarterly field water quality measurements from discrete inflow points of greater than 0.1 gpm shall be noted by Echo Bay as needed for reporting purposes. Monitoring data from underground seeps shall be recorded on a current map of the underground workings and also in tabular format. These maps shall also note the location of grouted seep areas and the dates grouting was performed to assist in evaluating the effectiveness of the grouting program. They shall be submitted to the Authorized Officer, BLM, on a monthly basis, or as otherwise identified in the Hydrologic Monitoring Plan.

Mine water that is not used within the mine will be discharged from the portal to the infiltration pond. This discharge is regulated by WDOE Permit No. 8033. The portal discharge will be intermittent, and shall be monitored using a totalizing flow meter. Meter readings and field water quality parameters shall be recorded three times each week. During the periodic monitoring of the infiltration pond, the observed water level shall be recorded and accumulated sediment shall be removed as necessary to maintain the volume and infiltration capacity of the pond, as specified in

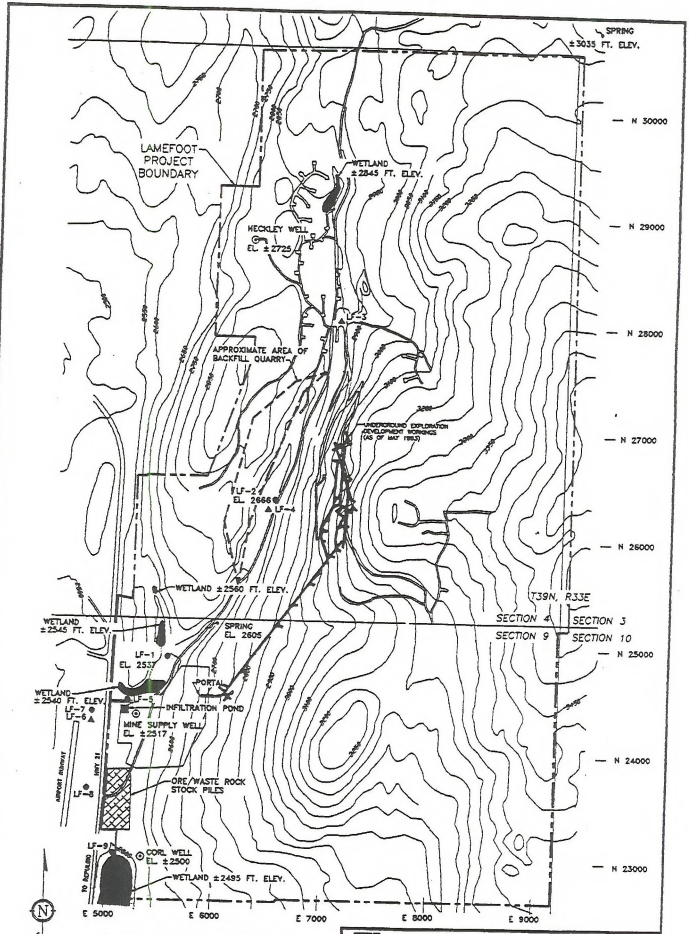

SPRING
±3635 FT. ELEV.
LAMEFOOT PROJECT BOUNDARY
WETLAND
±2845 FT. ELEV.
HECKLEY WELL
EL. ±2725
A-3
APPROXIMATE AREA OF BACKFILL QUARRY
UNDERGROUND EXPLORATION DEVELOPMENT WORKINGS (AS OF MAY 1993)
LF-2
EL. 2666
LF-4
WETLAND ±2560 FT. ELEV.
WETLAND
±2545 FT. ELEV.
SPRING
EL. 2605
LF-1
EL. 2537
PORTAL
WETLAND
±2540 FT. ELEV.
LF-7
LF-6
LF-5
INFILTRATION POND
MINE SUPPLY WELL
EL. ±2317
ORE/WASTE ROCK STOCK PILES
LF-3
LF-9
CORL WELL
EL. ±2500
WETLAND ±2495 FT. ELEV.
TO KETTLE
HWY 31
ARROW SUMMIT
T39N, R33E
SECTION 4
SECTION 3
SECTION 9
SECTION 10
N 30000
N 29000
N 28000
N 27000
N 26000
N 25000
N 24000
N 23000
E 5000
E 6000
E 7000
E 8000
E 9000
N
EL ±2500 APPROXIMATE WATER ELEVATION AT WELL SPRING, OR WETLAND.
EXISTING WATER WELL
SHALLOW MONITORING WELL
DEEP MONITORING WELL
SPRING
0 300 600 900 1200
SCALE IN FEET
ECHO BAY LAMEFOOT PROJECT
SOURCE: ECHO BAY 1993a
ECHO BAY MINERALS CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON
HYDROLOGIC MONITORING LOCATIONS
DATE: NOV 93
FIGURE 8
FILE: DRILNEW

TABLE 4

LAMEFOOT MINE
HYDROLOGIC MONITORING PROGRAM DURING OPERATIONS

Sample Location	Flow	Water Level	Field Water Quality	Laboratory Water Quality[1]	Comments
Mine Water					
Underground Seeps	M		Q		Summed to estimate inflow
Portal	3/W				Totalizing meter installed
Infiltration Pond		3/W	3/W	M (O&G)	Weekly visual inspection; facility area
Surface Water					
Spring at 2605'	M		M	Q	V-notch weir installed
Spring at 3035'[2]	M		M	2B	N.E. of permit area
Wetland at 2495'		M	M		
Wetland at 2540'		M	M		
Wetland at 2545'		M	M		
Wetland at 2845'		M	M		
Groundwater Monitoring Wells					
LF-1 (shallow)		M	Q	Q	N. of infiltration pond and wetland 2540'
LF-2 (shallow)		M	Q	O	N. along Wolfe Camp Road
LF-3 (deep)		M	Q	Q	N. of mine
LF-4 (deep)		M	Q	Q	W. of mine
LF-5 (shallow)		M	Q	Q	N. of inf. pond
LF-6 (deep)		M	Q	Q	W. of inf. pond
LF-7 (shallow)		M	Q	Q	W. of inf. pond
LF-8 (shallow)		M	Q	Q	W. of stockpiles
LF-9 (shallow)		M	Q	Q	S. of stockpiles
Private Water Wells					
Mine Supply Well (Echo Bay)		A	A	A	At mine surface facility pad near infiltration pond
Heckley (Echo Bay)		A	A	A	N.W. of mine
State Park[2]		A	A	A	Near Curlew Lake

Explanation of Symbols:
W = weekly
M = monthly
Q = quarterly
A = annually
2B = Two baseline samples to be collected during first year of monitoring

Water Quality Parameters:
Field = pH, conductivity, temperature

Laboratory = See parameter list on Tables 2-5 and 2-6
(O&G) = Oil and grease analysis in addition to parameter list

1 Long list of laboratory parameters to be analyzed for the first year of monitoring. During subsequent years the complete list will be analyzed once per year and the short list of parameters will be analyzed for the remaining samples (see Tables 2-5 and 2-6)

2 This will be monitored if access can be arranged.

TABLE 5

LAMEFOOT MINE PLANNED
POST-CLOSURE HYDROLOGIC MONITORING PROGRAM

Sample Location	Flow	Water Level	Field Water Quality	Laboratory Water Quality[1]	Comments	Duration (Years)
Mine Water						
Behind Sealed Portal-approx. elev. 2610'		Q	Q	A (O&G)	300 ft. well required in backfilled workings.	10/30[2]
Deepest Workings - approx. elev. 2400'		Q	Q	A (O&G)	500 ft. well required in backfilled workings.	10/30[2]
Surface Water						
Spring at 2605'	Q		Q	Q	V-notch weir installed	10/30[2]
Wetland at 2495'		Q	Q			10
Wetland at 2540'		Q	Q			10
Wetland at 2545'		Q	Q			10
Wetland at 2845'		Q	Q			10
Groundwater Monitoring Wells						
LF-1 (shallow)		Q	Q	Q	N. of infiltration pond	10/30[2]
LF-2 (shallow)		Q	Q	Q	N. along Wolfe Camp Road	10/30[2]
LF-3 (deep)		Q	Q	Q	N. of mine	10
LF-4 (deep)		Q	Q	Q	W. of mine	10/30[2]
LF-5 (shallow)		Q	Q	Q	N. of inf. pond	10/30[2]
LF-6 (deep)		Q	Q	Q	W. of inf. pond	10/30[2]
LF-7 (shallow)		Q	Q	Q	W. of inf. pond	10/30[2]
LF-8 (shallow)		Q	Q	Q	W. of stockpiles	10
LF-9 (shallow)		Q	Q	Q	S. of stockpiles, if accessible	10
Private Water Wells						
Mine Supply Well (Echo Bay)		A	A	A		10/30[2]
Heckley (Echo Bay)		A	A	A	N.W. of mine	1
State Park[3]		A	A	A	Near Curlew Lake	1

Explanation of Symbols:
Q = quarterly
A = annual

Water Quality Parameters:
Field = pH, conductivity, temperature
Laboratory = see parameter list on Tables 9 and 10
O&G = Oil and Grease in addition to list

1 Long list of laboratory parameters to be analyzed quarterly during the first year after closure, then once per year during years 2-10, and once per 2 years during years 12-30. The short list of parameters will be analyzed for quarterly samples during years 2-10.

2 After initial 10-year monitoring, selected locations will be monitored once every two years from year 12 through year 30 after closure.

3 If access can be arranged.

TABLE 6

PARAMETERS AND ANALYTICAL METHODS FOR WATER[1] (METALS)

Parameter	Long List[3]	Short List[4]	Analytical Method[2] Recommended Method
Aluminum (Al)	X		EPA Method 200.7
Antimony (Sb)	X		EPA Method 200.7
Arsenic (As)	X	X	EPA Method 206.2
Barium (Ba)	X		EPA Method 200.7
Beryllium (Be)	X		EPA Method 200.7
Cadmium (Cd)	X		EPA Method 200.7
Calcium (Ca)	X		EPA Method 200.7
Chromium (Cr), Total	X		EPA Method 200.7
Copper (Cu)	X	X	EPA Method 200.7
Iron (Fe)	X	X	EPA Method 200.7
Lead (Pb)	X	X	EPA Method 239.2
Magnesium (Mg)	X		EPA Method 200.7
Manganese (Mn)	X	X	EPA Method 200.7
Mercury (Hg)	X	X	EPA Method 245.1 or 245.2
Molybdenum (Mo)	X	X	EPA Method 200.7
Nickel (Ni)	X		EPA Method 200.7
Potassium (K)	X		EPA Method 200.7
Selenium (Se)	X	X	EPA Method 270.2
Silicon	X		EPA Method 200.7
Silver (Ag)	X		EPA Method 200.7
Sodium (Na)	X		EPA Method 200.7
Thallium (Tl)	X		EPA Method 279.2
Zinc (Zn)	X	X	EPA Method 200.7

1 NOTE: Samples for metals analyses will be analyzed for total recoverable metals. Selected samples may be field-filtered and analyzed for dissolved metals.

2 EPA Methods are NPDES-approved, per 40 CFR 136 Tables: EPA 200 Methods from Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, March, 1979. Revised March 1983.

3 Long list of parameters to be analyzed during the first year of monitoring, then annually thereafter.

4 **Short list** of parameters to be analyzed for the remainder of intervening sample intervals.

TABLE 7

PARAMETERS AND ANALYTICAL METHODS FOR WATER (ANIONS AND OTHERS)

Parameter	Short List[3]	Long List[2]	Analytical Method[1] Recommended Method
Alkalinity, Total, HCO_3/CO_3 and Hydroxide	X	X	EPA Method 310.1
Ammonia (NH_3) - as N	X	X	EPA Method 350.1
Chloride (Cl)		X	EPA Method 325.1
Orthophosphate		X	EPA Method 365.1, 365.2, or 365.3
Hardness		X	Calculated from Ca and Mg
Fluoride (F)		X	EPA Method 340.2
Nitrate (NO_3) - as N		X	EPA Method 300.0
Nitrate + Nitrite (NO_3 + NO_2) - as N	X	X	EPA Method 353.2
pH	X	X	EPA Method 150.1
Specific Conductance	X	X	EPA Method 120.1
Sulfate (SO_4)	X	X	EPA Method 375.4
Total Suspended Solids (TSS)	X	X	EPA Method 160.2
Total Dissolved Solids (TDS)	X	X	EPA Method 160.1
Oil and Grease[4] (O&G)	X	X	EPA Method 413.1

[1] EPA Methods are NPDES-approved, per 40 CFR 136 Tables: EPA 100 and 300 Methods from Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, March, 1979, Revised March 1983.

[2] Long list of parameters to be analyzed during the first year of monitoring then annually thereafter.

[3] Short list of parameters to be analyzed for the remainder of intervening sampled intervals.

[4] Only Infiltration Pond will be sampled for Oil and Grease until post-closure monitoring begins.

WDOE Permit No. 8033. Water quality measurements shall be collected at the point of discharge to the pond if no water is present in the pond. Otherwise, the water quality measurements shall be obtained by collecting a sample of the standing water in the settling or infiltration ponds. Samples shall be collected monthly for laboratory water quality analyses. The samples collected shall be analyzed for total recoverable metals, major ions, nitrate/nitrite, and total suspended solids (TSS). In addition to the listed parameters, water from the portal or infiltration pond shall be analyzed monthly for oil and grease. Collection of additional samples by Echo Bay may be required as determined by the Authorized Officer, BLM, from internal mine sumps during those intervals when there is no discharge to the surface.

b. **Surface Water**. Surface water includes (a) water discharging from springs, and (b) water contained within the various wetland areas at the mine site. Surface water monitoring shall consist of quantifying discharge and water levels, as well as measuring field and laboratory water quality. These measurements will be used to document natural variations in surface water quantity and quality, and to identify potential impacts of mining that may indicate the need for mitigation.

If possible, measurements of flow rate shall be made monthly at two springs. One of the springs is located within the Wolfe Camp drainage at an elevation of 2,605 feet (Spring 2605), while the other spring is located northeast of the permit boundary at an elevation of 3,035 feet (Spring 3035). Visual observations of water conditions shall be made and recorded monthly at four wetland areas by Echo Bay. The wetland areas are located within the permit boundary at elevations of 2,845 feet (Wetland 2845), 2,545 feet (Wetland 2545), 2,540 feet (Wetland 2540), and 2,495 feet (Wetland 2495).

During the monthly visits to the springs and wetlands, field water quality measurements shall be performed at each location if the sites are accessible and conditions permit (e.g., measurable flow). The purpose of this sampling is to establish a characterization of general water quality at these locations which can be used as a possible indicator for mining impacts. Samples for laboratory water quality analyses shall be collected every quarter from Spring 2605, and shall be coincident with quarterly sampling of groundwater monitoring wells. The purpose of this sampling is to monitor possible seasonal variations in water chemistry (which are naturally occurring), or variations which may have been induced from mining operations or other sources. In addition, laboratory water quality analyses shall be collected from Spring 3035, if conditions permit. Two baseline samples shall be collected (an initial sample and a confirmation sample) from this spring during separate sampling events. The purpose of this sampling is to document baseline water chemistry in the off-site spring, so that potential future impacts could be assessed at this location.

c. **Groundwater Characterization**. A groundwater characterization study shall be completed by an independent, professional hydrogeologist with expertise in fracture flow analysis. This program will be necessary in order to assist in interpreting monitoring results. A work plan that includes time frames shall be submitted to the Authorized Officer, BLM, for review and acceptance. The program shall include, but not be limited to, the following items:

(i) Additional wells to define the permanent (pre-mining/post-closure) saturated zone (i.e., water table) and water quality throughout the project area. The number, location, and function of each drill hole shall be determined following further evaluation of the conceptual groundwater flow model and consultation with BLM.

(ii) Pump tests on some or all of the existing and new wells to determine hydraulic characteristics of the aquifers.

(iii) An interpretive report that identifies the predicted post-closure groundwater level within the mine and adjacent areas.

(iv) A detailed analysis of the flow system and its role in contributing water inflows to the mine and potential water outflows from the mine, based on existing and new drill hole data. Potential local flow paths and transport rates shall be identified.

(v) Identification of potential attenuation mechanisms and any additional studies necessary to verify the extent of attenuation.

(vi) Recommendations for modification of the existing water monitoring plan based on findings of the study.

(vii) Refinement of the interpretations of background and baseline water quality parameters.

d. Groundwater Monitoring. Conditions shall be monitored in two older existing monitoring wells, six monitoring wells installed in 1994, one well point installed in 1994 and several existing private water wells as required by WDOE Permit 8033 and as described in the Hydrologic Monitoring Plan (Figure 12). This network of monitoring wells is designed to detect possible changes in water quality or water level (a) during operation and post closure of the mine, (b) from seepage through ore/waste rock stockpiles, and (c) from seepage below the infiltration pond. The following tasks are part of the groundwater monitoring program:

- Drilling, installation, and development of four shallow monitoring wells in 1994
- Drilling, selective hydraulic testing, installation, and development of three bedrock wells in 1994
- Groundwater level monitoring and sampling of the older existing monitor wells, the monitoring wells installed in 1994, and selected private wells.
- Post-closure, construction of a valve/drain pipe at the portal, and two monitoring wells into the workings

Three monitoring wells (LF-5, LF-7, LF-8) and a monitoring well point (LF-9) have been installed within the shallow unconsolidated sediments. The purpose of these wells is to document natural variations in groundwater flow directions and water quality within the unconsolidated sediments, and to identify potential impacts from mining that may indicate the need for mitigation.

Three monitoring wells (LF-3, LF-4, and LF-6) have been installed within the deep bedrock beneath the mine site. The deep wells will be used to further characterize the permeability, flow pathways, and hydraulic connection with shallow groundwater for baseline characterization, in addition to their use for monitoring water quality within the bedrock.

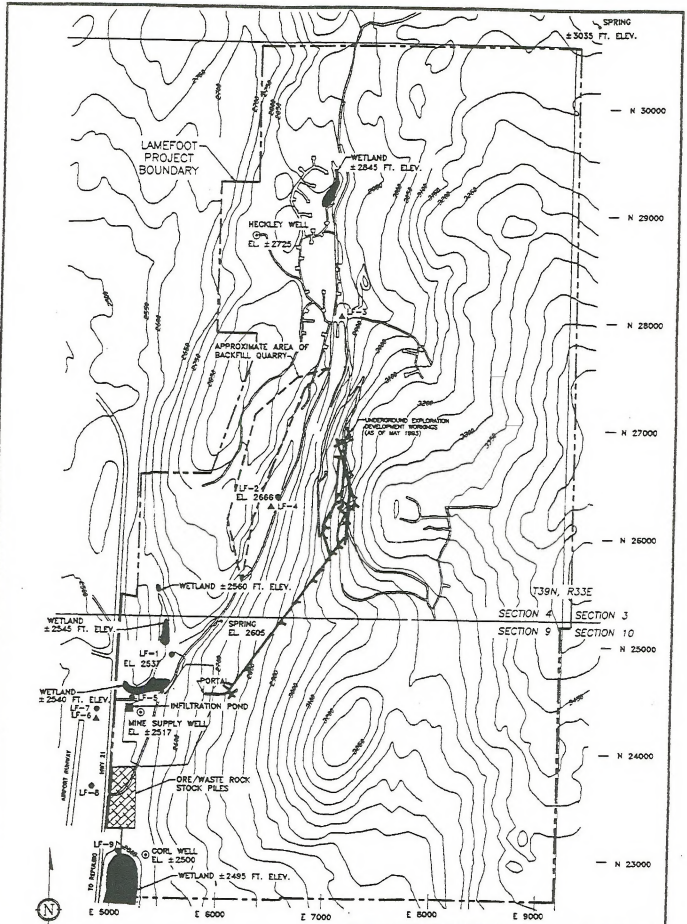
Groundwater levels shall be monitored on a monthly basis in the monitoring wells and well point. The purpose of this monitoring is to evaluate groundwater flow directions in the unconsolidated sediments and the bedrock, and to evaluate water level fluctuations which may be attributable to the seasons or mining operations. Water levels shall also be monitored in private water wells prior to sampling.

The two older shallow monitoring wells and seven monitoring wells installed in 1994 shall be monitored monthly for the first six months field and laboratory water quality parameters and thereafter according to the schedule in the Hydrologic Monitoring Plan. Additionally, several private water supply wells will be monitored annually as part of the program. This monitoring will supplement the data obtained from the existing and new monitoring wells and will be used to identify any potential impacts to the private wells that may require mitigation.

Post-closure, an internal detection monitoring and control system shall be installed to measure water levels and quality within the plugged mine workings. Echo Bay shall monitor the internal mine workings in accordance with the Hydrologic Monitoring Plan. This will involve two approaches.

First, Echo Bay shall install a drain pipe and valve on the main portal bulkhead at the time of construction. This valve (likely including a drain pipe with screens, filter, gauges, and valves) may be used for draining of the upper workings if water treatment becomes necessary. The valve may also be used to remove water quality samples. The pipe shall be sized to allow for a maximum mine inflow/outflow of 125 gpm.

Second, Echo Bay shall install two monitoring wells from the land surface above the mine into the mine workings immediately after installation of portal bulkheads. One well shall be constructed into the workings behind the portal plug, down to an elevation of approximately 2,600 feet above MSL. The second well shall be constructed into the deepest and



ECHO BAY LAMEFOOT PROJECT
SOURCE: ECHO BAY 1993a

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HYDROLOGIC MONITORING LOCATIONS

DATE: NOV. 93 | FIGURE 12

FILE: DRILNEW

more northern part of the workings, down to an elevation below the maximum mining depth. The wells would be used for long-term monitoring of water quality and levels within the backfilled mine workings (minimum of 5-30 years post-closure).

Monitoring of groundwater, surface water, and/or mine water shall be required following closure of the mine operations. The monitoring plan, established by the Hydrologic Monitoring Plan, will change as a historical data base is developed which identifies the geochemical trends of these waters. The number and location of monitoring points and the types of analytes that will be required is dependent upon this information and upon WDOE requirements at the time of closure. The historical data will be able to indicate whether some monitoring points no longer require monitoring, or whether additional monitoring points or methods may be required.

The proposed monitoring network is expected to be sufficient for post-closure monitoring. An initial proposal for monitoring frequency is presented in Table 5. After 10 years of post closure monitoring, a selected number of sample locations shall be monitored once every two years to detect long-term geochemical changes during years 12 through 30 after mine closure. This monitoring program is intended to ensure that no unnecessary or undue degradation occurs from the operations. As noted below, first annual (and later, periodic) reports will tally and summarize the analytical results.

The monitoring plan may be modified as necessary during operations or post-closure to take into consideration the historical monitoring data. Post-closure, the monitoring plan shall outline the most appropriate monitoring locations, monitoring frequencies, and analytes for this period, along with appropriate reporting procedures. Monitoring water quality in the backfilled mine shall be accomplished by sampling from two points within the mine workings after closure.

Laboratory analyses of the samples indicated on Table 5 include the parameters listed on Tables 6 and 7. The complete list of parameters shall be analyzed quarterly for the first year after mine closure. During subsequent years, the complete list shall be analyzed only once per year (or every two years for biannual samples) with intervening quarterly samples analyzed for the "short list" of parameters as indicated on the Table 6 and 7.

e. Recordkeeping and Reporting. Recordkeeping and reporting will be in accordance with the requirements of WDOE Permit No. 8033 and documentation procedures for BLM presented in the hydrological monitoring plan. Figure 10 summarizes the detailed water quality monitoring planned. All records of monitoring activities and results shall be retained for the operational life of the mine. Records and results shall be kept in the files at the mine site. Following mine closure, the records and files shall be retained at Echo Bay's corporate headquarters in Denver, Colorado.

Operational monitoring results shall be reported to the WDOE and the *Authorized Officer,* BLM on a monthly basis. Reporting and filing shall be in accordance with the requirements of the WDOE Permit No. 8033 (Sections S3 and S7). The report shall present the tabulated measurements and the laboratory analytical results in a standardized format in hard copy and computer disk. In the case of post-closure monitoring, reporting frequency shall coincide with the monitoring frequency. For example, quarterly monitoring and reporting would be performed during the first 10 years after mine closure based upon the schedule presented in Table 5. An annual or periodic interpretive monitoring report, according to Figure 11, will therefore also present a discussion of monitoring data, water quality and quantity trends, and effectiveness of mitigation.

4. Water Treatment

Should the need for water treatment arise, additional studies will be completed by Echo Bay to identify the appropriate technologies. Echo Bay will be required to conduct a detailed evaluation to determine the most suitable technology prior to implementing treatment. Other potential future water quality issues will be handled by Echo Bay in conjunction with either the BLM or the WDOE.

a. Actions During Operations. In the event that control of water flow and contaminant sources are unsuccessful at controlling nitrates and other constituents, then other measures will be required.

(i) Echo Bay shall conduct monitoring of the external wells, seeps and wetlands as described in the Hydrologic Monitoring Plan, unless otherwise approved by the Authorized Officer, BLM. Echo Bay shall report these data, and take action as required by the conditions of any permits developed by the WDOE, in conjunction with the BLM. Specific actions shall be designed based upon the conditions occurring at the time and location of detection of a problem, as well as predicted trends of increasing degradation. Some examples of secondary mitigation actions may include additional grouting, surface water diversion at the mine, water management, or other source control techniques to control ground water inflows.

A series of Trigger Levels will be developed by the Authorized Officer, BLM, for water quality parameters based upon natural background levels. These Trigger Levels will be used as measures of performance to determine the effectiveness of source control and containment of water quality degradation within the mine workings. Upon first noting an exceedance of the Trigger Levels, Echo Bay shall collect additional samples immediately following the reported exceedance, then monthly at the pertinent sites to verify the exceedance. The Authorized Officer, BLM, may determine that unnecessary or undue degradation has occurred when concentrations of these parameters in the Secondary Level (external detection) sites exceed the Trigger Levels.

(ii) Should Trigger Levels continue to be exceeded at any of the Secondary Level sites, Echo Bay shall conduct additional evaluations to identify the most suitable treatment methods. Echo Bay shall be required to implement one or more of these treatment technologies if the Authorized Officer, BLM, or other Federal and State agencies determine such action is necessary because initial corrective measures are unsuccessful at reducing concentrations within the Secondary Level monitoring sites. Specific treatment technologies at that time will need to be evaluated based upon the actual chemistry of the water detected in the monitoring system.

b. Actions Post-Closure. A post-closure monitoring program shall be implemented by Echo Bay that includes primary, secondary, and tertiary levels of action to address undesirable constituent levels. The measures and type of response actions that shall take place are as follows:

(i) Alert Level Measures - Internal Detection: Two monitoring wells shall be placed into the predicted saturated zone of the mine workings within 30 days after mine closure in locations that have been reviewed and approved by the BLM prior to installation. These will be monitored according to the detailed Hydrologic Monitoring Plan that will be included in the Plan of Operations. Post closure concentrations within the mine pool will be predicted by the BLM using kinetic test results and other data. Any detection of constituents at concentrations greater than the maximum predicted ranges shall be reported to the BLM within 24 hours. BLM will then determine whether expanded monitoring frequency, locations, or parameters are needed to evaluate water quality trends. If BLM determines that such expansions are necessary, Echo Bay shall comply with the written instructions of the Authorized Officer, BLM.

(ii) Remediation Level Measures - External Detection: In order to verify the effectiveness of source control and containment mechanisms, monitoring of external wells, springs, and wetlands shall occur as previously described in the Hydrologic Monitoring Plan. Within twelve months of completion of the FEISS, the BLM will review the water quality data and determine background levels to set trigger levels for remediation. The established baseline for each monitoring location and for individual monitoring parameters will be determined. These levels will be further refined as the monitoring program continues. Trigger levels will be developed in consultation with State agencies, but will not necessarily be the same as water quality permitting standards developed by the State. Any detections of constituents at concentrations greater than (a) trigger levels or (b) more stringent State or Federal standards, shall be reported within 24 hours to the Authorized Officer, BLM, and to the appropriate

State and Federal agencies. If either of these occur, BLM will require expanded monitoring measures as stated above, plus remediation measures for water quality degradation that threatens to impact beneficial use or natural resources. Remediation could include interceptions wells, slurry cut-off walls, replacement of water supplies for domestic use, water treatment, replacement of wetland water supplies, or other measures which may be deemed necessary.

(iii) Extensive Remediation - Internal and External Detections: If monitoring at both internal and external locations indicates that the performance criteria as defined under 4(b)(i) inside the mine workings and Trigger Levels outside the mine workings are consistently being exceeded 5 years after the bulkhead installation or after post-mining waters in the mine pool reach equilibrium, whichever occurs sooner, then the Authorized Officer, BLM, will consult with other State and Federal agencies and will require Echo Bay to:

- Take any or all of the measures previously described in 4(b)(i) or (ii)at the Alert or Remediation levels. BLM will determine which measures are necessary to bring the operation into compliance with the performance criteria and will communicate these measures to Echo Bay.
- To dewater by pumping solution from the mine portal or dewatering wells.
- To initiate active water treatment to meet the water quality standards. If dewatering and water treatment are required, these actions shall continue until source control measures have been demonstrated to be effective in meeting water quality standards.
- To enhance source-control measures such as reopening the workings to apply grouting, building cutoff walls, and constructing surface and groundwater diversions upgradient of the mine workings.
- Use other effective alternative measures developed for the site specific conditions.

5. Water Quality Detection and Treatment Contingency Program - Hydrologic Monitoring Plan Interpretive Reports
The following summarizes how Lamefoot water monitoring activities will be reported, and the subsequent agency use of these reports to evaluate the impacts of the mining activities. The present scenario assumes about 2.5 years of operations and thirty years of post-closure monitoring and oversight. Regulatory oversight may be required for longer than or less than thirty years (post-closure).

a. Data Reporting and Evaluation.

Operations Phase - Figure 11 presents an overview of the proposed Evaluation Schedule of activities. The water resources monitoring that is the basis for these activities is summarized in Section IV.E.3. Echo Bay shall submit periodic reports to the Authorized Officer, BLM, as identified in the hydrologic monitoring plan, and any additional reports that may be needed.

Operational data shall be compiled by Echo Bay and delivered to the agencies (BLM and, where appropriate, other Federal or State agencies) within one month of receipt from the laboratories. These data shall be analyzed quarterly for simple concentration trends (using graphs and summary tables) by Echo Bay. In most instances, the plots will include only indicator parameters - field pH and specific conductance, total alkalinity, nitrate plus nitrite, and sulfates (discussed below), plus any constituents which appear to have anomalous concentrations or show increasing trends. An annual Cumulative Trend Analysis Report summarizing all of the indicator parameters and other water resources data (Tables 4 through 7) will be prepared by Echo Bay and its contractors and submitted to the Authorized Officer, BLM, and other agencies by the end of April following the year of monitoring.

Indicator parameter trends would also be related to natural "background" or baseline concentrations. The present understanding of baseline groundwater quality is limited and will be augmented with samples from the newly constructed wells discussed in Section IV.E. As shown on Figure 10, annual data reports shall be prepared each year during the Operations Phase.

Post-Closure Phase - Echo Bay shall prepare periodic Data/Evaluation Comprehensive Summary Reports, following the annual or periodic Cumulative Trend Analysis Reports discussed above, as shown on Figure 11. These reports shall be submitted to the Authorized Officer, BLM, and other designated agencies within five months of mine closure, and within five months after the end of post-closure years 3, 5, 7, 10, 15, 20, 25, and 30. The Comprehensive Summary Reports shall include cumulative summaries of the annual report data and any other pertinent data, from pre-mining through the current reporting year. These reports shall also include updated discussions and, if necessary, additional analysis and interpretation of site conceptual hydrogeology and water quality trends. Additionally, the reports shall include recommendations of the need for geochemical modeling considering the current monitoring results and other factors.

Agency Evaluation - The agencies (BLM and other specified Federal or State agencies) will use the Annual and Periodic Post-Closure reports to: (1) evaluate the effectiveness of the primary and secondary monitoring programs; (2) identify any needed changes in these programs - i.e., additional wells or abandonment of wells, changes in monitoring frequency, other parameters; (3) evaluate the need for other mitigation activities - i.e., additional grouting, water diversions, water treatment or other mitigation methods; and (4) determine the appropriate increases, decreases, or release of financial guarantees and/or changes in criteria for financial guarantee requirements. Upon review of the early Post-Closure Data/Evaluation summary reports, the agencies may direct that future Post-Closure Reports include simulations of future groundwater flow and transport, as well as geochemical modeling.

F. Power/Water Requirements

Electrical power is purchased from the Public Utilities District of Ferry County. A substation at the site steps down the power from the Public Utilities District distribution line to 4.16 kV. A smaller substation at the portal further reduces voltage to 480v. Additional substations and powerlines may be installed, subject to the review and approval of these facilities, in advance, by the Authorized Officer, BLM.

Water requirements for Lamefoot and other elements of the Kettle River operations are shown on Table 2.

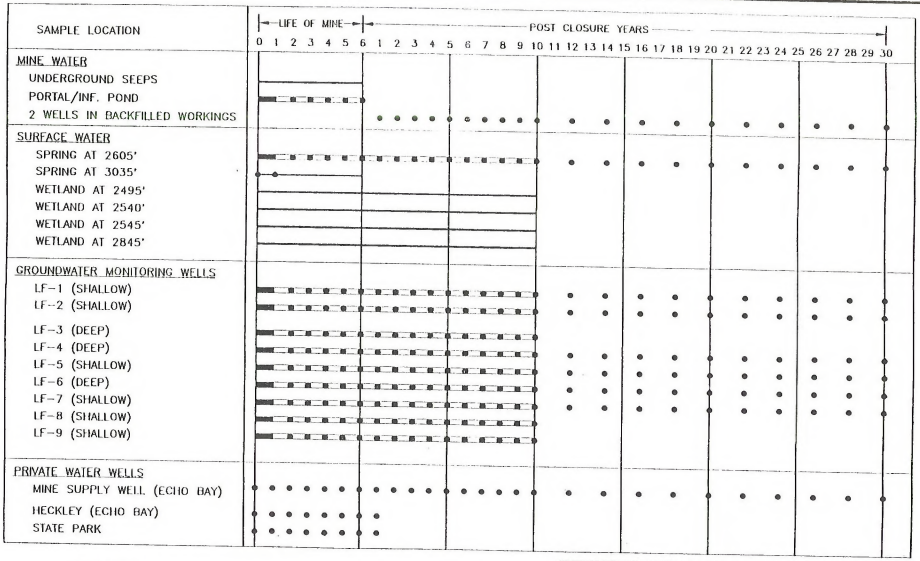
G. Waste Rock Disposal Area

These temporary waste rock disposal areas are located near the mine portal as shown on Figure 2. Some additional waste rock will be added to these piles during completion of exploration and startup of the commercial mining operation. The additional materials will be added to the top of the piles without significantly altering the existing waste footprint. About 260,000 tons of waste rock is present in the surface piles. Transport of waste underground for use as backfill will commence early in the commercial production phase and continue throughout the mine life. The remaining waste rock will be placed directly as backfill in the underground workings. A maximum of about 350,000 tons of waste rock will be temporarily stored in the waste rock stockpile over the life of the mine, assuming that all currently indicated mineralization within the Selected Alternative is mined.

H. Ore Transportation

The ore will be temporarily stockpiled at the Lamefoot site and then loaded into highway haul trucks by a front end loader for transportation to the mill. These trucks will probably be rated at a 20-ton capacity and would trail a 10-ton or 20-ton "pup," or tandem trailer. All trucks shall conform to requirements of the Washington State Department of Transportation and the Ferry County Road Department, and will be permitted by the agencies if and as required.

The primary route for the haul trucks will be south along the two-lane State Highway 21 to the County Old Kettle Falls Road (formerly known as Cooke Mountain Road) then east to the Jack Mays Pride Road. The ore will be hauled on Jack Mays Pride Road to Fish Hatchery Road then east to the Key Mill (Figure 13). A one-way trip for the ore haul will include a total of 5.0 miles of state highway and 3.8 miles of county road. This is the longest of the potential routes



EXPLANATION

- QUARTERLY OR MORE FREQUENT MONITORING/LONG LIST
- QUARTERLY OR MORE FREQUENT MONITORING/SHORT LIST
- QUARTERLY OR MORE FREQUENT MONITORING/FIELD PARAMETERS
- ANNUAL MONITORING/LONG LIST

ECHO BAY LAMEFOOT PROJECT

SOURCE: ECHO BAY 1994

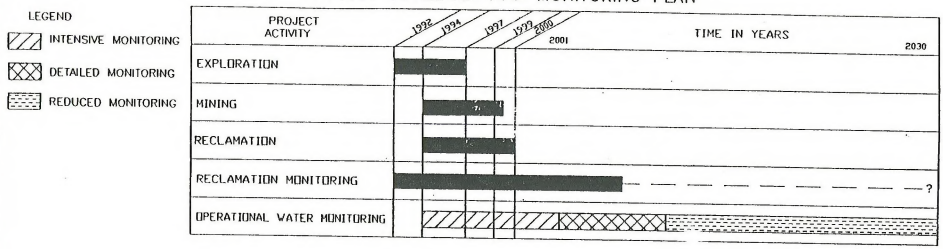
ECHO BAY MINERAL CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON

LAMEFOOT MINE WATER QUALITY MONITORING BY YEAR

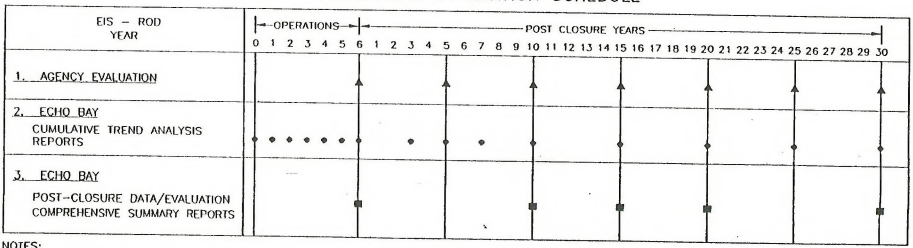
DATE: JUNE 1994 | SCALE: NA | FIG NO. 10

LAME2-48

PROJECT SCHEDULE AND MONITORING PLAN



MONITORING EVALUATION SCHEDULE



NOTES:

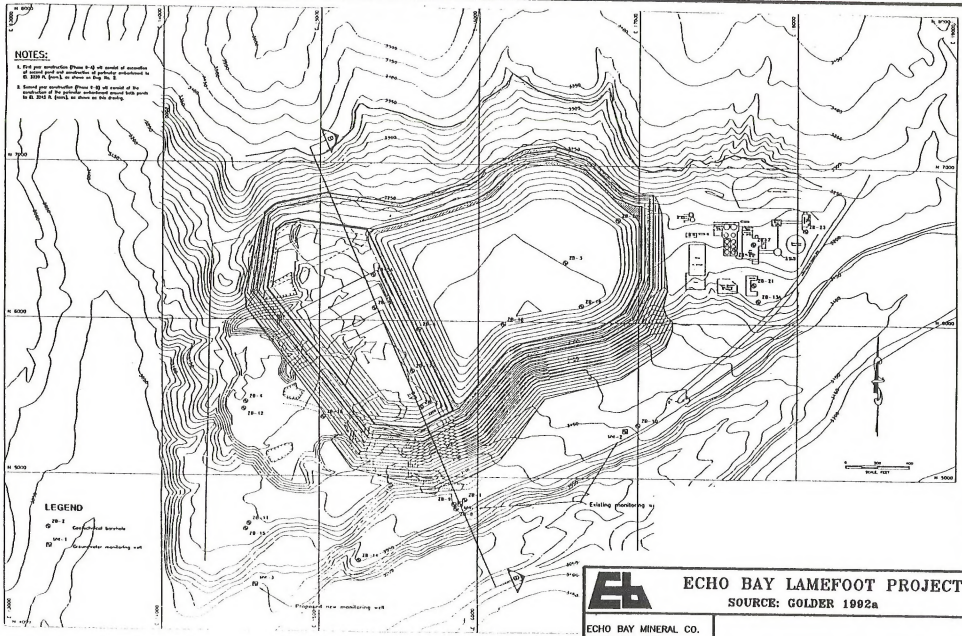
1. ADDRESSES NEEDED CHANGES TO:
   - MONITORING PROGRAM (PROBLEM IDENTIFICATION, FUTURE ACTIVITIES)
   - BONDING REQUIREMENTS
   - FURTHER EVALUATION METHODS
2. CUMULATIVE TRACKING AND RECORD KEEPING OF INDICATOR AND OTHER PARAMETERS.
3. INCLUDE CUMULATIVE EVALUATIONS OF ANNUAL REPORTS FROM BASELINE TO PRESENT, AND CONCEPTUAL HYDROGEOLOGICAL/WATER QUALITY/GEOCHEMICAL EVALUATIONS.

ECHO BAY LAMEFOOT PROJECT
SOURCE: ECHO BAY 1994

ECHO BAY MINERAL CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON

LAMEFOOT MINE PROJECT SCHEDULE AND MONITORING EVALUATION

DATE: JUNE 1994 | SCALE: NA | FIG NO 18


NOTES:
1. First year construction (Phase 1-A) will consist of excavation of lowest pond and construction of perimeter embankment to El. 3039 ft. (asl.), as shown on Dwg. No. 2.
2. Second year construction (Phase 1-B) will consist of the construction of the upper embankment to the ultimate crest height to El. 3062 ft. (asl.) as shown on the drawing.
LEGEND
Groundwater monitoring well
Proposed new monitoring well
Existing monitoring w
ECHO BAY LAMEFOOT PROJECT
SOURCE: GOLDER 1992a
ECHO BAY MINERAL CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON
FACILITY LAYOUT
DATE: JUNE 1994
SCALE:
FIG. NO. 1 3

considered. Its use will increase fuel consumption and vehicle emissions, but will use the upgraded road surface that was constructed in 1992-93. A road maintenance agreement between Echo Bay and the County provides for economic support in the costs of upkeep of the road. Echo Bay has also contributed funding for the reconstruction of the County road. Improvements of the Old Kettle Falls Road to be completed in 1993-94 will allow for year-round (all-weather) usage.

During commercial production, ore hauling will range from 30 to 70 round trips per day, depending on the truck size and actual production rate at a given time. The ore haul will be restricted to twelve hours per day between the hours of 6:30 a.m. to 6:30 p.m., seven days per week unless road conditions during the day require night haulage. Proposed and actual ore haul rates for the Lamefoot Mine and other Kettle River Project mines are summarized on Table 8. The proposed Lamefoot haul rates will be in effect for the life of the mine as defined in Section IV.B.

Public access to the Key Mill is also provided via an existing county road (Fish Hatchery Road). This route is not proposed for mine-related traffic, but will be used by employees going to and from work.

I. County Road Relocation

The primary access to the Lamefoot site is the previous alignment of old Wolfe Camp Road (Figure 2), which was vacated by the County on January 11, 1993. The relocated Wolfe Camp Road (see "county road diversion," Figure 2) provides access to residences to the north. The backfill quarry is designed in part as a highway road cut, and will also include provisions for future use as a quarry by the County Road Department for construction aggregates. It is further planned to realign Wolfe Camp Road (see Fig. 7) to the west side of the Wolfe Camp valley instead of its current location on the east side of the valley. This relocated alignment would largely occupy a previously disturbed area in the quarry. Some new surface disturbance (up to 7.4 acres) will occur on private land as a result of this relocation.

A portal will be built next to the current county road so that material excavated from the quarry can be hauled underground for placement as backfill. This backfill may or may not require crushing, depending on the size reduction experienced during blasting. The quarry will be developed selectively to maximize production of neutral to basic (non-acid generating) rock, while minimizing production of rock with potential for acid generation. Cement storage facilities will be constructed on the surface and underground. An underground batch plant will be required for preparation of cemented backfill.

J. Reclamation

Reclamation activities shall include reclamation of surface disturbance and underground workings. Reclamation of drill site and access roads will be continued using the methods described in the revised Plan of Operations unless other measures are approved in advance in writing by the Authorized Officer, BLM. Surface disturbance associated with underground exploration and underground disturbance shall be reclaimed at closure.

Surface reclamation activities shall include removing structures, regrading, ripping, topsoiling, seeding, fertilizing and control of noxious weeds to ensure the establishment of desirable plant communities. The purpose of these activities shall be to re-establish pre-mining drainage patterns and provide a stable surface and topographic conditions compatible with the surrounding landscape.

Reclamation of underground workings shall be by backfilling the stopes. In addition, all surface openings including the main portal, the borrow area portal, and ventilation shafts shall be plugged in accordance with the requirements specified for the Selected Alternative.

TABLE 8

KETTLE RIVER MINES PRODUCTION AND KEY MILL TAILINGS CAPACITY

Mine Source	Haul Rate Tons/Day				Mill Throughput (000s tons)			
	1988 Proposed	1992 Proposed	1993 Actual	1994 Proposed	1988 Proposed	1988 to 1993 Actual	1994 Proposed	1995-2000 Proposed
Overlook Mine	1,000-1,500	1,200	0	0-600	Not specified	1,581	300	0
Kettle River Mine	300-500	0	0	0	Not specified	245	0	0
Key East/Key West Mine	0	2,000	2,500	0	0	597	270	0
Lamefoot Mine	0	0	150	1,200-2,000	0	85	876 to 1,460	803 to 1,390
K-2 Prospect	0	0	0	0	0	0	0	400 to 900?
Tailings Capacity					7,000	2,544/3,700	6,700	6,700
Total Capacity, Conceptual Design					9,600		9,600	9,600

Echo Bay shall provide verification by independent, registered professional engineers on the designs, installation, and effectiveness of the grouting program, closure bulkheads, and shaft caps. Echo Bay shall submit the names and qualifications of the proposed engineers to BLM, and the BLM will notify Echo Bay whether the engineers are acceptable. These engineers shall be recognized experts in grouting and closure design, and shall review and approve the designs. The engineers shall perform periodic quality control/quality assurance inspections, including witnessing installation and preparation of "as-built" engineering drawings. The engineers shall submit reports to the Authorized Officer, BLM, within 30 days after completion of each review and inspection. If the engineers identify variations with the approved designs and installation, BLM shall be notified within 24 hours and the construction activities shall cease immediately until written BLM approval is obtained.

To ensure the integrity of the bulkheads and to maximize bulkhead design life and protect public safety, the plan for bulkhead design and construction shall be modified to include the following:

a. The bulkheads shall be designed and constructed by Echo Bay in accordance with any applicable codes at the time of construction and designed for site-specific conditions.

b. The design investigations shall consider the relative effectiveness of dual bulkheads versus single bulkheads. The recommendation for the most appropriate design for the actual site conditions at that time shall be based on the Best Available Technology for the most effective means of perpetual closure.

c. The design shall be for water impoundment bulkheads which assure non-communication between the mine pool and areas outside the mine, and which positively prevent hydrofracturing to the ground surface and release of water from the mine pool. The maximum head used in the design shall be based on the presumption that the mine openings may completely flood with water.

d. The design shall be modified to be resistant to low pH, high sulfates, and corrosion or chemical attack by other deleterious substances.

e. The bulkheads and the mine closure and sealing program shall be designed to eliminate leakage at or near the sites of the bulkheads.

f. Grouting provided during construction shall be adequate to ensure that there is no leakage around the bulkhead, either at the contact of the bulkhead with the wall rock or within the wall rock at design conditions.

g. A qualified, registered professional engineer shall prepare and submit to the Authorized Officer, BLM, for approval, at least three months prior to the proposed construction of the bulkheads, the design and construction specifications and engineering drawings. These shall reflect existing site conditions and be consistent with the requirements specified in the approved Plan of Operations.

h. The bulkhead placed at the main portal shall include pipe and valve installation to allow access for sampling and treatment.

i. The bulkhead installation program shall include provisions for post-closure verification of the adequacy of seals, bulkhead integrity and wall rock integrity, until such time as the internal mine pool has filled to an equilibrium level.

j. The shaft caps and upper portals shall be installed at the time of closure and surface reclamation may take place after the Authorized Officer, BLM, has reviewed and approved the bulkhead installation. These upper shaft caps and portal bulkheads shall serve the function of minimizing airflow, as well as impounding water if the mine should fill to those levels.

K. Exploration Activities

1. Ongoing Activities

From 1989 to 1992, extensive surface drilling was conducted at the Lamefoot Project by reverse circulation rotary and coring techniques. Exploration drilling occurred throughout the land holdings but focused on the primary area of mineralization in a zone about 1,500 feet long and up to 140 feet wide. A total of 280 holes were drilled on the surface of which 59 are located on federal land.

Roads were built to accommodate access by drilling equipment and support vehicles. All of the surface disturbance to date on federal land is associated with this drilling program. Figure 9 shows the location of existing drill roads on public and private land. A detailed description of these roads and the drilling can be found in the revised Plan of Operations.

Subsequent exploration will be implemented under this Record of Decision to further explore, delineate and develop specific areas of the mineralized body in preparation for commercial mining. The primary elements are:

- Development of additional levels between initial drifts on ore
- Development of access drifts
- Additional exploratory drilling from the surface

Based on information currently available, the total material extracted during the Phase I and II underground exploration program has been approximately 260,000 tons of waste rock and 114,000 tons of ore.

Additional exploration will be conducted for extensions of the known mineralization and for new deposits in the immediate area. It is possible that additional surface exploration drilling may be warranted within the areas shown as public and private lands on Figure 14. Also, additional (infill) drilling of shallower portions of the previously defined deposit may be required to better delineate ore boundaries or to study geotechnical characteristics of the ore and host rock.

The general principal for access is to keep new disturbance to a minimum by using cross-country travel or helicopter supported drilling where appropriate. New drill pads may be constructed as necessary for access by the drill rigs. Any new roads shall be constructed and reclaimed by methods discussed in the revised Plan of Operations. The exact location of new roads will be determined by the location of the target to be drilled. These locations will be established based on results of the exploration and production phases.

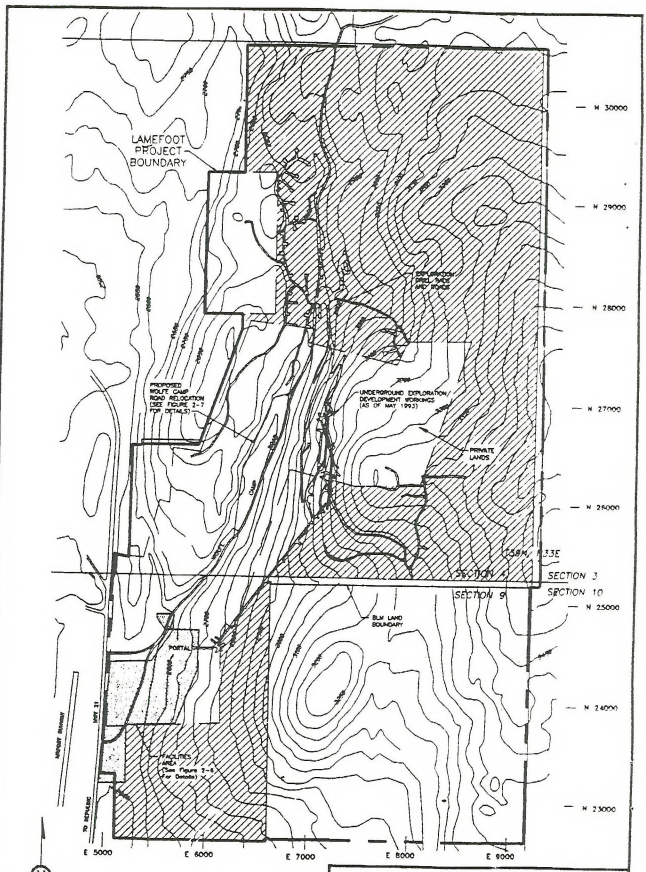
2. Existing Surface Facilities

Site surface infrastructure at the mine site consists of an office, shop, dry (change house), core storage facility, supply storage area and parking. Services include an electrical substation, compressor, two water wells and a septic field. Also present at the site are waste rock disposal areas, a mine water infiltration pond, a stormwater infiltration catchment and topsoil stockpile areas. Diversion ditches have been constructed at the site to control storm water runoff. The site layout showing the approved and constructed facilities listed above is presented on Figure 2.

L. Alternative 4 - Alternative Sub-County Road Access for Backfill

The Selected Alternative includes Alternative 4 for introducing backfill materials to the underground workings. This access includes excavation of an adit in the east valley wall of the Wolfe Camp Drainage beneath the existing Wolfe Camp Road. This will eliminate the traffic control and safety concerns associated with the meeting of mine traffic and local traffic at the intersection of the portal access road and the county road as described in the proposed action and shown on Figure 3. Traffic on the Wolfe Camp Road is expected to require rerouting for 2 to 4 weeks during construction of the adit and reconstruction of the road.

Wolfe Camp Road traffic will be detoured temporarily along an existing drill road (along the valley bottom) during construction of the adit entry and reconstruction of the road (Figure 7). The adit entry would be a 15-foot wide, 18-foot



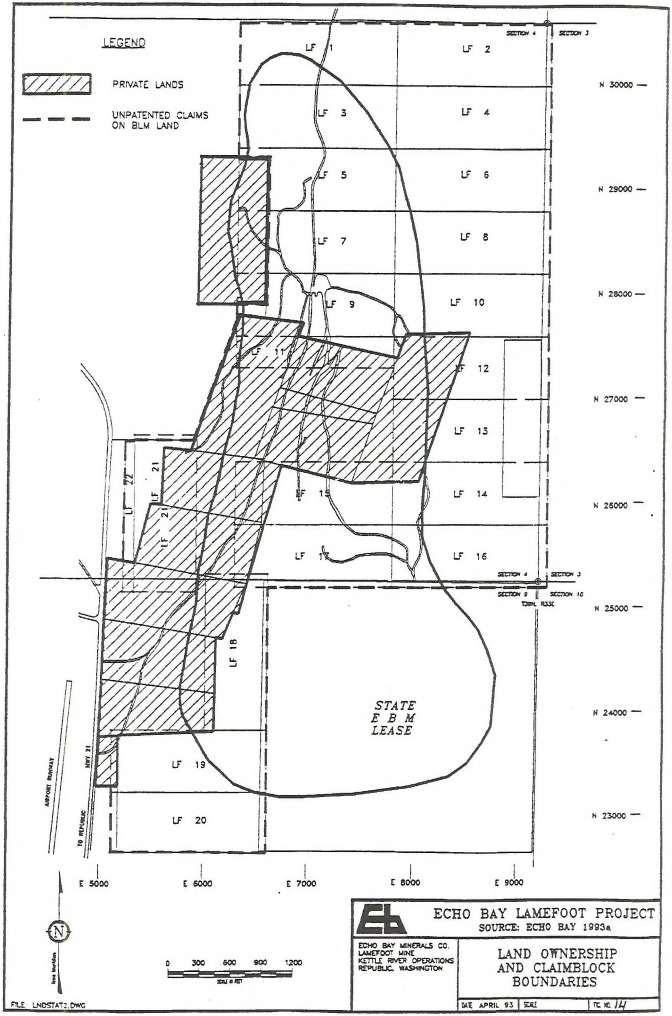
ECHO BAY LAMEFOOT PROJECT

SOURCE: ECHO BAY 1993a

ECHO BAY MINERALS Co
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON

SITE TOPOGRAPHY SHOWING EXISTING DRILL ROADS, FACILITIES AND EXPLORATION/ DEVELOPMENT WORKINGS

DATE | SCALE 1"=600' | FIG NO. 5-7


LEGEND
PRIVATE LANDS
UNPATENTED CLAIMS ON BLM LAND
LF 1
LF 2
LF 3
LF 4
LF 5
LF 6
LF 7
LF 8
LF 9
LF 10
LF 11
LF 12
LF 13
LF 14
LF 15
LF 16
LF 17
LF 18
LF 19
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LF 22
SECTION 4
SECTION 3
SECTION 9
SECTION 10
T28N, R33E
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N 25000
N 24000
N 23000
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E 7000
E 8000
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STATE E B M LEASE
AIRPORT RUNWAY
HWY 21
TO REPUBLIC
0 300 600 900 1200
SCALE IN FEET
ECHO BAY LAMEFOOT PROJECT
SOURCE: ECHO BAY 1993a
ECHO BAY MINERALS CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON
LAND OWNERSHIP AND CLAIMBLOCK BOUNDARIES
DATE APRIL 93
SCALE
FIG NO 14
FILE LNDSTAT2.DWG

deep open cut through the road covered with a steel and concrete roof, followed by the reconstructed roadway. The mine workings will then be extended from underground to the west to connect with the completed adit entry and portal.

A relatively flat fill area will be developed for access to the portal. The access adit, sumps, drop passes, and loading chutes will be completed using conventional underground development methods such as drilling, blasting, mucking, and hauling. Surface facilities will include the portal and a cement silo with baghouse and will require upgrading an existing road to provide access for haul trucks.

Underground facilities will include an upper access ramp for truck hauling uncemented backfill, a drop pass for cemented backfill (Figure 15), loading chutes from the pass, a ventilation/service raise, drill hole for cement access, a backfill truck bay/mixing station, and a lower access ramp to the underground mine workings.

The backfill truck bay will consist of either a circular drive beneath the cemented and uncemented backfill loading chutes or separate back-in drifts. If the circular drive is selected, underground haul traffic will be one-way around the drive, eliminating the need for backing (and resulting noise from backup beepers) of haul trucks.

Uncemented backfill materials, possibly including oversized fragments from blasting operations, would be hauled directly to the underground workings from the portal/adit entry.

Cemented backfill materials will be dumped into the cemented backfill drop pass from an underground haul truck. The drop pass will be filled sufficiently to allow truck loading from a gated loading chute similar to that described above. Cement will be introduced in the appropriate proportions through a valved drill hole terminating at the mixing station. Excess mine water will be piped to the mixing station from the underground workings. Mixing will occur in the mixing tower and the backfill, cement, and water mixture will then be deposited into the waiting haul truck.

Following truck loading, cemented backfill materials will be hauled down the lower access ramp to the underground workings and placed as described in the Proposed Action.

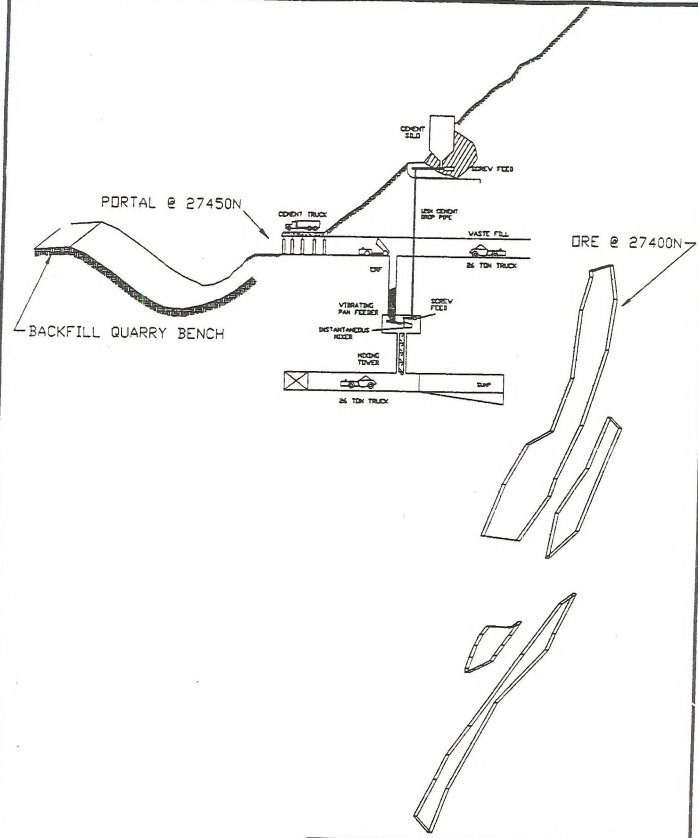
M. ADDITIONAL CONDITIONS OF APPROVAL

1. All operations shall be carried out in accordance with the procedures described in the revised Plan of Operations, unless otherwise approved in writing by the Authorized Officer, BLM. To the extent that there are any discrepancies between the Plan of Operations and this Record of Decision, Echo Bay shall revise the Plan of Operations to conform to the Record of Decision.

2. All proposed modifications to the plan of operations shall be subject to review in advance by the Authorized Officer, BLM, and no modifications shall be put into effect unless Echo Bay obtains the prior written approval of the Authorized Officer, BLM.

3. Whenever under the Selected Alternative and additional conditions of approval Echo Bay is required to develop a study, plan, specification, design, or other document, that study, plan, design, specification, or other document must be submitted to the Authorized Officer, BLM, for review and approval. If approval is not granted, the action proposed in those documents may not be implemented and no subsequent action pursuant to the proposal may be undertaken, other than revision and resubmittal for additional review. If approval, or approval with modification, is granted, Echo Bay must conduct its operations in accordance with the study, plan, design, specification or other document, as approved and amended.

4. Wherever under the Selected Alternative and additional conditions of approval Echo Bay is required to conduct or develop a study relative to geology, geochemistry, groundwater, surface water, acid generation characterization, and similar matters, Echo Bay shall submit a proposed work plan to the Authorized Officer, BLM, for review and concurrence prior to initiating the study. The purpose of these work plans will be to reach agreement in



ECHO BAY LAMEFOOT PROJECT

SOURCE: ECHO BAY 1993

ECHO BAY MINERAL CO.
LAMEFOOT MINE
KETTLE RIVER OPERATIONS
REPUBLIC, WASHINGTON

LAMEFOOT PROJECT
CEMENTED ROCKFILL PLANT
CONCEPTUAL LAYOUT

DATE: JUNE 1994 | SCALE: 1" = 100' | FIG. NO. 15

CRFP4B

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
SPOKANE DISTRICT OFFICE
1103 N. Fancher
Spokane, WA 99212-1275

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