CLOSURE

POLICY: It is the policy of the OR/WA BLM that reclamation, including closure, of mining operations be conducted and completed in a proper manner to ensure the protection of the public lands, both short and long term, under BLM jurisdiction. It is the responsibility of the BLM to protect the long-term health of the public lands. Authorization to allow the release of contaminated waters into the environment must be in compliance with the Clean Water Act, Safe Drinking Water Act, respective state law, Endangered Species Act, other applicable environmental laws, and consistent with BLM's multiple use and resource protection responsibilities under the Federal Land Policy and Management Act (FLPMA).

It is the policy of the OR/WA BLM that all modifications to an approved Plan of Operations regarding closure will be reviewed and approved by the Authorized Officer under 43 CFR 3809. Any Federal Decision to approve a modification to an approved Plan of Operations, including changes to the closure plan, must be in compliance with the requirements of NEPA.

It is the policy of the OR/WA BLM to coordinate and collaborate to the fullest extent practical with the State regulatory agencies responsible for the permitting and oversight of mine reclamation and closure activities. Where appropriate, the BLM will utilize the State environmental regulatory requirements, guidance and standards as the base for its analyses and reviews. The BLM recognizes the State's authority under the Clean Water Act, and Safe Drinking Water Act, and in carrying out its responsibilities under FLPMA will rely on the State's decisions pursuant to that authority.

IMPLEMENTATION: The "OR/WA Bureau of Land Management Guidance for Mining Reclamation/Closure Activities - is intended as a guide in meeting the requirements of this policy. Specifically the attached document provides guidance to the BLM in meeting its responsibilities to ensure the evaluation and analysis of potential impacts associated with reclamation and performance monitoring of Dumps, Heaps, and Tailings Impoundments. The appropriateness of the individual discussions will depend on the issues being addressed and the decisions being made.

CONTACT PERSON: Questions concerning this policy and the attached guidance document should be directed to.

Attachment 1

OR/WA Bureau of Land Management Guidance for Miing Reclamation/Closure Activities

INTRODUCTION

The Bureau of Land Management (BLM) is responsible for management of public lands and resources for present and future generations under our statutory mandates. BLM is committed to close coordination and working through State and local regulators and their statutory primacy requirements to meet our Federal statutory and resource management objectives. BLM has the responsibility to ensure reclamation, including closure, of miing operations on BLM-administered lands is conducted and does not result in unnecessary or undue degradation of the public lands. This responsibility includes understanding technical issues associated with the closure of mining operations and making informed decisions. This guidance document is intended to facilitate OR/WA BLM Field Offices in carrying out their responsibilities, ensuring coordination with the appropriate State regulatory agencies.

There are four main topics covered in this guidance document.

When faced with miing reclamation, including closure, the Authorized Officer must ensure decisions will not result in unnecessary or undue degradation of the public lands. All actions must comply with the appropriate federal and state laws, and consistent with BLM's multiple use responsibilities under the Federal Land Policy and Management Act (FLPMA).

Reclamation decisions need to be coordinated and made in collaboration with the State regulatory agencies responsible for the permitting and oversight of mine reclamation, including closure activities.

The BLM must ensure that activities such as long-term or perpetual maintenance of vegetation and/or wetlands, to include monitoring are provided for when these elements are part of fluid management or site stabilization. Fence maintenance, grazing management, weed invasion or increased salinity have all adversely impacted vegetation at reclamation sites, consequently these elements must all be considered in the long-term planning.

The BLM field specialists and managers need to understand and consider all the technical issues associated with mie reclamation, including closure activities and the long-term implications of closure, while ensuring that reclamation, including closure activities, is conducted in a timely and effective manner.

Specific technical issues addressed in this guide are disposal and monitoring of heap detoxification waters, heap drain-down waters, process pond sludge, final cover designs for dumps and heaps, tailings impoundments, and risk assessment.

RECLAMATION/CLOSURE ACTIVITIES

In this guidance document, the term "closure" refers to the act of closing any phase of a mining operation where further operations are not intended. It is the final step of the overall reclamation process in closing down a mining operation or any phase of an operation.

AUTHORITY, ANALYSES AND DECISIONS

All surface management activities, including reclamation, must comply with all pertinent Federal laws and regulations, and all applicable State environmental laws and regulations. The fundamental requirement, implemented in 43 CFR 3809, is that all mining under Plan of Operations or Notice on the public lands must prevent unnecessary or undue degradation. The Plan of Operations and any modifications to the approved Plan of Operations must meet the requirement to prevent unnecessary or undue degradation. Authorization to allow the release of effluents into the environment must be in compliance with the Clean Water Act, Safe Drinking Water Act, Endangered Species Act, other applicable Federal and State environmental laws, consistent with BLM's multiple use responsibilities under the Federal Land Policy and Management Act and fully reviewed in the appropriate National Environmental Policy Act (NEPA) document.

The BLM should ensure reclamation issues, including closure, are adequately addressed as part of the initial Plan of Operations. However, it needs to be recognized that proposed reclamation activities found in the original Plan of Operations are subject to change and are likely to change. With mine development, more detailed hydrologic, geologic and chemical information and actual monitoring data becomes available that may warrant changes to the reclamation, including closure activities, described in the approved Plan of Operations. Where the operator proposes or the BLM requires modification to the proposed reclamation activities, including closure, the Plan of Operations must be modified.

The Authorized Officer is responsible for ensuring modifications to approved Plans of Operations, including mine closure decisions, are properly reviewed prior to approval. In assessing the need for additional NEPA documentation, the authorized officer should consider the significance of the proposed modification and the adequacy of the original NEPA documentation. Any Federal decision to approve a modification to an approved Plan of Operations must be in compliance with the requirements of NEPA. If the modification involves actions that have been evaluated under previous NEPA review, the authorized officer may issue a Documentation of Land Use Plan Conformance and NEPA Adequacy (DNA).

Any required NEPA document needs to consider the potential environmental impacts of the proposed modification, including impacts to water resources associated with the saturated and unsaturated hydrologic zones. For the purpose of this guidance document, the unsaturated zone is the portion of the earth immediately below the land surface and above any saturated hydrologic zone. Within this zone the pores contain both water and air, but are not totally saturated with water. If a mine closure plan proposes discharge of fluids then zero-discharge and fluid treatment alternatives must be considered in the NEPA document. Environmental analyses will be conducted according to BLM's NEPA guidelines contained in H-1790-1.

COORDINATION

Early, consistent cooperation and participation by all Federal and State Regulatory Agencies, Tribal entities, Industry, and Environmental Organizations is likely the single most effective way to reduce costs and delays in the current review and approval process. For mining on public lands, the BLM is the lead agency and land manager, and as such needs to take the responsibility to ensure the appropriate coordination takes place with all parties. In addition to the need to coordinate with other governmental entities, the BLM needs to ensure it meets its obligations under NEPA to provide the public an opportunity to review and comment on decisions affecting public lands.

The OR/WA BLM is specifically committed to coordinate and collaborate to the fullest extent practical with the State regulatory agencies responsible for the permitting and oversight of mine reclamation and closure activities.

Coordinated Review of Technical Issues

The BLM will cooperatively review and approve methodology and technology necessary to ensure adequate evaluation of water quality issues. Where appropriate, the BLM will utilize State environmental regulatory requirements, guidance, standards and testing methods as the basis for its analyses and reviews. This includes deferring to U.S. Environmental Protection Agency (EPA) decisions pursuant to their authority under the Clean Water Act, Safe Drinking Water Act, Resource Conservation and Recovery Act, and other applicable Federal and State environmental laws where appropriate. For your reference, attached is an EPA information sheet identifying Federal requirements affecting groundwater discharge. Except for point source discharges to waters of the U.S., currently there are no numeric Federal standards for permitting discharges into the environment as part of mine closure. The overriding BLM standard is found in the 43 CFR 3809 regulations, specifically the requirement to prevent unnecessary or undue degradation.

TECHNICAL ISSUES

This section of the guidance covers: disposal of heap detoxification waters, disposal of heap and tailings impoundment drain-down waters, disposal of process pond sludge, cover designs for dumps and heaps, tailings impoundments, and Risk Assessment. Each issue discussion contains methods and technical alternatives that should be evaluated under best management practices for water and sludge disposal.

General Disposal Criteria - The general criteria for review and decisions regarding disposal are:

- Compliance with all applicable Federal and State Laws
- Reduction and minimization of environmental harmful constituents
- Utilization of a risk assessment approach if necessary to address any remaining constituents or concerns.

Assurance of long-term maintenance and performance of disposal method .

Disposal of Heap Detoxification Waters, and Heap and Tailings Impoundment Drain-Down Waters - The following methods for the disposal of heap detoxification waters and heap and tailings impoundment drain-down waters should be evaluated in the Plan of Operations and NEPA document:

Land application by infiltration, leach field, injection of treated water, or irrigation.

Evapotranspiration (zero discharge)

Wetlands

Bioreactors

The following information needs to be collected and evaluated for any proposed method of disposal:

Locations for the proposed disposal.

Volume of disposal solutions.

Predicted drain-down analysis.

Water Quality (water quality monitoring for disposal design and long-term water quality monitoring to assess disposal design performance).

Land application by infiltration, leach field, injection of waste water, and irrigation.

In addition, the following information needs to be collected and evaluated for proposed land application methods of disposal:

Chemical characteristics of the solution to be disposed.

Survey of surface waters (locations of streams, springs, lakes, wetlands).

Depth of the shallowest water table or ground water aquifer.

Hydrogeological characteristics of the disposal area.

Ground water quality (State regulation).

Soils and subsurface lithology, including attenuation analysis as needed.

Vegetative survey including representative nearby riparian and wetland areas within a defined area of influence even if not included in area of disturbance.

Ecological survey.

Screening Level Ecological Risk Assessment/Ecological Risk Assessment.

These analyses would include, but not be limited to, state-required analyses for potential degradation of waters of the State. This should also include methods for validating operators predictions, such as monitoring wells, lysimeters, and water quality sampling.

General discussion of methodology and technical approach applied to waste water disposal techniques:

Evaporation

Evaporation of drain-down and process waters are an important part of the water balance management at most mine operations. The process of evaporating water usually takes the form of evaporation ponds or direct soil surface evaporation such as off a heap, dump, tailings impoundment or other similar structure. Evaporation of water can be enhanced by numerous methods such as snow guns, misters, wobblers, drip lines, atomizers, and felt blankets, but to name a few. Evaporation ponds and other containment structures are managed and operated under OR/WA State regulation and law.

Land Application

Land application can take the form of one time discharge from ponds(process solutions) and may or may not be part of the detoxification process, it can also be from heap drain-down as a result of chemical stabilization activities conducted on a heap or can be a longer term natural drainage process from heaps, dumps or tailing impoundments, etc. Land application is a form of water disposal that involves discharge of waste waters into a leach field or infiltration gallery. A land application process can be of short duration, but is usually long-term and can require both long-term maintenance and monitoring to evaluate performance. All land application processes are permitted under State law and regulation.

Constructed Wetlands

Constructed wetlands are useful systems to both clean up and evaporate mine waste water, while conserving resources and costs associated with water disposal and treatment. The two most commonly utilized constructed wetlands are the free water surface wetland and the subsurface flow wetland. The free surface wetland, consists of a basin or natural channel with some type of barrier to prevent seepage, soil materials to support the roots of vegetation, and water at a shallow depth flowing into the system. The subsurface flow wetland, consists of a basin or natural channel with barrier to prevent seepage, but the bed contains porous soil or rock materials at greater depth and volume. The soil and rock materials support vegetation root structure. The design of this system assumes that the water level in the bed will remain below the top of the soil and rock materials. The water flow path in both systems is assumed to be horizontal.

The most widely used constructed wetland is the subsurface flow wetland. The advantages of the subsurface flow wetland are that the soil and rock materials provide a greater available surface area for treatment and efficiency is greater. Also the position of the water and the plant debris on the surface of the bed offer better thermal protection during cold periods. Local plant species should be used to establish the bed and coordination on this matter should be with BLM specialists during the design phase. Wetlands are most effective where mine waste waters have low levels of inorganic solids and precipitation of metals is not extremely high. The design must insure that appropriate soil and rock materials exhibit hydraulic characteristics suitable for the system. Suitable materials are one that provide and maintain appropriate pore space, hydraulic conductivity, and allow vegetative root growth and establishment.

Evapotranspiration Cells

Evapotranspiration cells are one of the most widely used methods to dispose of mine waste waters for the purpose of reclamation/closure. Evapotranspiration cells are usually constructed from existing process ponds, but can be new structures as well. The cells most often are located in natural drainages down-gradient from the structure being drained or dewatered (heaps, dumps, tailings impoundments, etc.). The purpose of the cells are for evaporating and transpiring mine waste waters. The cells are usually lined for containment and the liners can be synthetic membrane, clay, or other artificial liner materials. The media used in the cell design is usually soil and rock. Additionally the design may consist of a surface layer (top soil or organic matter) for establishing plant growth and root systems. The soil and rock materials must have appropriate characteristics for porosity, hydraulic conductivity, and storage of moisture so that evaporation and plant transpiration can be maximized.

Bioreactors

Bioreactors degrade contaminants in water with microorganisms through attached or suspended biological systems. Bioreactors can be constructed and applied to clean up of discharges associated with most postmine conditions. However, one should be familiar with the limitations associated with bioreactors and their applications.

Design Considerations for Wetlands and Evapotranspiration Cells

Hydrology

A basic concept of the wetland/evapotranspiration cell is maintenance of flow beneath the surface of the media in the bed or cell. Flow beneath the bed or cell can be facilitated by developing a good system design. Things to address during the design phase, are bed void space clogging due to organic loading and root growth that reduce effectiveness of porosity and hydraulic conductivity. Water chemistry of the drain-down or dewater waters must be analyzed for soluble salts, metals, and inorganic solids, and organics.

The bed size must be analyzed for water volume capacity consistent with the drain-down or dewatering source. The bed materials must be analyzed for soil characteristics, water movement, storage, chemical compatibility, and vegetative sustainability.

Outlet and Safety Overflow Structures

The wetland/evapotranspiration cells should have a working outlet or overflow safety system to prevent impacts from failures or unusual precipitation events that may occur. The outlets are usually down-gradient natural discharge flow points, they can be the natural drainage channel or engineered channel for transmitting water out of a wetland. The outlet is necessary to control and maintain consistent flow for the wetland system to function properly. The evapotranspiration cells should have a safety containment pond that functions as a catchment for water that moves past a cell under failure conditions or over capacity.

Vegetation

For wetlands/evapotranspiration cells, it is recommended that locally available plant types be used for vegetation since they have already adapted to the environmental conditions. An initial application of fertilizer will also enhance plant development.

Disposal of Process Pond Sludge - Process pond sludge must be tested to determine metal content, pH, and water content prior to evaluating disposal alternatives. The test method utilized to test the sludge should be identified in either EPA/SW-846 or ASTM. In addition, the sludge should be dried to the greatest extent possible before disposal takes place, this can be completed by dewatering or evaporating the water out of the sludge.

Ways to dispose of sludge:

- Dry the sludge and bury it on-site on containment.
- Treat the sludge and bury it on-site on containment.
- Remove the sludge to an off-site approved waste management facility.

If sludge(s) are disposed of on-site through burial, an appropriate cover and capping system must be designed to:

Provide optimum evaporation.

Provide optimum surface water run-off and routing.

Provide in-place physical stabilization.

Provide optimum evaporation (use of soil materials, vegetation, engineering design, etc.).

Minimize infiltration through sludge burial system with geosynthetic liners – dependent on the chemical characteristics of the sludge.

Covers for Dumps, Heaps, and Tailings Impoundments

Current best management practices may require placement of a cover onto dumps, heaps, and tailings impoundments, keep in mind that environmental conditions determine the need for and use of cover systems. The objectives of a cover system vary for dumps, heaps, and tailings impoundments, but most often include:

Dust and erosion control.

Chemical stabilization of acid-forming mine waste by reducing the availability of oxygen.

Contaminant release control by reducing infiltration.

Provision of growth medium for establishment of sustainable vegetation.

The design of a cover usually involves analyzing impacts, this process quantifies the relationship between cover performance criteria and environmental impacts. The specific environmental impacts to be evaluated depend on the objectives of the proposed cover system design. The environmental impacts most commonly evaluated by BLM during cover system design are:

Impacts on surface water quality (State law and regulation).

Impacts on groundwater quality (State law and regulation).

Impacts on air quality (State law and regulation).

Impacts on vegetation

Impacts to wildlife (ecological).

Most quantitative cover design analyses include a relationship between cover performance criteria and types of impacts associated with the mine waste or structure to be covered. The following is an impact scenario based on cover performance criteria:

<u>Infiltration</u> relates directly to impacts associated with surface water and groundwater quality, vegetation, and wildlife.

Oxygen Availability relates directly to impacts associated with surface water and groundwater quality, and wildlife.

Soil Loss/Erosion relates directly to impacts associated with surface water and groundwater quality, and air quality.

Plant Density relates directly to impact associated with surface water quality, and vegetation, wildlife.

Numerical analyses should be conducted to establish the relationship between predicted impacts and cover system performance criteria once impact scenarios have been developed. The type of numerical analysis utilized can vary from simple empirical and analytical models to more robust numerical models. Some examples of models used in impact analysis are:

Run-off and erosion models to estimate soil loss and surface water quality.

Geochemical speciation and reaction models to evaluate geochemical controls in waste rock, heaps, and tailings.

Air flow models to assess wind deposition and movement of materials.

Acid Rock Drainage models to evaluate quality of water moving through and out of dumps, heaps, and tailings impoundment.

Groundwater flow and transport models to assess natural groundwater systems, dewatering practices, infiltration, re-injection, and surface water groundwater interactions, and contaminant fate and transport.

Ecological models to assess plant community development and wildlife impacts.

GENERAL CONSIDERATIONS FOR COVERS

The design of a cover system is based on providing sufficient erosion control, run-off control, water storage capacity, evaporation, and minimizing infiltration of water through the dump, heap or tailings impoundment. The following considerations are necessary in the design of a cover system:

Climate – The total amount of precipitation over a period of year(s) or month(s), its form and distribution, will provide information to determine capacity. The cover design may need to include snow cover and spring melt. Other factors to address are temperature, atmospheric pressure and relative humidity.

Soil Type – Many types of soils or rock are used for cover materials, they include fine-grained materials, such as silts and clays. Fine-grained materials have been shown to exhibit greater storage capacity than more coarse-grained materials like sand. The storage capacity of soils varies between different soil-types, and depends on quantity of fine particles and bulk density of the soil. One important aspect of cover construction is to minimize the amount of compaction that takes place during placement. Higher bulk densities may lower the storage capacity of the cover material, consequently inhibiting good growth of plant roots.

Soil Thickness – The thickness of the cover layer depends on the required storage capacity, pore space, and potential water quality which is determined by the water balance for the dump, heap or tailings impoundment. The cover thickness also depends on the proposed vegetation rooting depth requirements. The thickness of the cover media needs to be consistent with extreme weather conditions, such as snow melts and precipitation events, or periods of time during which evapotranspiration rates are low and plants are dormant.

Vegetation Types – Vegetation for the cover system is used to promote transpiration and minimize erosion by stabilizing the surface of the cover. Grasses, shrubs, and trees have been used to promote evapotranspiration on cover systems. A mixture of native and nonnative plants made up of semi-arid/high desert species usually is planted, it is desirable to utilize a native plant mix when possible, because these species are less likely to disturb the natural ecosystem.

Soil and Organic Properties – Nutrient and salinity levels affect the ability of the soil to support vegetation. The cover media needs to be able to provide nutrients to promote vegetation growth and maintain the vegetation system on the cover. Low nutrient or high salinity levels can be detrimental to vegetation growth, and if present, supplemental nutrients may need to be added to promote vegetation growth on the cover. In addition, topsoil promotes growth of vegetation and reduces erosion. For cover system planning purposes topsoil should be stock piled or acquired from other sources to augment plant growth on the cover media. In cover system designs it is basic practice to augment cover media with at least six inches of topsoil or other organic supplements to promote vegetation.

Performance and Monitoring – Protection of surface water and groundwater quality is one of the goals of the final cover system for dumps, heaps, and tailings impoundments (surface water and groundwater are regulated under State law). Potential degradation to surface water and groundwater can result from release of leachate generated in dumps, heaps, and tailings impoundments. The rate of leachate generation can be minimized by reducing the amount of available water moving through a dump, heap or tailings impoundment. As a result, the action of minimizing infiltration becomes a key performance criterion for dump, heap, and tailings impoundment final cover systems.

The amount of water in soil, or the soil water content, is an important component of a dump, heap or tailings impoundment's overall water balance. It is also important for providing water to plants and for transporting solutes. Evaporation of water from soil, transpiration by plants, movement of water, and the transport of solutes in soil are functionally related to soil water content. Soil water is a dynamic property that varies both spatially and temporally.

Soil water content in dumps, heaps, and tailings impoundments should be measured periodically. Soil moisture measurements are required for modeling flow and for onsite water management.

A number of direct and indirect methods are available to measure soil water content as shown in Table 1. The gravimetric method (direct method) is a standard technique commonly used to collect reference data on soil water content. Indirect methods include: electrical conductivity, capacitance and resistance, neutron thermalization, and gamma ray and neutron attenuation. Of these methods, the ones that appear to have the greatest use and applicability are: gravimetric soil-water content; Time Domain Reflectometry (TDR), manometer and gauge tensiometers (see Figure 1), an electrical capacitance method; and neutron probe (neutron thermalization). Techniques such as TDR or frequency domain capacitors have the advantage of real-time readouts and no radioactive source.

Infiltration performance typically is reported as a flux rate in inches or millimeters of water that has moved downward through the dump, heap or tailings impoundment in a designated period of time (usually 1 year). Infiltration monitoring for covers such as lysimeters or direct measurement soil moisture probes and calculating the flux are both techniques used to establish performance. Infiltration monitoring can also be assessed directly by using leachate collection systems. For dumps, heaps, and tailings impoundments with lysimeters, soil moisture probes or solute collection systems in place, the amount and composition of solute generated can be used as an indicator of the performance of the cover system. Vacuum samplers can be used to obtain pore-liquid samples from up to 6 feet below the ground surface. Pressure-vacuum lysimeters (see Figure 2) are recommended for water sample collection to a depth of 50 feet.

Monitoring Systems – The objectives of field performance monitoring are to:

Develop an understanding for key processes and characteristics that control performance.

Obtain a complete water balance for the cover system put in place.

Develop credibility and confidence with respect to performance of the proposed cover system from a reclamation/closure perspective.

Develop a database to calibrate numerical modeling tools, which can be used to predict long-term cover system performance.

Critical parameters to measure include the net percolation of meteoric water and the ingress of atmospheric oxygen into the underlying waste materials, with meteoric water percolation related to other water balance components as follows:

PERC = delta S + NSI, and NSI = PPT – AET – RO

Where:

PERC is the percolation into the underlying waste material from meteoric water.

Delta S is the change in moisture storage within the cover layers

NSI is the net surface infiltration.

PPT is precipitation.

AET is actual evaporation.

RO is runoff.

Generally, the design and installation of lysimeters to monitor evaporative fluxes as well as net infiltration is well understood and implemented in the soil science discipline. However, the design of lysimeters for dry cover system monitoring programs in the mining industry have usually not included lysimeter design aspects established in the soil science discipline. Mine companies or their consultants should utilize saturated/unsaturated seepage numerical models to design lysimeters installed in the field to ensure they will provide an accurate assessment of net percolation quantitiesunder a variety of precipitation events.

Lysimeters can be installed underneath a cover system as shown in Figure 3, at the down-gradient toe of dumps or heaps or within tailings impoundments. Water collected in a lysimeter is directed toward a monitoring point and measured using a variety of devices such as, porous cup collection, tipping bucket, and pressure transducers.

Soil moisture monitoring can be used to determine moisture content at discrete locations in the cover systems and to evaluate changes over time in horizontal or vertical gradients. Soil moisture is measured using methods to determine relative humidity, soil matrix potential, and resistance. A high soil moisture value indicates that the water content of the cover system is approaching its storage capacity.

Maintaining the effectiveness of the cover system for an extended period of time is another important performance criterion. Short-term and long-term performance monitoring of the final cover system should include settlement effects, erosion or slope failure, and vegetative sustainability.

Criteria for Cover Design Engineering and Placement

The procedures for cover design engineering involve BLM coordination and specialist interaction in all phases of the engineering design and analysis of the final cover. All BLM specialists that deal with resources effected by impacts related to cover designs for dumps, heaps, and tailings impoundments should take an active part in coordinating and participating with the mine operator, contractors, state regulators, federal agencies, environmental entities, and tribal governments.

Procedures involved with placement include oversight and quality assurance by BLM for all material types, quantities and engineering specifications associated with a final cover design, to include performance monitoring system(s).

Risk Assessment - A risk assessment approach may be initiated when all reasonable technologies have been used to reduce environmentally harmful constituents that may reside in soils, drain-down waters, effluents, and sludge.

When contaminants of concern are identified in drain-down or dewatering waters, soils or sludges during reclamation, and that water, soil, or sludge is being proposed for land application, a risk-based management process should be utilized if appropriate. The risk assessment process that should be used is outlined in the Environmental Protection Agency Guidance for Risk Assessment, as well as, other guidance referenced in this policy, such as BLM Management Criteria for Metals at BLM Mining Sites, Technical Note 390, 1996, revised 1999.

The following steps outline the EPA guidance and should be accomplished:

Identify the type of contaminant(s) present and the threat posed to both human and ecological resources.

Assess, through screening the waters, soils, and sludges to determine if site-specific contaminant levels are exceeding State, Federal and other appropriate standards.

If contaminants exceed State, Federal, or other appropriate standards then conduct a risk assessment to determine the associated risk to human and ecological resources.

The risk assessment will determine land application suitability and any additional treatment, redesign, mitigation necessary to ensure human and ecological health and safety.

The risk assessment process will allow the BLM to make an informed decision on land application proposals with regard to reclamation plans.

BLM managers should adhere to the principles listed below when making human and ecological risk management decisions:

The goal is to reduce human and ecological risks to levels that will result in the health and maintenance of the land for multiple use objectives.

Use site specific human and ecological risk data to make informed decisions.

Characterize the site risks.

Communicate the risks to the public.

Monitoring Water Disposal in the Unsaturated and Saturated Zones – The unsaturated zone is the portion of the subsurface above the ground water table. It contains, at least some of the time, air as well as water in the pore space and this water is under pressure that is less than atmospheric pressure. The most basic measurement of the water in an unsaturated medium is the water content or wetness. The water content is commonly defined as the volume of water per bulk volume of medium (soil or rock).

The saturated zone is the zone below the surface of the earth in soil or rock where pore space is filled with water under atmospheric pressure.

When a land application is utilized to discharge and dispose of process and drain-down waters through an engineered system, the performance of the system must be monitored. The monitoring can be conducted by a monitoring point(s) or series of monitoring points, specifically wells, piezometers and lysimeters placed within and down-gradient of the disposal area.

The well(s) should be located in the saturated zone (water table or aquifer), down-gradient of the engineered disposal system, and have enough coverage to account for both horizontal and vertical spatial movement of disposal waters as shown in Figure 4. The well(s) should also be located strategically to identify, measure, and monitor the groundwater system or natural subsurface conditions as shown in Figures 5 and 6. To observe the performance of the engineered water disposal system and confirm efficiency and/or effectiveness, wells should be placed at incremental distances down-gradient from the discharge point(s).

The piezometers and lysimeters should be located within the soil or unsaturated lithology zone to collect any discharge and monitor the discharge process for unsaturated zone characteristics as shown in Figure 7. The piezometers and lysimeters should be placed at varying depths and distances around and away from the engineered system. The collected solute can be used to measure rate of vertical and horizontal movement, attenuation, loading, and water quality.

EPA Information Sheet

The purpose of this information sheet is to summarize Federal requirements affecting groundwater discharges in OR/WA. The information sheet is arranged as a series of questions and answers.

What Defines an Underground Source of Drinking Water?

The Safe Drinking Water Act defines an Underground Source of Drinking Water (USDW) as and ground water containing 10,000 parts per million (ppm) or less total dissolved solid (TDS). However, EPA or a state can determine that water with less than 10,000 ppm TDS is exempted as an underground source of drinking water because of the factors such as: 1) whether or not it is currently a source of drinking water, 2) the economic and technical feasibility of extracting the water, 3) water quality of the aquifer (is it contaminated already, TDS too high to treat most effectively, or minerals or hydrocarbons naturally occur), or 4) subsidence or collapse is likely.

Is there Federal authority to protect an Underground Source of Drinking Water?

The Federal Safe Drinking Water Act (SDWA) Section 1431 gives EPA the authority to protect underground sources of drinking water. SDWA Section 1431 states that EPA can stop any activity which may cause an imminent and substantial endangerment to an underground source of drinking water.

Does the Underground Injection Control Program Apply to the Groundwater Infiltration Basin or Leach Field?

The Underground Injection Control (UIC) program was established under the Safe Drinking Water Act to protect ground water supplies. UIC program regulates the subsurface injection of waste fluids below, into and above underground sources of drinking water. Injection includes seeping, flowing, leaching and pumping with or without pressure. An injection well is a bored, drilled or driven shaft whose depth is greater than the largest surface dimension; or, a dug hole whose depth is greater than the largest surface dimension; or, an improved sinkhole; or subsurface fluid distribution system (an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute fluids below the surface of the ground). These are the new rules, effective April, 2000. OR/WA regulations currently do not include the subsurface fluid distribution system part, although leach fields, per NDEP policy, are considered injection wells.

The federal regulations are located at 40 CFR Part 144-147. There are five well classes:

Class I: Deep wells injecting below the lowermost USDW. Permit required.

Class II: Wells used for oil and gas production. Permit required.

Class III: Wells which inject fluids used mineral extraction. Permit required.

Class IV: Wells which inject hazardous or radioactive waste into or above a USDW.

Prohibited except as a part of a CERCLA or RCRA clean-up action.

Class V: Shallow wells that discharge into or above a USDW. These wells are currently authorized by rule, however all wells must 1) be inventoried and 2) cannot endanger a USDW. examples of Class V wells: dry wells collecting surface water runoff, automotive disposal wells, and septic tanks which accept industrial waste. A new Class V Rule was promulgated in December 1999, but only affects cesspools and automotive waste disposal wells. This rule added the new definition, and ties these well types to SWAP areas and sensitive ground water protection areas.

Percolation ponds are not covered by the federal UTC program because they do not fit the definition of injection well. Leach fields for drainage from a closed heap leach facility are currently not regulated under any of the five classes in the UIC program. However a facility would be covered under SDWA 1421 if it is endangering an underground source of drinking water.

What will EPA look for in NEPA reviews for Closing Gold Heap Leach Facilities?

Post-closure toxins mobility and acid generation may remain a problem for years the heap and subsequently in the heap drainage going out to an underground leach field. Some of the quest- ions to ask when evaluating the chemical constituents of the water that will be discharged are:

Look at the sulfide content of ore and spent ore. How was the geochemistry done? Were static or kinetic tests conducted?

What are the performance standards for closure? What would be the requirements if the heap leach pile drainage were placed in percolation ponds if it is toxic?

What is the geochemistry, structure, and hyrogeology of the substrate/rock under the heap leach pile drainage leach field?

What is the fate and transport capability of each contaminant in the drainage water?

What is the chemical composition of the solution remaining in the heap leach pile after the rinsing process to get below 0.2 mg/l CN in the residual solution? Will metals and other harmful contaminants become more concentrated in heaps over time?

Over what period of time will salts in the heap leach pile be discharged to the leach field? How does the chemical composition of heap leach pile drainage vary over time? Do salts and metals accumulate in holding ponds and move down through substrate in increasing amounts?

Look at heap cover design, vegetation, and climatic factors. Does it preclude meteoric water from moving down through closed heap? Is it dependent upon vegetation for that function? How will increasing salinity and climate change impact water movement in the heap? How will vegetation be reestablished as needed?

Look at the success criteria for reclamation/revegetation. How will integrity of cover be maintained?

Should lime or other neutralizing agent be added to heap cover to neutralize meteoric water?

What is the monitoring program for closure and post-closure leach field discharges to enable close tracking of water chemistry of changes and to evaluate the need for interventions?

Closure monitoring should continue through at least one rest period (or dry season) and wet season after the water meets all standards to check for upward trends or spikes in contaminant concentrations.

Are the leach fields or wetlands going to receive heap leach pile drainage forever, or is there some period after which the leach fields will not longer be necessary?

Have run-on and runoff controls for closed heap piles been evaluated to reduce the infiltration of water into heap and erosion of cover?

Are there contingency plans for large storm events, catastrophic failures of heaps infiltration rates too slow, etc.? What if high salinity or dry periods kill wetland vegetation? How will vegetation type conversion to annual weeds be prevented? How will fences be monitored and maintained?

Will post-closure passive or active maintenance be needed?

Are there bonds for closure, reclamation, and post-closure activities for the heap leach piles and the heap leach pile drainage leach field?

Does closure meet post-mining land uses?

Where are drinking water wells, agricultural wells, and surface water bodies in the project vicinity? How could seepage from the project affect these wells and water bodies?

Will seasonal changes affect the heap each drainage capacity or effectiveness?

How are the closed facilities treated by regulatory agencies? Are they industrial facilities?

In addition, wetlands are vulnerable to dry periods which may kill the wetland vegetation, to tree invasion which may compromise liners, and to long-term spontaneous liner failure, that may go undetected.