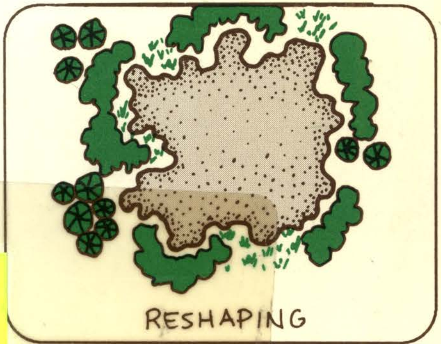

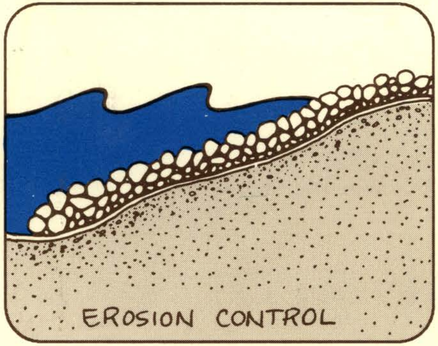

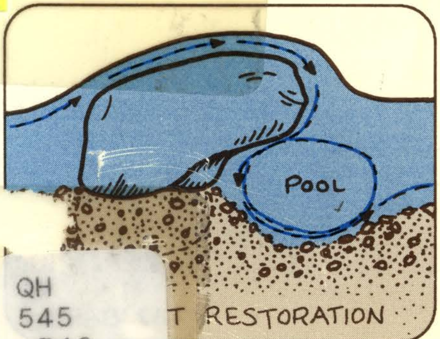

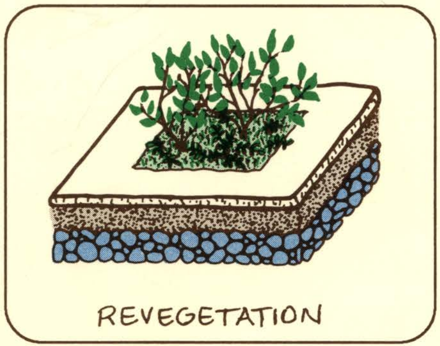

Placer Mining in Alaska

A Practical Guide to Mitigation and Reclamation

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

Placer Mining in Alaska

A Practical Guide to Mitigation and Reclamation

Bureau of Land Management
Alaska State Office
Anchorage, Alaska

The Bureau of Land Management manages the public lands and resources and their various values so that they are considered in a balanced combination that will best serve the needs of the American people. Management is based upon the principles of multiple-use and sustained yield; a combination of uses that takes into account the long term needs of future generations for renewable and non-renewable resources. These resources include recreation, minerals, wilderness, and scientific, natural, and cultural values.

The *mitigation* of placer mining's effects on these resources is a priority for the BLM in Alaska. As the manager of public lands, the BLM is committed to educating the public and miners about the potential impacts of mining activity and how to mitigate those impacts.

This brochure provides an overview of placer mining methods used on public lands in Alaska, and offers suggestions for mitigation and *reclamation*. These procedures and protective measures are complex; good engineering principles and knowledge of a specific site must be applied. A BLM-Authorized Officer (AO) can help reduce the risk of environmental impact caused by surface disturbance, by reviewing reclamation plans and recommending procedures at a specific site. Italicized terms appear in the glossary.

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1 PLACER MINING IN ALASKA

Many different procedures are used in a mining operation. The first step is to find or build an access road. The second step is to set up a camp.

The site is prepared with a bulldozer or other earth-moving machine, such as a front-end loader, belly dump scraper, dragline, or backhoe. An *infrastructure* is built to include two or more *settling ponds*, associated spillways, drainage ditches to prevent *erosion* and to collect runoff and groundwater, and working areas for the washplant, pumps, and motors.

If the area to be mined is within an *active stream channel*, a diversion is built to route the water around the area. The diversion is reinforced to withstand floods and keep mine water from entering the channel.

Trees, brush, *topsoil*, and *overburden* are stripped from the area to be mined. The topsoil and overburden are stockpiled separately. The stockpiles are protected from erosion and flooding by shaping and adding layers of cobbles or *riprap*. With good planning, materials can be stockpiled close to the active mine to reduce handling and hauling distances.

The amount of area stripped depends on the expected rate of production. On a typical mine, one to two acres are stripped ahead of actual mining. Areas with *permafrost* must be stripped at least a year in advance to allow for ground thawing.

The next step is usually to move exposed *gold-bearing gravels* with a bulldozer or other machine that pushes and stockpiles it near the washplant. This gravel is then fed by a front-end loader or backhoe into the washplant where it is *classified* by size using stationary and vibrating screens.

Classifying promotes more efficient gold recovery, reduces water use, and aids reclamation. Gravel pieces larger than two inches are ejected from the washplant into a pile, which is moved by a front-end loader. The undersized rock and gold-bearing gravel is mixed with water and flows through the *sluice box* or *jig unit* where the gold and heavy black sand are collected and concentrated.

The water that carries the gold-bearing gravel through the sluice box becomes laden with sediment and *turbid*. This *process water* flows from the end of the sluice box into a series of settling ponds. Fine sediments settle to the bottom of the ponds, clearing the water.

Most mine operations use a series of small settling ponds, as opposed to a large one. Small ponds are easier to build, repair, clean, replace, bypass, and reclaim when no longer needed.

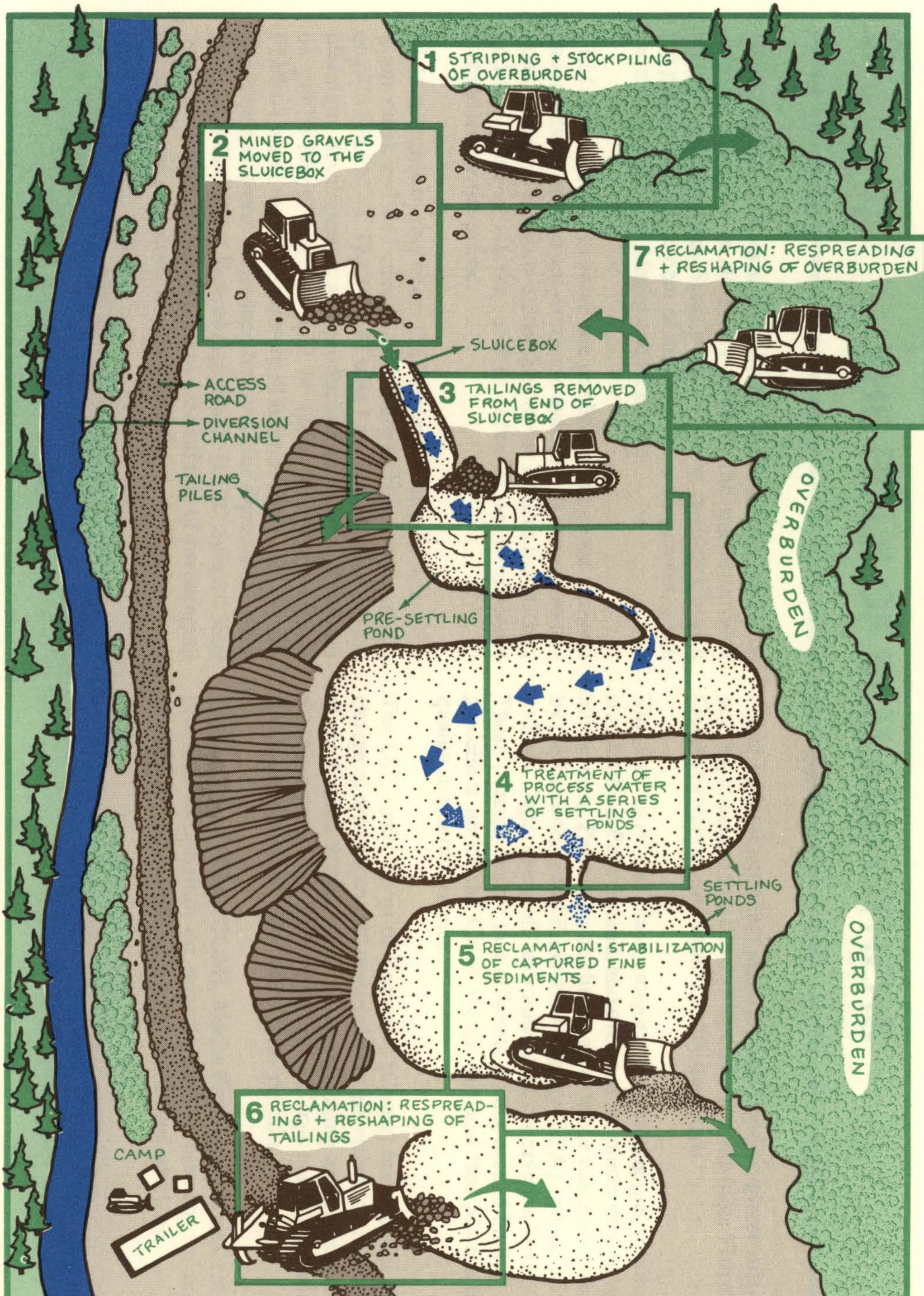
Surface runoff and ground water are often diverted around the operation into an adjacent stream, to reduce the volume of water flowing into the ponds that must be processed.

Once cleaned, the process water is recycled for use in the sluice or returned to an adjacent stream. Some placer mines operate with a *zero discharge* water recycling system, in which no *effluent* is returned to the stream.

Once mining is complete, *tailings* are replaced into the mine cut, reshaped, and covered with stockpiled overburden and topsoil. Settling ponds are reclaimed by halting water inflow and draining. If the ponds are in an active floodplain, accumulated sediment must be removed to prevent *stream siltation*. Sediment can also be removed for use as topsoil to aid revegetation of the site.

First coarse tailings, then overburden, and finally topsoil are pushed over the drained ponds to stabilize the sediment and prevent erosion. The site is revegetated where contouring and reshaping alone cannot prevent erosion or stream siltation.

If mining is unfinished at the end of a season, ponds, stream bypasses, and the mined areas are reinforced to prevent water inflow or erosion, and equipment is moved to high ground.



1 STRIPPING + STOCKPILING OF OVERBURDEN
2 MINED GRAVELS MOVED TO THE SLUICEBOX
7 RECLAMATION: RESPREADING + RESHAPING OF OVERBURDEN
SLUICEBOX
ACCESS ROAD
DIVERSION CHANNEL
3 TAILINGS REMOVED FROM END OF SLUICEBOX
TAILING PILES
OVERBURDEN
PRE-SETTLING POND
4 TREATMENT OF PROCESS WATER WITH A SERIES OF SETTLING PONDS
SETTLING PONDS
5 RECLAMATION: STABILIZATION OF CAPTURED FINE SEDIMENTS
OVERBURDEN
6 RECLAMATION: RESPREADING + RESHAPING OF TAILINGS
CAMP
TRAILER

2 THE ROLE OF BLM AND OTHERS

BLM-Alaska's success as a public land guardian and resource manager depends on its ability to serve the public through mutual understanding. Sustaining a working partnership with the public is a key element of multiple use management, given the special nature of Alaska and its people.

BLM-Alaska exists to serve the public, to safeguard the land and to ensure needed resources are available to future generations, to keep the nation's promises of the land to the Natives and the State of Alaska, and to serve as an information storehouse for the public.

BLM manages mining under the General Mining Law of 1872, as amended, and the Federal Land Policy and Management Act of 1976 (FLPMA). The 1872 Mining Law provides for the exploration, development, and production of mineral resources on public lands, and the right of access to mining claims. FLPMA states that the Secretary of Interior shall take any action required to prevent *unnecessary or undue degradation* of the land. Title 43 *Code of Federal Regulations* (CFR) Subpart 3809 implements this. Hence, BLM has the dual role of encouraging the use of and protecting the public lands.

Other Federal and State agencies also regulate placer mining activity, to ensure that the activity complies with State Fish and Game regulations and water quality standards.

The State of Alaska plays a major role in setting placer mining standards on Federal land, and oversees the placer mining permit process. Permits to discharge mine waste water are issued by the Environmental Protection Agency (EPA) and the Alaska State Department of Environmental Conservation (ADEC). These permits ensure that effluents do not exceed limitations guidelines under the Clean Water Act and that State water quality standards are met.

The U.S. Army Corps of Engineers (Corps) manages the discharge of *dredged and fill materials* into all *wetlands* and waters of the United States. Many of the mitigating and reclamation practices presented here may require Corps permits, in addition to the standard EPA and ADEC permits.

The Bureau of Mines (BOM), Alaska Field Operations Center, provides information on mineral land assessment, mineral availability, policy analysis, and state mineral activities.

The Alaska Miners Association (AMA) is the primary advocate for the development and use of Alaska's mineral resources. The industry-based AMA promotes mining and provides general assistance and support to the miners of Alaska. In some cases, the AMA will provide specific guidance to mining operations that have had trouble meeting requirements and regulations.

For more information contact the following:

U.S. Department of the Interior
Bureau of Land Management
Alaska State Office
Division of Minerals
222 West 7th Avenue, #13
Anchorage, Alaska 99513-7599
(907) 271-3343

U.S. Army Corps of Engineers
Regulatory Branch
Alaska District
P.O. Box 898
Anchorage, Alaska 99506-0898
(907) 753-2712

To obtain land status information and District Office telephone numbers and addresses, call the applicable regional land information office.

U.S. Department of the Interior
Bureau of Land Management
Alaska Southern Region
Land Information
222 West 7th Avenue, #13
Anchorage, Alaska 99513-7599
(907) 217-5960

U.S. Department of the Interior
Bureau of Land Management
Alaska Northern Region
Land Information
1150 University Avenue
Fairbanks, Alaska 99709- 3844
(907) 474-2250

U.S. Bureau of Mines
Office of the Chief
Alaska Field Operations Center
3301 "C" St., Suite 525
Anchorage, AK 99503-3935
(907) 271-2455

Alaska Miners Association
501 W. Northern Lights Blvd., Suite 203
Anchorage, AK 99503
(907) 276-0347

Alaska Department of Natural Resources
Division of Mining
3601 "C" St., Suite 880
Anchorage, AK 99510
(907) 762-2163

Alaska Department of Natural Resources
Division of Mining
Northern and other Regions
3700 Airport Way
Fairbanks, AK 99709
(907) 451-2790

3 LEGAL GUIDELINES

Under the General Mining Law of 1872, as amended, an individual has the right to stake a mining claim on open, unappropriated Federal lands available for the development and extraction of a discovered mineral deposit. The mining law guarantees claimants protection for all lawful uses of the claim for mining purposes, but sets the limits of their rights; if the requirements of the mining law are not met, no such rights exist.

In Alaska, much of the Federal land administered by BLM is closed to mineral entry. To determine which lands are open, inspect the public land records at the BLM State Office in Anchorage or the Fairbanks Land Information Office. Individuals found extracting minerals on *withdrawn lands* are subject to penalties by the land management agency.

Under the mining laws, minerals are classified as locatable, leasable, or salable. Only locatable mineral deposits may be staked or claimed. In locating a claim, the claimant must comply with the requirements governing the method of location and recording of claims.

Anyone who is a United States citizen or has declared an intention to become a citizen and any corporation organized under State law may locate a placer mining claim. Although there is no limit to the number of claims a person may hold, there must be an actual physical discovery of a valuable mineral deposit on each and every mining claim. Making mining improvements, posting a notice, or performing annual assessment work will not create or perpetuate a right or interest in the land if there are no valuable mineral deposits within the claim.

Placer claim types include the placer deposits of sand and gravel containing free gold or other minerals (those that have accumulated in the unconsolidated material of a stream bed) and also many non-metallic bedded deposits. Each claim is located by a legal subdivision or a metes and bounds description that is limited to 20 acres. However, an association of two miners may locate 40 acres.

The State of Alaska limits association claims to a maximum of 40 acres. Corporations are limited to 20-acre claims. Federal law specifies that in staking a placer mining claim, boundaries be clearly marked. It is advisable that a claimant check with the Alaska Department of Natural Resources, Division of Mining before attempting to locate a claim to ensure compliance with Federal and/or State regulations. Generally, staking a mining claim includes erecting corner posts or monuments, plus posting a notice of location on a post or monument in a conspicuous place.

Recording of mining claims on public lands involves filing a copy of the location notice in the appropriate State Recording Office and with the BLM State Office. Location notices generally contain the following information: claim name, claim number, name and address of claimant, type of claim, date of location, legal description obtained from an official survey plat or other U.S. Government map, map depicting location of the claim, minerals claimed, acreage of claim, and dimension of claim.

The legal description can be in terms of the section, township, range and meridian, or metes and bounds connection by distance and direction as accurately as possible from the discovery point to some well-known permanent object, such as an established survey monument, a hill, bridge, fork of a stream, or road intersection.

To properly record a claim or site with BLM, an owner must file a copy of the location notice under State law, including any amendments regarding the description of the claim or an affidavit of annual assessment work. Maps and other documents filed under State law must accompany the copy of the official record.

If operators perform and record the annual assessment work and meet all other requirements of Federal and State mining laws, they establish a possessory right to the mining claim to develop and extract minerals, and actions reasonably incident to the mining activity.

The mining laws give miners the right of necessary entry and exit across public lands to remove minerals and maintain their claims. This privilege does not mean that miners have the right to cause unnecessary or undue degradation to public lands while exercising the right of access to the claim. Miners are liable for damages if they unnecessarily cause loss or injury to United States property.

It is not necessary to have a patent to mine and remove minerals from a valid mining claim, but a patent gives a miner exclusive title to the locatable minerals and, in most cases, use of the surface and all other resources.

To operate a mine in Alaska, permits are required by as many as 13 State and Federal agencies. To assist the industry with applications in the permitting process, the State uses the *Annual Placer Mining Application* (APMA). For each year a miner intends to operate, a completed APMA must be submitted to the Department of Natural Resources, Division of Mining, prior to February 15. The Division of Mining processes the application and distributes the form to the appropriate agencies for permits. Although certain permits may not be required for a specific mining operation, each agency is allowed to review the application and make specific recommendations.

For more information concerning State mining laws and regulations which supplement the General Mining Law of 1872, plus information concerning the geology of specific areas in Alaska, contact the Alaska Department of Natural Resources, Division of Mining or BLM Alaska State Office, Division of Mineral Resources.

4 PLANNING CONSIDERATIONS

For most projects disturbing five acres or less per year, a notice of operations must be submitted to the BLM District Office that has jurisdiction over the area.

The notice must include the name and address of the mining claimant and operator, claim name(s) and serial number(s), a statement of activities proposed and their location, the period of operation, and a statement that all disturbed areas will be reclaimed to BLM standards.

For projects disturbing more than five acres a year, a *Plan of Operations* must be filed. Projects disturbing five acres or less in special management areas must also file a Plan of Operations. The plan must include all items required in a notice, as well as a topographic map or sketch showing: existing or proposed routes of access; aircraft landing areas, or other means of access; and the size of each area where surface disturbance will occur.

The plan must also include steps to prevent unnecessary or undue degradation. A BLM AO may help develop such measures if an operator lacks technical resources to do so.

If the project is inactive for an extended period, the plan must include measures to maintain the area safely and cleanly, and to avoid erosion and other impacts during this time.

Once a plan is submitted, an authorized officer will review its conformance with Federal regulations. Within 30 days, the officer will advise the operator that either: 1) the plan is approved; 2) changes or additions are needed; 3) additional time is needed to complete the review; or 4) other circumstances will delay plan approval.

All approved reclamation modifications become part of the plan. At any time during a project, the operator may propose to modify the plan or the authorized officer may request changes.

Specific mining requirements are described in Title 43 CFR 3809 regulations, available at all BLM District Offices.

Good planning can greatly reduce reclamation costs. For example, usually *fines* need not be removed from settling ponds located outside an active floodplain, which may be required for ponds within such a channel. Costs can also be reduced by storing gravel and topsoil close to the area of use.

Other cost-reducing factors to consider are the operator's level of efficiency, expertise, and available equipment. One operator graded an area by using a bulldozer that had just been serviced and was passing the disturbed area on return to the active mine site. Such practices are cost-effective uses of personnel and equipment, and will reduce reclamation costs.

Reclamation costs are not easy to determine because of site-specific variables, such as: size of the operation, location, closeness to access roads, amount of surface disturbance, topography, geotechnical properties, wildlife, type of stream channel, mining methods, settling pond configuration, etc.

Major costs are incurred for grading and contouring tailing piles, stockpiles, settling ponds, floodplains, and stream channels. To calculate grading cost, multiply the amount of material to be graded by the cost per unit of material to be moved. An engineer can assist in these calculations. Basic grading and contouring costs are usually slightly lower than for stream grading and will vary from site to site.

5 MITIGATING SURFACE DISTURBANCE

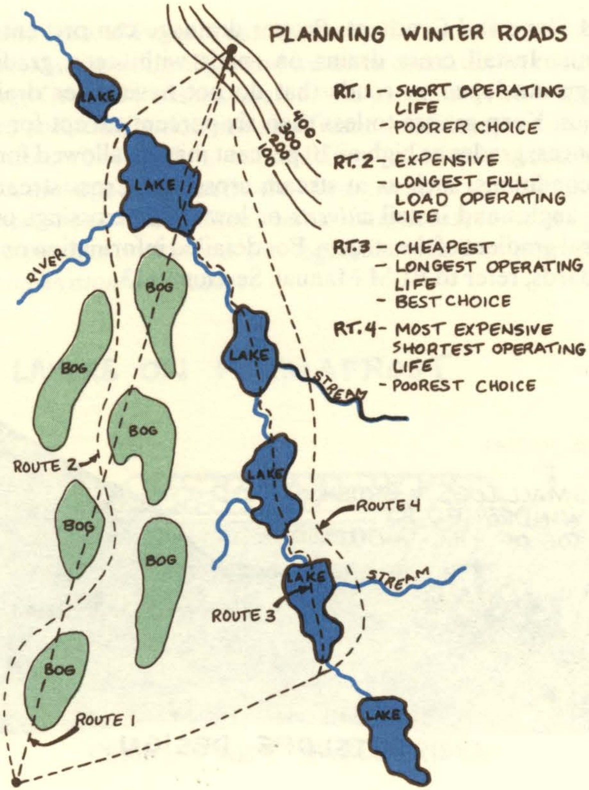
Mining operators must comply with environmental protection requirements for: air and water quality, solid waste treatment and disposal, visual resources, fisheries, wildlife and plant habitat, cultural and *paleontological* resources, access routes, land survey monuments, and reclamation. These requirements are listed in Title 43 CFR 3809.2-2.

Minimizing Access Impacts: The access route must be properly constructed and used to avoid impacts to the environment.

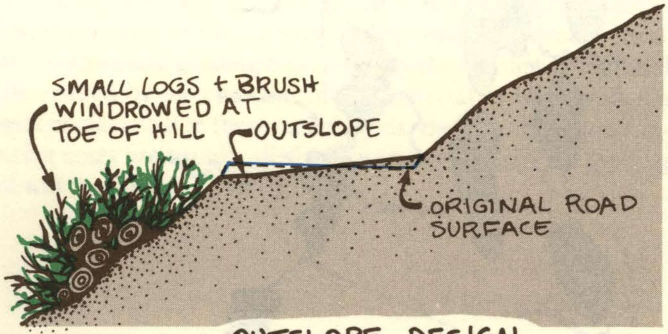
In selecting a route, avoid potential erosion hazards; sometimes a slight change in route may eliminate a major erosion problem.

If access across vegetation is necessary, do not use vehicles that remove or damage the organic layer. Such vehicles should be used only on a permanent gravel road. Winter access across vegetation should not be attempted until the organic layer is protected by an adequate layer of snow and frozen ground, or until snow and ice roads are constructed.

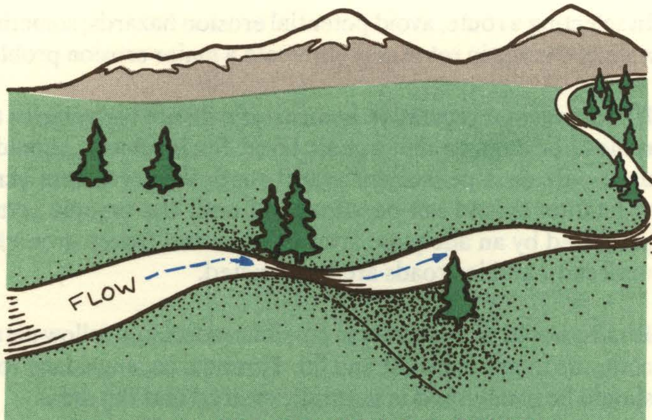
Roads should be as narrow as possible and should follow natural contours to minimize cut and fill. Turnouts on single lane roads should be established in naturally cleared and flat areas.



Road Slope and Gradient: Proper drainage can prevent road erosion. Install cross drains on roads with steep gradients. Design outslopes on roads that do not have inner drainage ditches. Keep grades to less than six percent except for short distances; grades as high as 10 percent may be allowed for special conditions, such as at stream crossings. Cross streams at right angles and install *culverts* or low water crossings on the natural gradient of the stream. For detailed information on road standards, refer to BLM Manual, Section 9113.

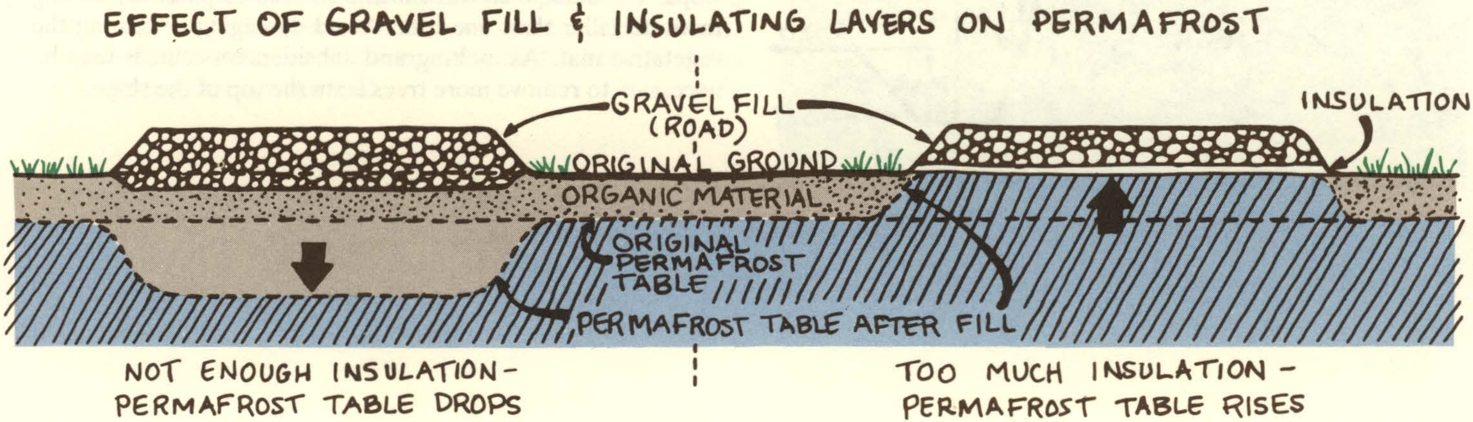


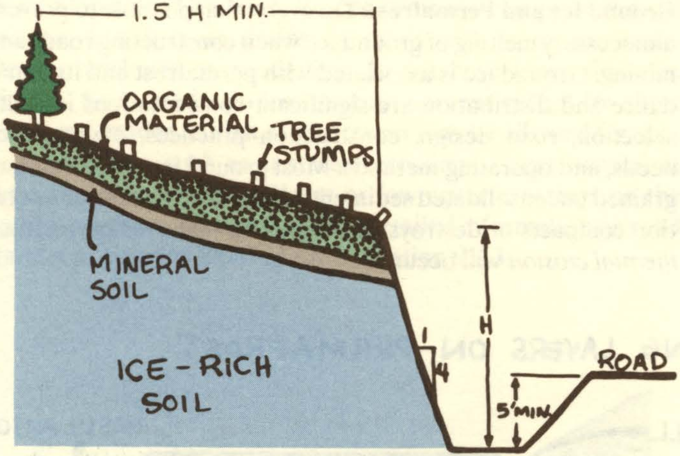
OUTSLOPE DESIGN



ROLLED GRADE OF 6% OR LESS

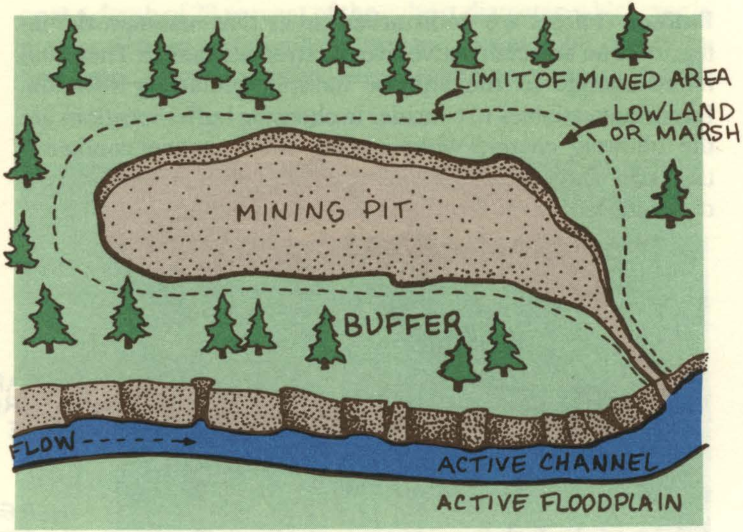
Ground Ice and Permafrost: Do everything possible to prevent unnecessary melting of ground ice when constructing roads and mining. Ground ice is associated with permafrost and its abundance and distribution are significant considerations in route selection, road design, construction practices, maintenance needs, and operating methods. Most ground ice occurs in fine-grained unconsolidated sediments. If the access route or operation compacts or destroys the vegetative mat over permafrost, *thermal erosion* will occur.





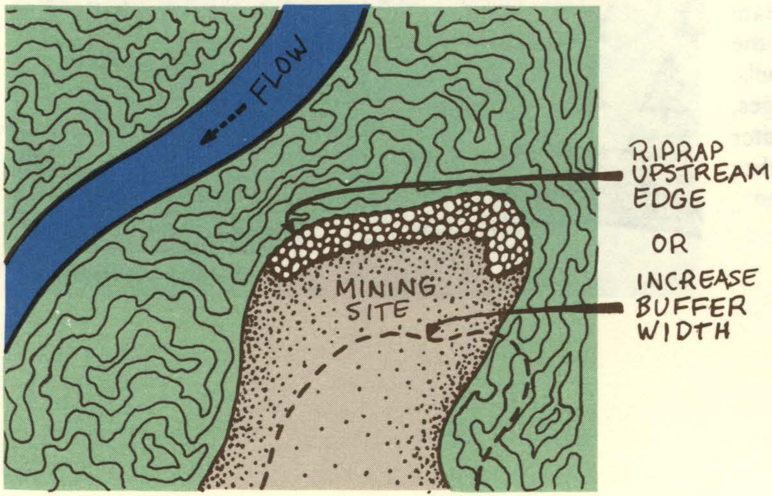
Cuts In Ice-Rich Permafrost Slopes: The best way to build a road across an *ice-rich* slope is to fill rather than cut. Avoid cuts in ice-rich slopes, because once cut, the slope may take years to stabilize. If cuts are unavoidable, use vertical backslopes from the road and provide a wide ditch at the base of the cut to allow for the removal of material. This allows melting ice-rich materials to deposit during the stabilization process. The ditch allows a porous *revetment* to help drain and stabilize the slope. Hand clear trees and standing brush from the top of the slope for a distance about 1 1/2 times the height of the vertical backslope. Cut stumps as close to the surface as possible, leaving them no taller than one foot. Avoid damaging or tearing the vegetative mat. As melting and subsidence occur, it may be necessary to remove more trees from the top of the slope.

Surface Disturbance During Operations: Before opening a new mine or expanding an existing one, consider all measures to minimize the disturbance, and plan for preservation and restoration of the area. Maintain a buffer of undisturbed land between the active channel and the operation. Avoid excavating in locations that will cause permanent channel changes or ponding of water. Avoid construction of river training or bank protection devices, since they may disrupt natural stream processes and may result in *scour* and erosion elsewhere in the stream system. Avoid crossing active rivers or stream channels. If needed, crossings may be made via temporary bridges, properly installed culverts, or correctly constructed low water crossings. To minimize siltation, use gravel fill ramps rather than cutting through the bank.

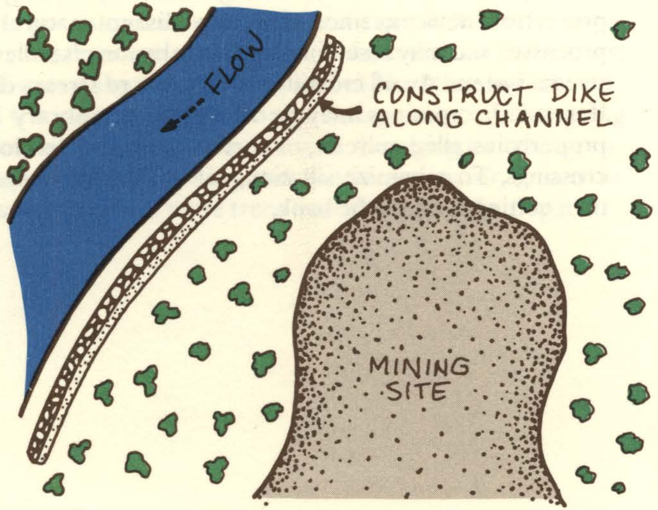


Buffers: Buffers are undisturbed areas that maintain the integrity of an adjacent active river or stream channel. They minimize change to the aquatic habitat, including siltation. Important variables to consider in choosing buffer locations are the following: channel width and elevation; channel configuration, size, and*hydraulic geometry*; *aufeis*; soil composition; type of vegetation; permafrost; and ice-rich stream banks.

Fish and Wildlife Habitat: Minimize fish and wildlife disturbance. Important wetland and *riparian* habitats are protected through Habitat Management Plans, with priorities and decisions made through the Bureau Planning System. BLM Manual Section 6740 contains information on wetland and riparian habitat management.



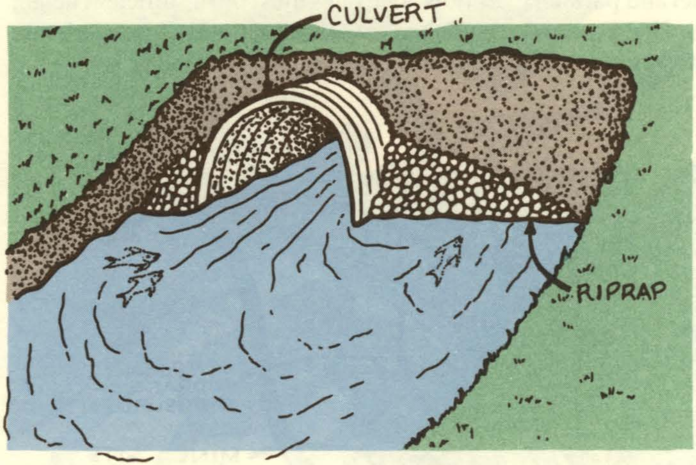
HEAVILY VEGETATED BUFFER AND FLOW THROUGH THE SITE IS ACCEPTABLE



LIGHTLY VEGETATED BUFFER AND FLOW THROUGH THE SITE IS ACCEPTABLE

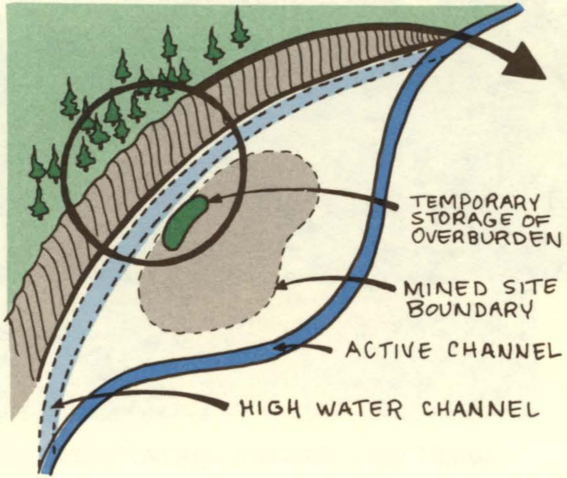
Providing For Fish Passage: When a stream or river crosses the access route, provide for the safe passage of equipment and fish. If the stream is shallow, a simple, well designed low water crossing may be best. If the stream flow is more variable, a bridge is better; this maintains the natural stream bed and gradient. If building a bridge or a low water crossing is not feasible, constructing a culvert is the next-best option. The average water velocity through a culvert should not exceed three feet per second during fish migration periods. To keep the water velocity low, select a *reach* with a low gradient. Install culverts on the same gradient as the drainage profile. Culverts should be constructed so that the water level is not less than eight inches during the open water season, when fish passage is necessary.

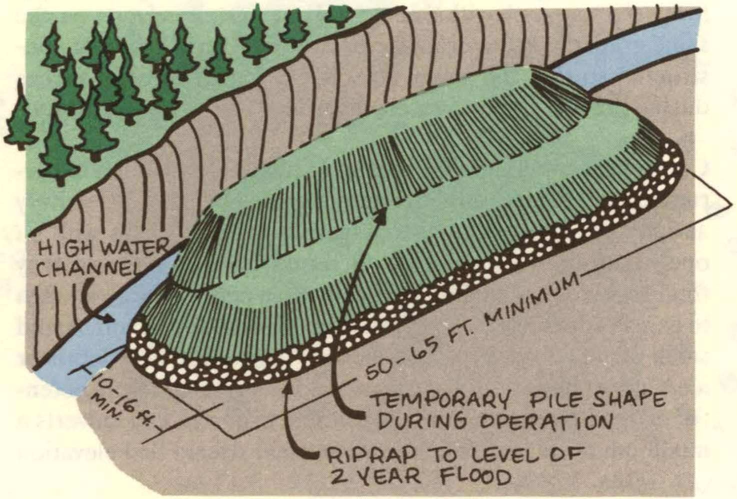
Culvert Construction: Culverts are usually constructed of corrugated metal pipe, although they can also be made effectively and economically from timbers. Arch metal culverts with an open bottom are preferable to round culverts because they retain natural stream bed materials. Use culverts large enough to carry snowmelt during the season of maximum runoff. Avoid small diameter culverts because they clog easily with debris or ice. Culvert intakes and outlets should be protected from potential erosion by riprap or other suitable material. Lay culverts a minimum of six inches below the normal stream bed elevation or at a depth of 20 percent of the culvert diameter, whichever is greater. Design and install culverts to prevent uplift caused by *hydrostatic pressure* at either the downstream or upstream end.



Topsoil and overburden: Store topsoil, large woody material, and the rest of the overburden in separate piles for revegetation after reshaping the disturbed areas. Store the separated topsoil and overburden in long, narrow piles away from the active channel and parallel to its flow. The piles must be of sufficient height and have armoring at the toe to withstand floods. Use moderate slope gradients to minimize erosion.

Toxic material: Store hazardous and toxic material away from the floodplain. Avoid fueling and servicing equipment within the floodplain, wherever possible. Remove all waste oil and solvents from the area in proper containers. Dispose of any effluents from support activities occurring on or near an operation, such as gray water, domestic sewage, and solid waste, in accordance with applicable State and Federal regulations. Do not dispose of toxic materials within the floodplain without approval.

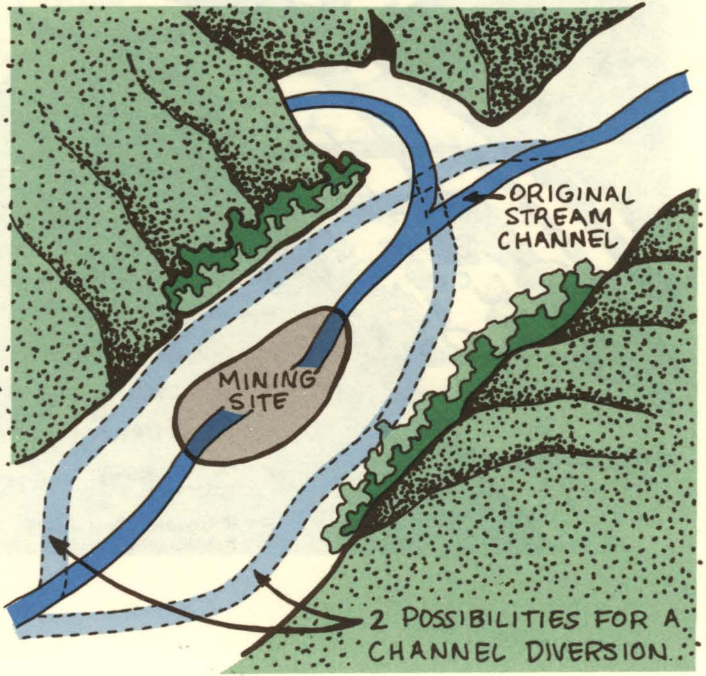


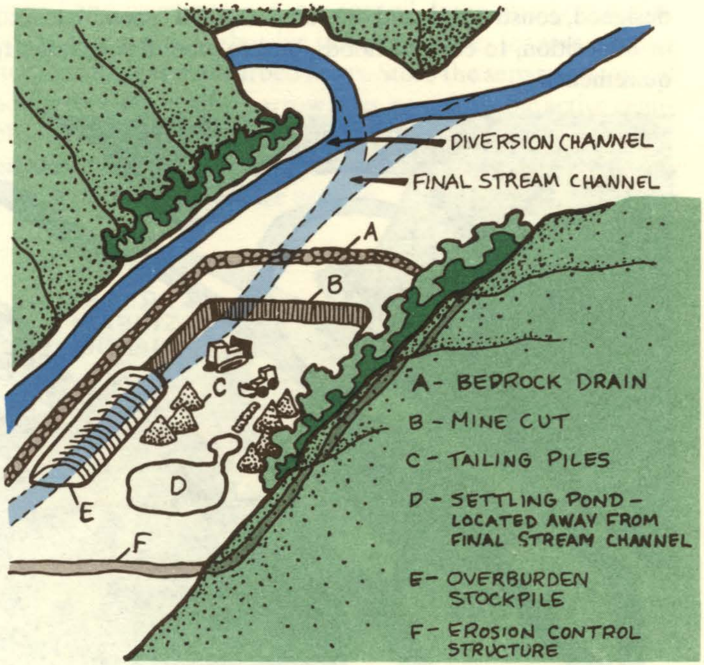


CONTROLLING WATER POLLUTION

Water quality is a top environmental concern and is strictly regulated by Federal effluent limitations guidelines and State water quality standards.

Non-point source pollution includes all stream turbidity, suspended sediment, and siltation resulting from soil erosion that cannot be traced to a single discharge point. Point source pollution is highly localized, and the origin can be traced to an identifiable point where the polluted discharge reaches a body of water. Effluent from a settling pond is point source discharge, while sediment washed off an exposed hillside is non-point source discharge. Methods used to control both types of discharge include stream channel diversions, settling ponds, bedrock drains, overland flow control, tailing pile grading, and stockpile placement and protection. Proper drainage requires identification of all sources of water on a site, and the sources of erosion; the operation can then be planned and executed to minimize erosion and avoid pollution of receiving waters. A properly functioning drainage system diverts clean water around an operation, and retains and treats sediment-laden water within the site. At mining sites within an active floodplain, the stream channel can be diverted to minimize water flow through the excavation area. The diversion should be located, designed, constructed, and operated to avoid excessive erosion or deposition, to contain floods, and to meet fish passage requirements.



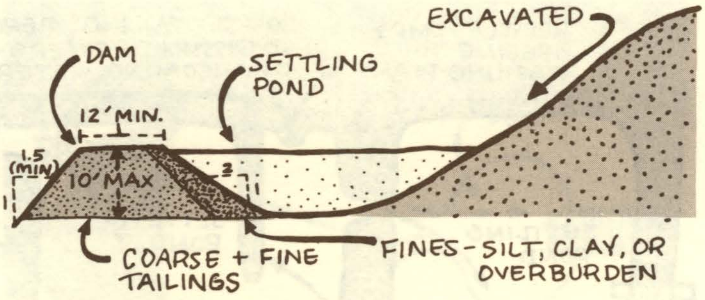


SETTLING PONDS

Settling ponds are designed to prevent downstream pollution by trapping and removing sediment from process water.

Settling Pond Planning: Potential pond locations must be identified in the planning phase. They may be permanently located or moved during the operation. The location of the active floodplain and the final stream channel are the most important physical parameters to consider, because during reclamation all sediment may have to be removed from a settling pond in the active floodplain. Also, the site plan should ensure that the least amount of water is used for the operation and all other water is diverted around the site.

Settling Pond Construction: The settling pond must be large enough to properly treat the expected site drainage and water used by the operation, in meeting water quality standards and effluent limitations. It must be sized to retain the volume of sediment and process water, allowing for storm surge capacity. Where possible, settling ponds should have a length to width ratio of at least two to one; a ratio of five to one is preferred. Additional information can be obtained from the Placer Mining Demonstration Grant Project Design Handbook, by L.A. Peterson and Associates, Inc., prepared for ADEC.



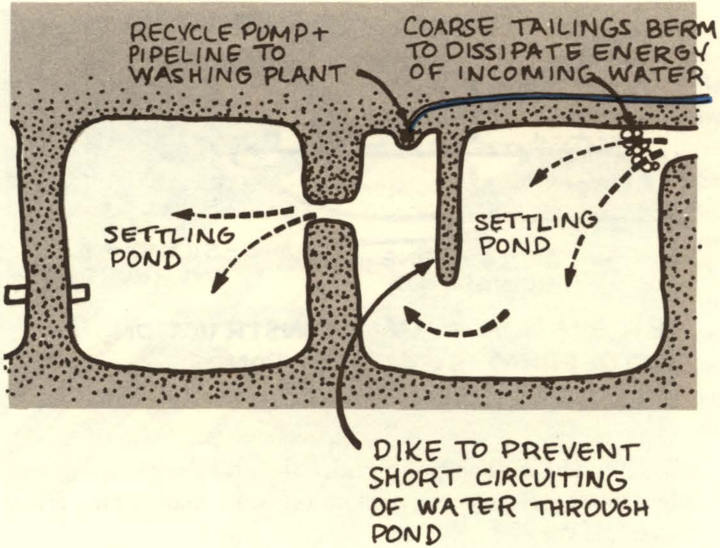
EXCAVATION + DAM CONSTRUCTION TO FORM SETTLING PONDS

SETTLING POND TYPES

There are several types of ponds used in water treatment strategies. Types most applicable in Alaska are outlet, filter, recycle and pre-settling ponds.

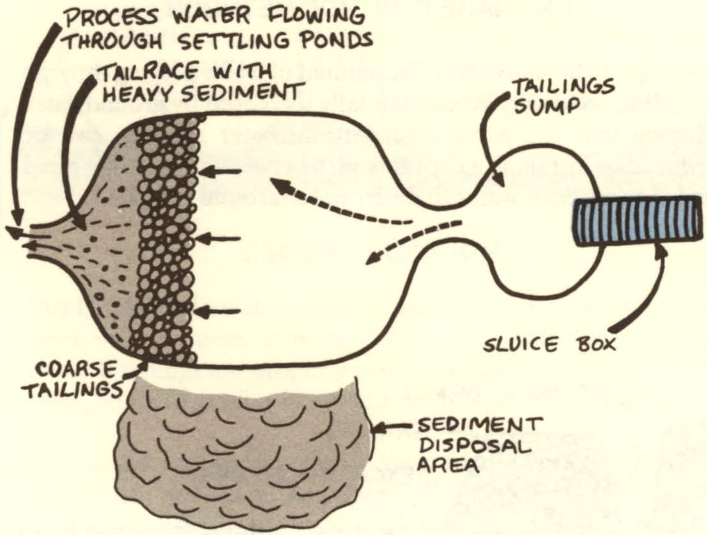
Outlet Ponds: Ponds with outlets have a large surface area, so the horizontal velocity of water is very low. The water should enter the pond over most of the width to make the entire pond effective. The settling pond outlet should be wide enough to allow the top clear water to skim off while maintaining a low horizontal velocity.

Filter Ponds: Filtering ponds do not have outlets. If the mine surface material is suitable, it is possible to build a pond with no outlet, that allows outflow by filtration through the *substrate*.



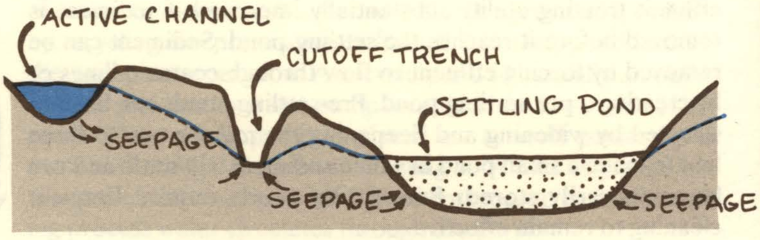
Recycle Ponds: Recycle ponds are used to reduce the volume of make-up water (fresh water added to the processing stream) by recycling the process water from the settling pond back to the washplant operation. A recycle pond is basically an outlet or filter pond with a water pump located at the lower side of the pond. The recycle pump is placed on a small peninsula to prevent floating debris from clogging it. A *dike* is placed between the water pump and the pond entrance to ensure incoming process water circulates through the pond.

Pre-settling Ponds: The life of ponds can be extended and their effluent treating ability substantially improved if sediment is removed before it reaches the settling pond. Sediment can be removed by forcing effluent to flow through coarse tailings or by creating a pre-settling pond. Pre-settling ponds can be constructed by widening and deepening the *tailrace* two to three feet to make a small pond in which sediment will settle and can be temporarily stored. Pre-settling ponds require frequent cleaning to remain effective.

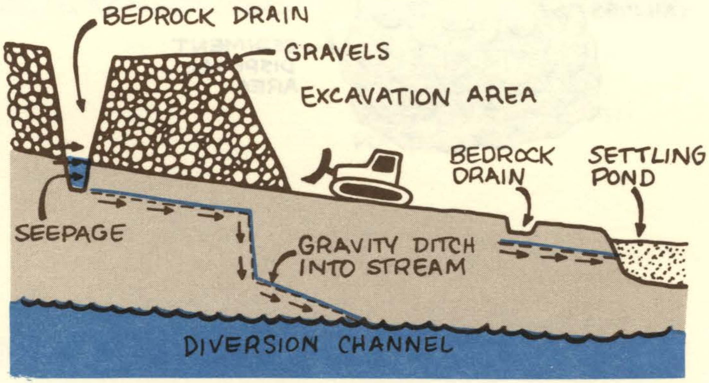


DRAINAGE CONTROL METHODS

Seepage of Groundwater: The amount of water passing through a settling pond may be substantially increased by groundwater seeping into the pond area. Groundwater seepage can be reduced by installing a cut-off trench between the settling pond and the source of water to divert water around the pond.

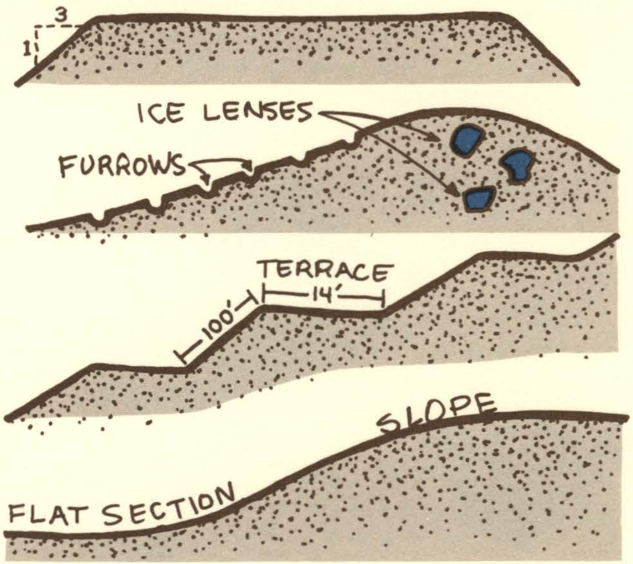


CROSS - SECTION

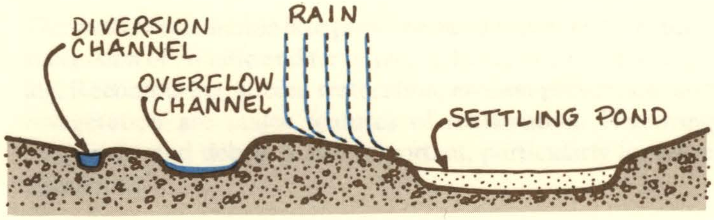


Bedrock Drains: Bedrock drains are used to collect groundwater that infiltrates the mine area. Two types of drains can be constructed: one that intercepts water above the mine area and diverts it into the stream or diversion channel, and one that collects water from within the work area and routes it to settling ponds.

Overland Flow: Overland flow from rainfall and snowmelt should be diverted around the mining site. Overland flow originating within the mining site should be collected and routed through the settling pond system.



SIDE VIEWS OF GRADED PILES



CROSS SECTION

Site Grading: Recontouring *spoil* and tailing piles during operations will minimize erosion and reduce overall reclamation costs. If tailings are properly placed and graded during operations, minimal grading is needed when the mine is closed.

Slopes and tailing piles should be graded as early as possible during the operation. Any large piles of stripped *loess* with thawing ice lenses should be graded to slopes of three to one. Constructing *terraces* and *furrows* parallel to the contours of steep side slopes, particularly outside the active floodplain, will reduce erosion and prevent slope failure. Backsloping terraces should have a minimum width of 14 feet and a maximum length of slope between terraces of 100 feet. Furrows may be spaced close together, providing for flatter slopes at the bottom of the contour.

7 RECLAMATION

The goal of reclamation is to promote and accelerate the natural succession of aquatic and terrestrial habitats disturbed by mining. Recontouring, stream restoration, erosion prevention, and revegetation are major features of reclamation. Removing equipment and debris is also important, particularly for large operations.

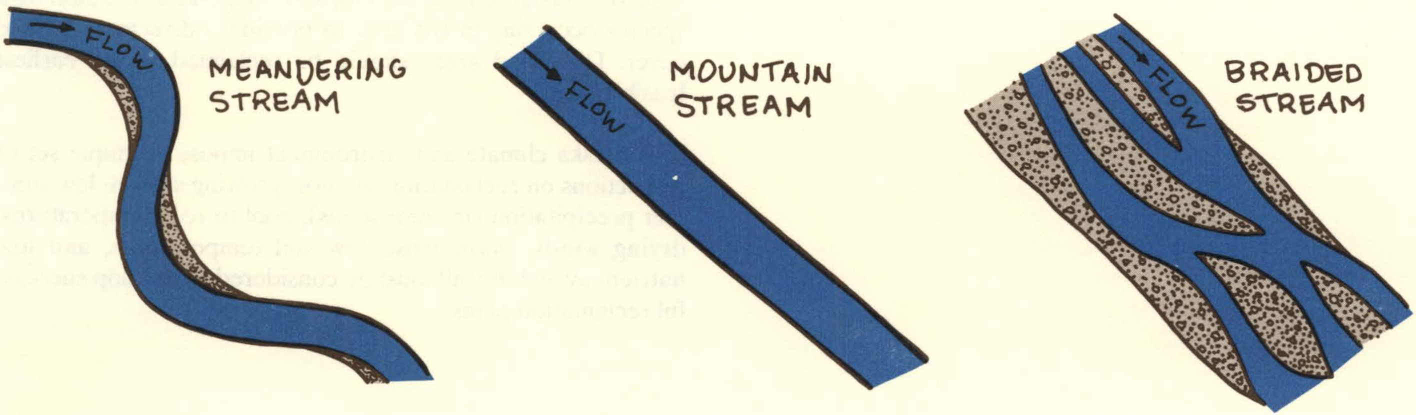
Reclamation of mined lands includes reshaping the land to a natural looking contour, restoring reshaped lands by replacement of overburden and topsoil, and revegetating the land with species occurring in the area to provide a diverse vegetative cover. Disturbed areas should be reclaimed at the earliest feasible time.

The Alaska climate and environment impose a unique set of restrictions on reclamation. A short growing season, low summer precipitation (in some areas), cool to cold temperatures, drying winds, permafrost, low soil temperatures, and low nutrient availability all must be considered to develop successful reclamation plans.

STREAM REHABILITATION

Stream rehabilitation involves designing a channel with natural stream patterns, cross-sectional geometry, longitudinal profile, and the sediment transport characteristics of the original stream. Fish passage and habitat must be provided when appropriate. A channel so designed will recover to its natural equilibrium rapidly.

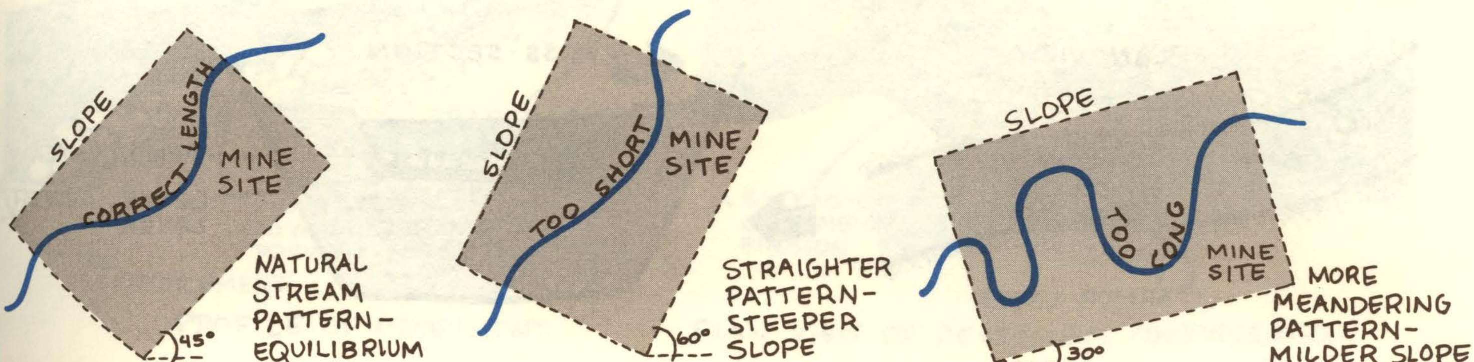
Stream Pattern: Stream pattern is the overall configuration of the stream. Patterns are classified into three types for reclamation purposes: *meandering streams*, *mountain streams*, and *braided streams*.



There are technical equations, maps, and graphs available to compute stream patterns; the basic factors are water flow (including possible floods), slope (elevation change), and stream length.

High water velocity and a high slope are characteristic of a mountain stream. Low water velocity and low slope are characteristic of a meandering stream or braided stream. The channel length through the mine site is critical to the sediment transport process. If the channel is too short, high stream velocity will tend to cause upstream erosion and deposition downstream. If the channel is too long, the low velocity will cause downstream erosion to occur while deposition will take place at the stream's upper end.

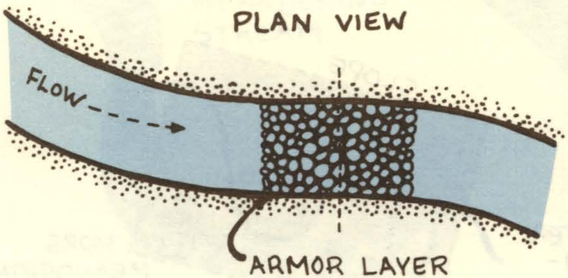
EFFECT OF CHANNEL LENGTH ON STREAM EQUILIBRIUM

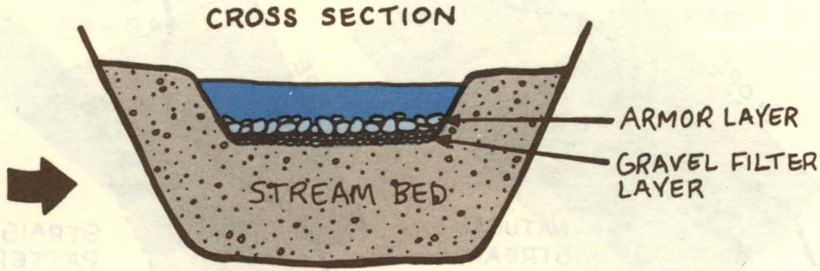


Bed Stability: The bed stability of a rehabilitated stream should approximate the stability of a natural stream with the same stream pattern. The type of stream determines the degree of bed stability needed. A meandering stream should have a stable bed up to 3/4 bankfull. A mountain stream should have a low sediment transport and a stable bed at bankfull conditions.

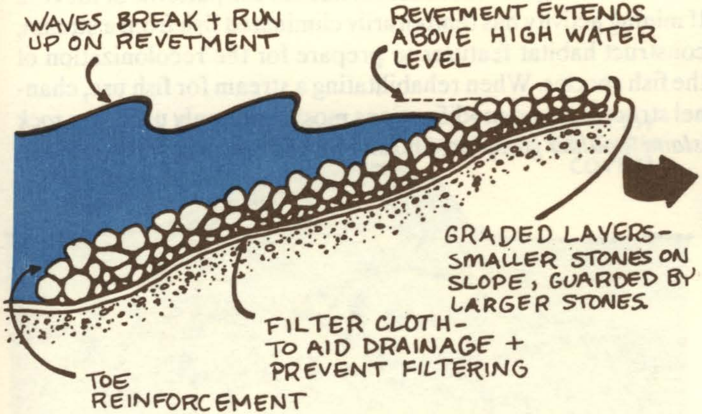
The stream bed can be protected by an *armor layer* of gravel and boulders. This layer can be developed by first placing gravel six inches deep to form a filter layer. In high velocity streams, place boulders above the filter layer to form the armor layer. In low velocity streams, the armor layer can be formed with cobbles or small boulders. The thickness of the layer should be equal to the longest dimension of the largest rock used in the layer.

The classification technique used by miners will make the various rock sizes available to stabilize the stream bed and will make the process less expensive.

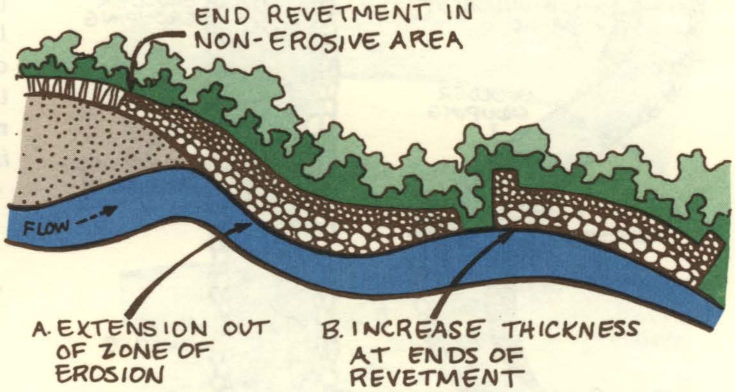




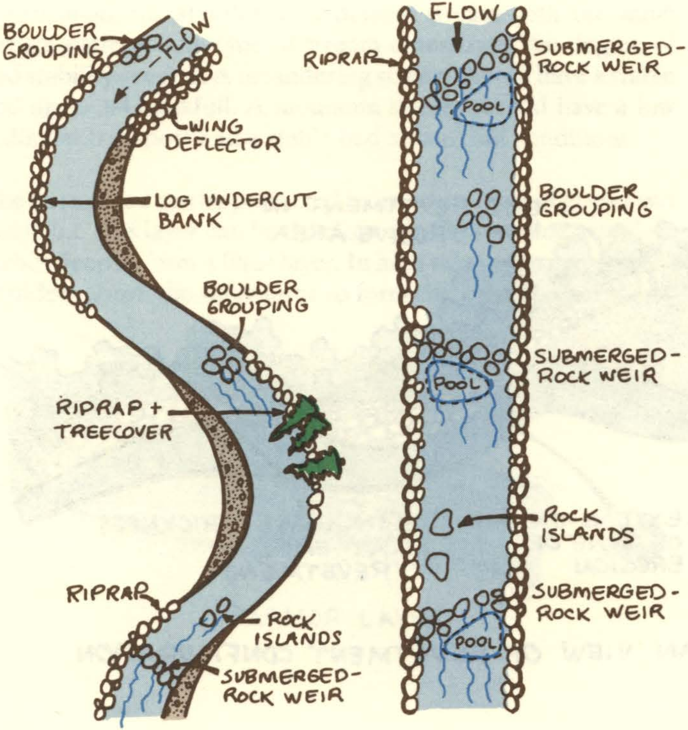
Bank Stability: Channel banks can be protected from erosion by revetment. Revetment will prevent lateral movement of the channel, but will also prevent plant regrowth, so use it only where necessary to stabilize the bank. Riprap of rubble or quarry stone is generally the most reliable and economical revetment.



PROFILE OF REVETMENT



PLAN VIEW OF REVETMENT CONFIGURATION

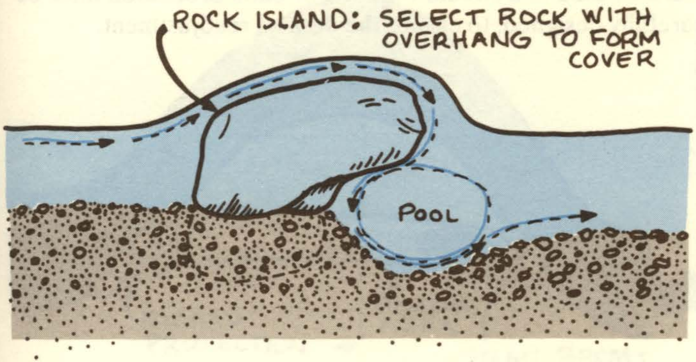


FISH HABITAT REHABILITATION

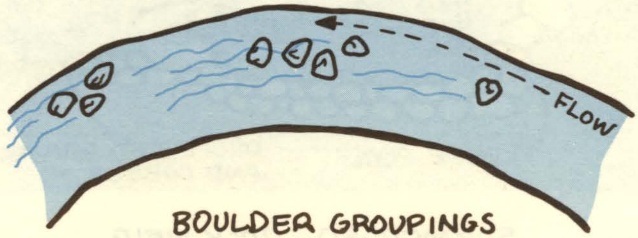
Placer mining in an active floodplain may damage fish habitat. The goal of rehabilitation is to ensure that fish can use the stream at the mining site.

To meet this goal, consider the fish species within and adjacent to the mine site, and the seasonal habitat use patterns of the fish. If mining activity has temporarily eliminated fish from a stream, construct habitat features to prepare for the recolonization of the fish species. When rehabilitating a stream for fish use, channel structures and modifications most commonly used are: *rock island*, *boulder grouping*, and *submerged rock weir*.

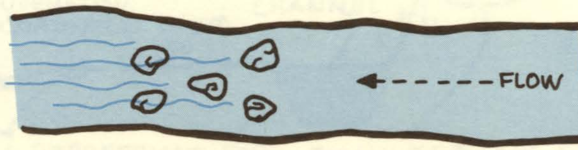
The rock island is a simple and effective means for improving fish habitat in streams. A rock island can be formed by placing a boulder three to four feet wide in the stream bed. Place the boulder near the upstream end of a shallow pool or the downstream portion of *riffles*. The boulder, when properly aligned, scours out a pool that serves as a resting place for fish and provides protection from predators.



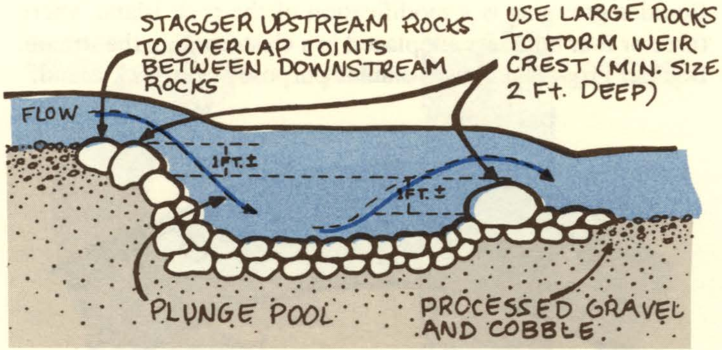
Boulder grouping is a modification of the rock island where three or four boulders are placed in a cluster within the stream. Boulder groupings serve a similar purpose as the rock island.



BOULDER GROUPINGS ON STREAM CURVES



BOULDER GROUPINGS ON STRAIGHT STREAM



SUBMERGED - ROCK WEIR

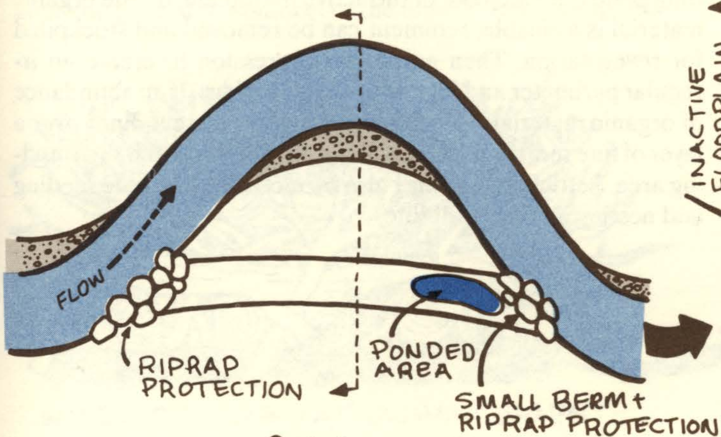
The submerged-rock weir is an effective modification for steep gradient, high velocity streams. It is designed to reduce velocities and increase depth by creating small *plunge pools* on the downstream side of the weir.

Construction and placement of habitat features in the water alters stream hydraulics. Such alteration may cause minor bed scour, bank erosion, or deposition near the habitat feature as the stream readjusts its configuration. These readjustments in the bed are part of the habitat rehabilitation process. Habitat features used in a stream with bed or bank protection must be carefully designed, to ensure the desired readjustment.

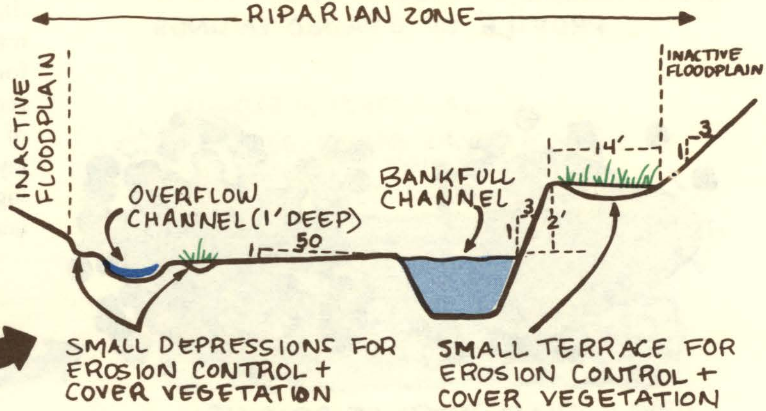
FLOODPLAIN REHABILITATION

Floodplain rehabilitation promotes rapid recovery to pre-mining conditions. Rehabilitation begins with grading the tailing piles to slopes and contours that match the topography of the area. The stored stockpiles of overburden and topsoil are then graded over the tailings to form *undulating* contours that provide a growing medium for new vegetation and limit excessive erosion. Different techniques should be employed in the different zones of disturbance. Guidelines may be adjusted depending on the available quantity of material.

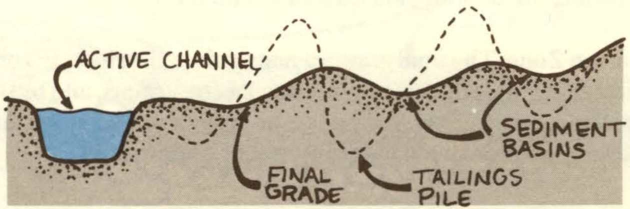
Riparian Zone: The final grade of materials in the riparian zone is dictated by water flow and engineering constraints, and by the type of stream channel that has been designed. The slope and contour grading of a meandering stream is illustrated.



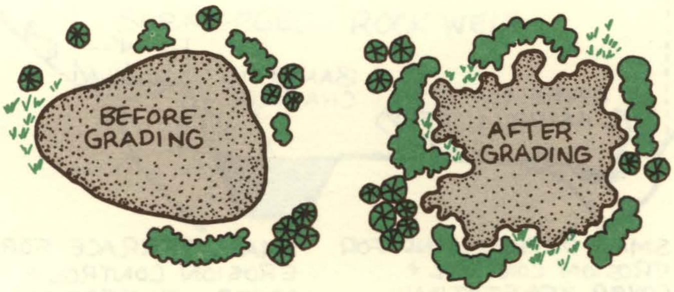
PLAN VIEW



CROSS-SECTION



PROFILE OF GRADED TAILINGS



PLAN VIEW OF GRADING

Inactive Floodplain: The *inactive floodplain* should be shaped to allow floods to spread out as shallow flow while remaining contained.

Settling Ponds: Reclaim settling ponds during site grading. Drain ponds within the active floodplain and remove and stockpile the sediment for use in the revegetation process. Once the sediment has been removed, fill the pond depression with coarse tailings and grade to a natural contour. Even If the settling pond is located out of the active floodplain, if little organic material is available, sediment can be removed and stockpiled for revegetation. Then grade the depression to create an irregular perimeter and fill it with coarse tailings. If an abundance of organic material is available, place the coarse tailings over a layer of fine sediment and grade the pile level with the surrounding area. Settling ponds may also be modified to create feeding and nesting areas for wildlife.

Stockpile Dispersal: Placement of organic material depends on the amount available for distribution, which varies with each site. When stream rehabilitation provides fish habitat but organic material is limited, vegetation must first be established in the riparian zone. Establish vegetation adjacent to streams, ponds, in low lying areas that collect runoff, and in any wildlife migration corridor created during final site grading.

If material is abundant it should be distributed over the entire area and graded to conform to the natural valley contours.

Revegetation: Revegetation replaces lost habitat in the shortest time possible. Consider revegetation when sloping and contouring alone will not control erosion and stream siltation.

Riparian vegetation differs from upland vegetation; plants that grow beside streams must endure wet soil and periodic flooding. Willows, poplars, cottonwoods, and alder are common woody riparian plants.

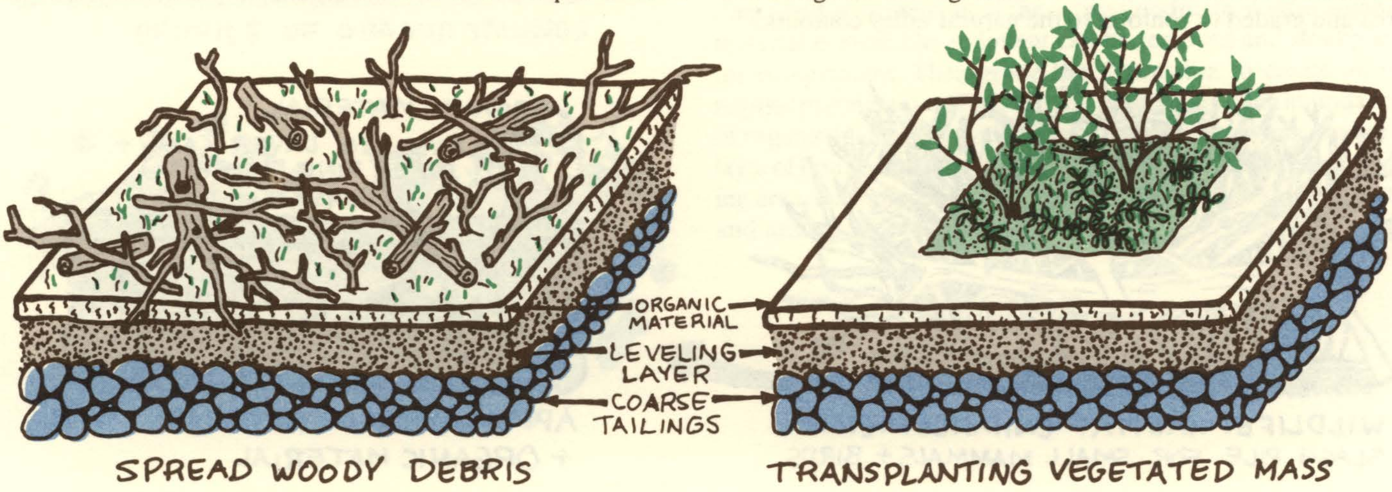
WILDLIFE- HABITAT ENHANCEMENT- SLASH PILE FOR SMALL MAMMALS + BIRDS

APPLICATION OF LEVELING LAYER + ORGANIC MATERIAL

Disturbed riparian vegetation should be re-established to prevent erosion and property damage and to restore the area to a more productive condition. Each revegetation process is unique, but some general guidelines lead to successful results.

Before beginning the process, develop a simple plan of what is required at the mining site. The BLM District AO can help develop the plan. Permits may be required before beginning restoration. Check with the Habitat Division of the Department of Fish and Game and the Regulatory Branch of the Corps of Engineers before attempting to revegetate. These agencies can make recommendations about successful revegetation at a particular site.

When revegetation is needed, choose plants that can withstand the Alaska climate. Some common revegetation alternatives include: spreading woody debris across the top layers of soil; removing soil and vegetation from an undisturbed location and



placing the material in shallow depressions; planting dormant cuttings, bundles, and rooted cuttings; and planting seedlings and seeds, and applying fertilizers.

Seeds are usually the least expensive plant materials for revegetation. However, they must be properly applied and have sufficient moisture for germination. They can be used when site erosion is not a major problem. Seedlings can be used when site conditions are harsh and where a faster developing ground cover is important enough to offset the greater costs. The Alaska Department of Fish and Game handbook, Field Guide for Streambank Revegetation, gives helpful information on revegetation.

GLOSSARY

active stream channel: a channel that contains flowing water during the ice-free season.

Annual Placer Mining Application: application that is used to operate a placer mine in Alaska.

armor layer: a layer of coarse material that covers finer material and is resistant to erosion by flowing water.

aufeis: an ice feature formed by water overflowing onto a surface, such as river ice or gravel deposits, and freezing in layers.

boulder grouping: boulders grouped in streams or channels, that are used in habitat rehabilitation to provide hiding and resting areas (small pockets or pools) for fish.

braided stream: a stream containing two or more interconnecting channels separated by unvegetated gravel bars, sparsely vegetated islands or occasionally heavily vegetated islands.

classified: separated by size.

Code of Federal Regulations (CFR): regulations promulgated and enforced by Federal agencies, which have the full force of the law.

culvert: a structure used to channel water over or under a road.

dike: a wall built partially or totally around an area to prevent water from entering or leaving.

dredged and fill material: dredged material is excavated from water. Fill is material used to replace an aquatic area with dry land, or to change the bottom elevation of a waterbody.

effluent: a liquid discharged as waste, such as water that has been used in a sluice box.

erosion: the physical process of sediment removal by wind, water or ice.

fines: the smaller-grained particles of soil, usually consisting of fine sand, silt, and clay that settle slowly to the bottom of a body of water.

furrow: a long narrow groove in the ground surface.

gold-bearing gravel: the type of material found in a placer gold deposit; a surficial mineral deposit formed by mechanical concentration of mineral particles from weathered debris.

hydraulic geometry: those measures of channel configuration, including depth, width, velocity, discharge, slope, roughness, and bed particle size.

hydrostatic pressure: pressure exerted by water at any given point in a body of water at rest.

ice-rich: permafrost material with a high water content in the form of ice.

inactive floodplain: the portion of a floodplain that lies between the riparian zone and the 100-year flood recurrence boundary.

infrastructure: basic physical structural part of a mining operation.

jig unit: a gravity concentrator using the pulsating flow of water to separate heavy minerals from lighter material.

loess: a deposit of silty material having an open structure and relatively high cohesion due to cementation by clay or calcareous material at the grain contacts.

meandering stream: a stream that follows a winding pattern back and forth within the floodplain. The meandering channel shifts downvalley by an ongoing pattern of erosion and deposition. Few islands are found in this type of stream and gravel deposits typically are found on point bars at the insides of each curve or meander.

mitigation: activities that can avoid or reduce the adverse impact or effect of placer mining on the environment.

mountain stream: a single channel, high gradient stream.

overburden: any organic or inorganic material lying on top of placer gravels that must be stripped to reach the deposit of useful materials or ores.

paleontological: pertaining to fossils or ancient life forms.

permafrost: perennially frozen ground, soil, rock or any other earth material whose temperature remains below zero degrees centigrade (32^0F) continuously for two or more years.

Plan of Operations: document describing completely those mining operations disturbing five surface acres or more, and any operation except casual use, in areas designated for potential addition to, or an actual part of the National Wild and Scenic Rivers System, and Areas of Critical Environmental Concern, the National Wilderness Preservation System administered by BLM, and areas closed to off road vehicle use.

plunge pool: a deep, relatively large hollow or cavity scoured in the bed of a stream at the foot of a waterfall or rapid by the force and eddying effect of the falling water.

process water: the water used in a gold recovery process, as in a sluice or jig unit.

reach: a straight continuous, or extended part of a stream, viewed without interruption (as between two bends) or chosen between two specified points.

reclamation: reasonable measures that will prevent unnecessary or undue degradation to Federal lands, including reshaping land disturbed by operations to an appropriate contour and, where necessary, revegetating disturbed areas to provide diverse vegetative cover.

revetment: a facing of solid material built to protect an embankment against erosion.

riffle: a shallow rapid in a open stream, where the water surface is broken into waves by obstructions wholly or partially submerged.

riparian: pertaining to or adjacent to the banks of a stream or other body of water.

riprap: angular rock used as an armor layer to prevent erosion.

rock island: a habitat feature in streams, made from large rocks that create scoured out pools, that serve as resting places for fish.

scour: concentrated erosive action by running water.

settling pond: a pond designed and constructed to remove sediment from water by simple settling.

sluice box: a simple device used for gravity concentration consisting of a trough with riffles. Gold settles into the riffles and lighter materials are carried through the box by turbulent water.

spoil: overburden or mineral waste excavated and redeposited in surface mining.

stream siltation: the deposition or accumulation of silt that is suspended throughout a body of water or in some considerable portion of it; esp. the choking, filling, or covering with silt.

submerged-rock weir: a habitat feature in a stream that reduces stream velocities and increases water depths.

substrate: stream bottom materials including silts, sands, gravels, cobbles, boulders, and bedrock.

tailings: material which has been processed through a mining operation that is too poor in value to be treated further and is usually stacked in piles.

tailrace: a channel in which mine tailings are carried away.

terrace: a nearly level raised strip of land with a sloping front, esp. one of a series of levels rising one above another.

thermal erosion: the thawing of ice-rich permafrost material resulting in thermokarst (land forms that appear as depressions in the ground surface or cavities beneath the ground surface).

topsoil: the dark-colored upper soil layer containing organic material that ranges from a fraction of an inch to two or three feet thick, depending on soil type.

turbid: stirred up or disturbed, such as by sediment; not clear or translucent, being opaque with suspended matter, such as of a sediment-laden stream flowing into a lake; cloudy or muddy in appearance.

undulating: rippling or scalloped land surfaces, having wavy outlines or appearances.

unnecessary or undue degradation: surface disturbance greater than what would normally result when an activity is being accomplished by a prudent operator in usual, customary, and proficient operations of similar character.

wetlands: areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similiar areas.

withdrawn land: an area of federal land withheld from settlement, sale, location, or entry under some or all of the general land laws, to maintain other public values or to reserve the area for a particular public purpose.

zero discharge: a condition where there is no release of water back into a stream, either through a pipe, by overflow, or by visible seepage through a dam or tailings filter.

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