3.0 ENGINEERING AND PRELIMINARY DESIGN

3.1 SUMMARY OF PRELIMINARY DESIGN

The design for the BCR is a modification of Option B, which was described in the Big Creek Repository Conceptual Design Alternatives Technical Memorandum. The final design includes the following modifications to Option B.

- Slimes dewatering, which was considered as a means to increase the repository capacity and stability, will not be conducted. Instead, phased waste placement will be used to provide for repository stability.
- Clean soil will be used in the surface layer (top 6 inches) of the entire final cover.
- Existing cover soil will not be removed.

The BCR will have a footprint area of approximately 15 acres and an estimated available capacity of 250,000 cubic yards. The anticipated operating life of the repository is about 10 years. The primary function of the BCR will be disposal of contaminated yard soil. Based on assumptions used in the ROD, approximately 140,000 cubic yards of waste will be generated by yard soil removals.[1] Therefore, the available capacity of the BCR is anticipated to be adequate for disposal of all contaminated soil generated by yard cleanups in the Basin, if required. Disposal of other mining-related contaminated soil and sediment that meets the waste acceptance criteria may also be conducted at the BCR.

The repository design is an attempt to maximize available volume without incurring additional site costs to remove or modify slimes in the north portion of the site, or costs to relocate or raise the 115 kV overhead electrical transmission lines. However, current plans call for the rerouting of the 13 kV electrical distribution line. The design can be summarized as follows:

- Estimated capacity of 250,000 cubic yards
- Final cover system will be 2 feet thick and include a 6-inch thick clean soil surface layer; the cover will be designed to limit percolation to a maximum of 4 inches per year
- Phased waste placement will be used to provide for repository stability
- Existing 13 kV overhead electrical line will be relocated; 115 kV electrical transmission lines and the natural gas pipeline remain without modification
- Maximize surface area of relatively flat, 3 percent upper slope portion of waste cells

[1] In the ROD, it is assumed yard removals will be conducted at 907 properties, with 150 cubic yards of soil removed per property.

- 3H:1V exterior sides slopes to promote runoff
- Additional armor material will be placed on the bank of Big Creek in the "critical reach" for erosion protection
- Administrative and decontamination areas located in southern portion of site
- Site access from the south
- The final land use will be open space with the final designation being developed in conjunction with Shoshone County, as the site nears completion.

The design of the BCR is summarized in Table 3-1. A plan view of the repository is shown in Figure 3-1. A cross section of the repository showing the anticipated final surface elevations is shown in Figure 3-2.

3.2 HYDROLOGIC MODELING

The repository design was developed with consideration of the results of hydrologic modeling of water percolation through the repository. The modeling was conducted using the industry-standard Hydrologic Evaluation of Landfill Performance (HELP) Model, Version 3.07. Controlling percolation is important to enhance the stability of the low-shear-strength slimes and limit impacts to groundwater.

The HELP model was used to estimate the percentage of precipitation falling on the repository surface that will percolate into the alluvial aquifer under existing conditions and after placement of waste and construction of a final cover. Several scenarios were evaluated using the HELP model, and the results are documented in the Big Creek Repository Conceptual Design Alternatives Technical Memorandum (March 26, 2002). For a 2-foot-thick soil cover with a hydraulic conductivity of 10^{-5} centimeters per second (cm/sec), the model indicates the amount of precipitation falling on the repository that percolates to the alluvial aquifer may be reduced to approximately 13.5 percent of the annual average precipitation of 32.49, or 4.4 inches per year of percolation (a reduction of 60% compared to existing conditions). Although not quantified, consolidation of the slimes following waste placement should further reduce percolation of precipitation to the alluvial aquifer. The HELP model results are summarized in Table 3-2.

In addition, site-specific contaminant transport modeling was conducted to confirm that no unacceptable adverse impacts would result to adjacent surface water and groundwater. The contaminant transport modeling, which is described in Appendix B of the DAR, predicted groundwater would not be impacted within the foreseeable future with a cover performance standard of 4 inches of percolation per year.

3.3 ENGINEERING CONSIDERATIONS

3.3.1 Stability of Tailings Pond

The repository will be constructed on top of an existing tailings pond that contains low-shear-strength tailings ("slimes"). As the weight of additional fill is added, pore water will slowly drain from the slimes, resulting in increased shear strength of the slimes. If fill is added too rapidly, the pore water may not have adequate time to drain, and the additional weight of the fill could cause slope failure. Because of the potential for slope failure, the repository will be loaded slowly using a phased filling procedure that allows the slimes to develop strength. In addition, pore water pressures and settlement will be monitored throughout the operating life of the repository. These additional data will verify that the repository is being fill in a safe manner. A geotechnical analysis of the stability of the BCR concluded that, if the site is loaded and capped properly, the repository will be stable during filling and after placement of the final cover. The stability analysis is documented in Appendix F of the DAR.

The phased filling procedure is designed to address concerns about the stability of low shear strength slimes in the northern portion of the site. An initial surcharge berm of waste soil will be placed along the top of the existing north, west, and east tailings pond slopes. Subsequent filling will build the berm progressively toward the center, until a uniform thickness of waste has been placed. In this manner, shear strength will be developed in the slimes and increase the factor of safety against slope failure.

3.3.2 Overhead Electrical Power Lines and Natural Gas Pipeline

The design height of the repository is restricted by two 115 kV and one 13 kV overhead electrical power lines that cross the site. The southern most 115 kV power line is located approximately 200 feet north of the south toe of the low-level cell. The 13 kV power line and the northernmost 115kV power line are located approximately 300 feet and 250 feet south of the tailings pond north dam wall, respectively.

Under the current design, the alignment and height above existing grade of the 115 kV lines will not be modified. However, the 13 kV lines will be moved. If at some future date the State and the EPA feel the cost to move the 115 kV lines to accommodate expansion of the BCR is warranted, they may also be moved. Nonetheless, the current plan will restrict the height of the BCR in the locations near the power line, primarily for safety reasons. The height of the repository will be restricted to provide a minimum clearance of 30 feet, measured from finished grade. It may be necessary to restrict the size and operation of equipment during construction and waste placement to provide adequate clearance to these power lines. Construction will always follow OSHA requirements for work under a high voltage power line.

A natural gas pipeline runs parallel to the south toe of the BCR. This 6-inch-diameter pipeline is pressurized at 200 pounds per square inch (psi) and may be exposed in the channel of Big Creek. In addition, the pipeline may not be covered with fill. The precise location of the pipeline will be determined during the repository design phase, and appropriate measures will be included in the

design and operation of the repository to limit the potential for damage to the pipeline. The BCR will not be expanded to the south and will have no impact on the pipeline.

3.3.3 Bank Erosion

Flooding of Big Creek in 1997 eroded a portion of the southwest corner of the tailings pond. Sunshine repaired this damage. The potential exists for future damage to the south and west embankments due to significant flood events. Therefore, an erosion control plan will be implemented in 2004 to protect the BCR along the "critical reach" of Big Creek. The location of the "critical reach" is shown in Figure 3-1. The hydrologic analysis of Big Creek is documented in Appendix D of the DAR.

The potential for impacts from flooding of the South Fork Coeur d'Alene River are expected to be limited to backwater ponding within Big Creek, which is not expected to result in erosion of the repository side slopes. The top of bank elevation of the South Fork at its confluence with Big Creek (approximately 2,405 feet) is lower than the existing elevation of the repository slope toe adjacent to Big Creek (2,411 feet). The repository would be further protected from South Fork flood water by the presence of the former railroad embankment.

3.3.4 Liner and Leachate Collection System

An engineered liner and leachate collection system will not be required beneath waste material placed in the BCR for several reasons:

- Based on contaminant transport modeling (Appendix B or the DAR), the 4-inch percolation performance standard will reduce percolation by 60 percent or more and will be adequate to control offsite discharges to groundwater or surface water
- Based on laboratory testing, the "slimes" underlying the repository have a hydraulic conductivity of approximately 3×10^{-6} cm/sec, which will be further reduced due to consolidation of the slimes
- Groundwater beneath the site is already impacted and not expected to further degrade over time as a result of waste placement, based on contaminant transport modeling
- There are no current or anticipated future alluvial groundwater users
- Highly concentrated principal threat material (e.g., metal concentrates) will not be disposed of in the BCR (see Section 5.5)

3.3.5 Slope Configurations

To maximize repository volume beneath the cover system, the BCR will be designed with steeper side slopes and a relatively flat top slope. Side slopes will not exceed 3H:1V, and top

slopes will be 3 percent. The slope configurations have been designed to be stable, reduce erosion and percolation, limit human health risks, and have low long-term O&M requirements.

3.4 COVER DESIGN

Facility closure will include construction of a cover over waste placement areas. The cover will be designed to reduce erosion and percolation, limit human health risks, protect beneficial uses of Big Creek, and have low long-term O&M requirements. The final cover system will consist of a 2-foot compacted soil layer that will permit not more than 4 inches of percolation per year to the alluvial aquifer. The final cover system (i.e., soil and vegetation) will be optimized to maximize evapotranspiration and minimize percolation. Special materials and/or a geosynthetic layer may also be used as part of the final cover system to further reduce percolation, if necessary.

The 2-foot soil layer will consist of a minimum 6-inch topsoil layer and an 18-inch select fill layer that will meet specific requirements for organic content, pH, and texture (i.e., grain size) in order to support vegetative growth. The 6-inch topsoil layer will meet criteria for "clean fill" as defined by contaminant concentrations that are <100 mg/kg lead, <100 mg/kg zinc, <100 mg/kg arsenic, <5 mg/kg cadmium, and <5 mg/kg antimony. The 18-inch select fill layer will not contain more than 1000 mg/kg lead (this should permit a wider range of source areas for final cover material, including some material segregated from incoming waste streams, while not compromising the integrity of waste containment in the repository).

Topsoil will receive a suitable seed mix that will result in appropriate vegetative cover. The plant species selected should provide protection from erosion, not be an attractant to ungulate wildlife species, and be stable and capable of regeneration while minimizing long-term maintenance requirements. Shrubs and trees should not be planted unless they are incorporated into the function of the final cover design.

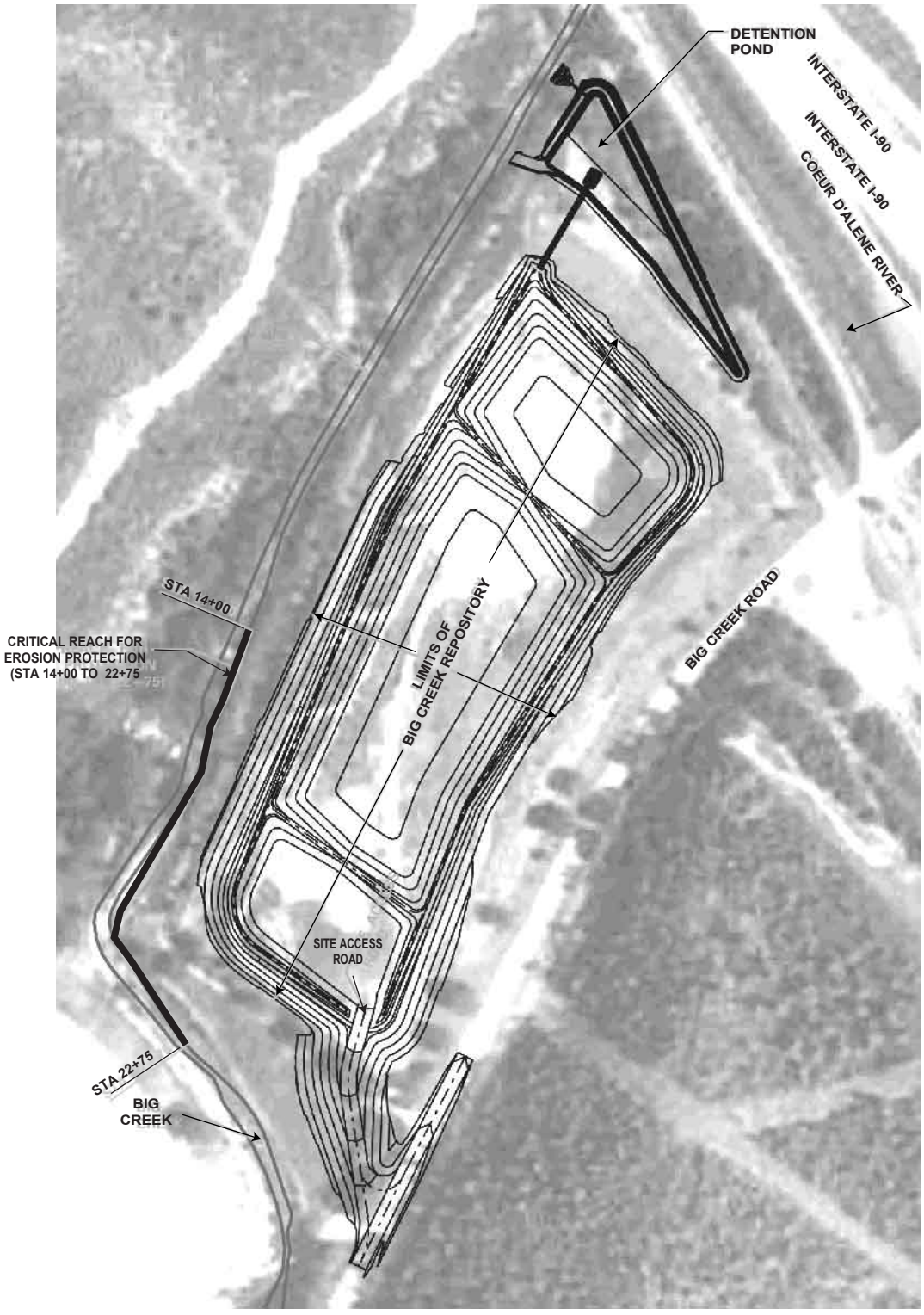
The percolation performance standard (maximum of 4 inches per year) was selected considering the results of contaminant transport modeling and other evaluations, which is documented in Appendix B of the Big Creek Repository Design Analysis Report. The transport modeling evaluated the potential for waste materials placed in the repository to impact groundwater and surface water. At this maximum percolation rate, modeling indicates that metals (antimony, arsenic, cadmium, lead, and zinc) leached from waste materials placed in the repository would not impact groundwater or surface water at concentrations exceeding surface water quality standards within the foreseeable future. HELP modeling indicates the percolation performance standard could be achieved by a 2-foot cover with a hydraulic conductivity of 10^{-5} cm/sec to 10^{-6} cm/sec. Appendix B of the DAR contains an additional evaluation performed by IDEQ of options for achieving the 4-inch percolation performance standard using a soil cover system.

3.5 STORM WATER MANAGEMENT SYSTEM

A storm water management system is necessary to collect and control runoff during storm events, prevent the erosion of cover material, provide stability for all hydraulic conveyance structures, and limit impacts to water quality in Big Creek. Storm water management is described in Section 6.1 of the DAR and Appendix B of the Operations Plan. Runoff from the facility will be directed into a detention pond for removal of suspended solids prior to discharge from the site. Because site conditions prohibit sizing the detention pond to contain the entire expected 100-year runoff volume, the detention pond will be sized to contain the excess runoff compared to pre-project conditions that would be generated during a 100-year storm event. The 100-year storm is defined as the precipitation event for which there is an estimated probability of occurrence of 1% each year. The capacity of the detention pond will be approximately 2.4 acre-feet, which will contain approximately 58% of the expected 100-year runoff volume (see Appendix C of the DAR for details). Any runoff that could not be contained would be discharged to Big Creek through a low-level outlet pipe and an overflow spillway. The pond location is shown in Figure 3-1.

The critical period for runoff control is during filling of the repository, prior to placement of the final cover, because waste materials may be exposed to erosion. The repository contractor will be required to develop a work plan for controlling runoff. Best management practices (BMPs) will be implemented to limit erosion and offsite transport of waste materials, including channelization of runoff, use of geosynthetic erosion control materials and silt fences, placement of temporary cover soils, and revegetation. The final repository cover includes a surface layer of clean, vegetated soil, which will limit the potential impacts to water quality in Big Creek from runoff water after closure of the repository.

33754181-61A



N

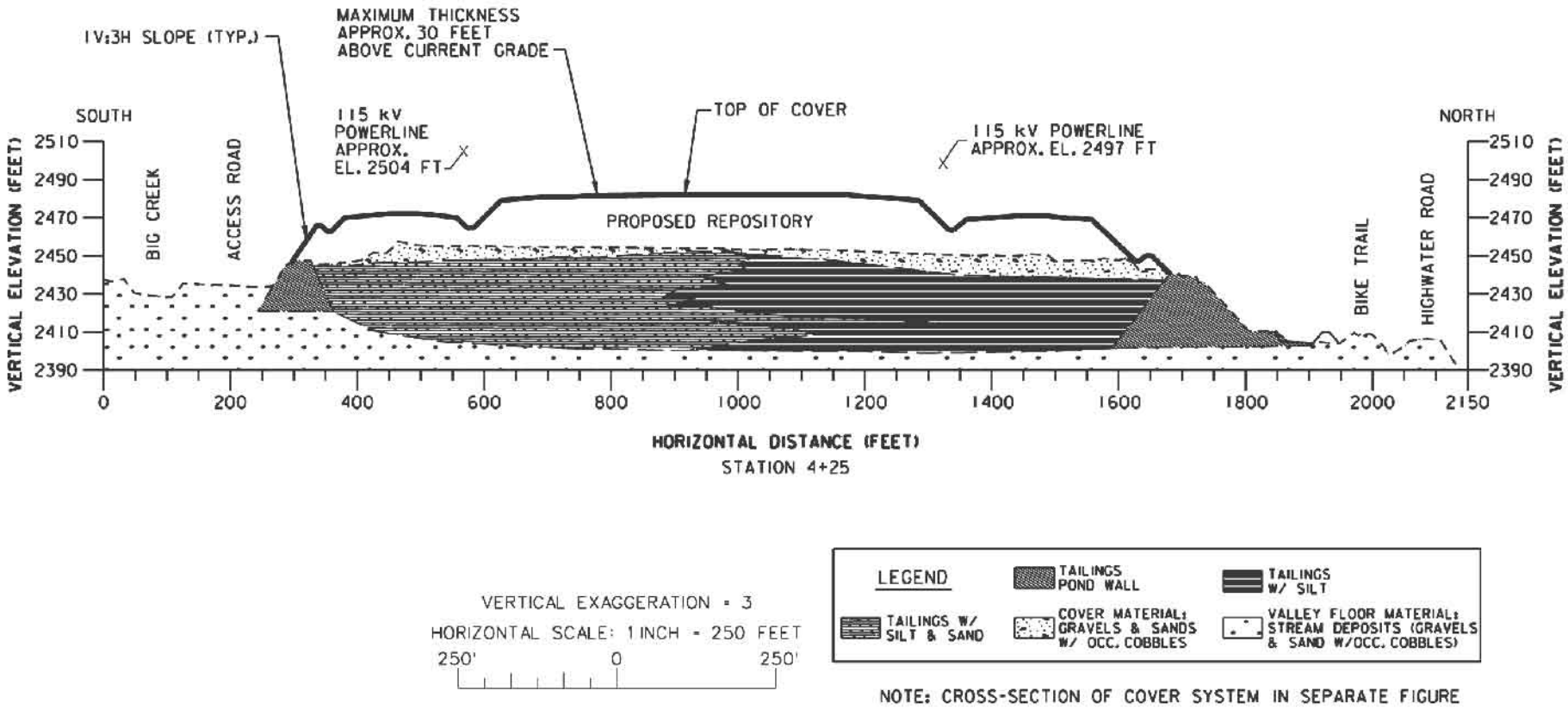
0 300

Approximate Scale In Feet

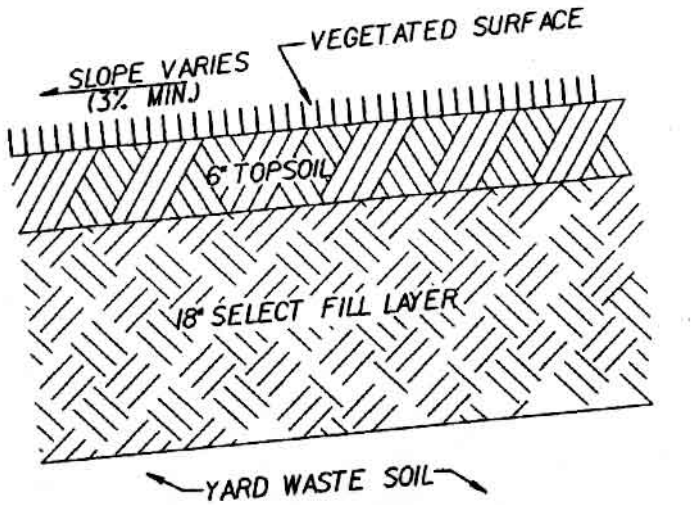
Date of Areial Photo: August 6, 1975

EPA REGION 10	Coeur d'Alene Basin BIG CREEK REPOSITORY	Doc. Control: 4162500.07168.05.a EPA No. 18.4	**Figure 3-1** **Site Plan**

3375418-61B



EPA REGION 10	Coeur d'Alene Basin BIG CREEK REPOSITORY	Doc. Control: 4162500.07168.05.a EPA No. 18.4	**Figure 3-2** **Repository Cross Section**



Notes:

1. The final cover system will be comprised of a two-foot compacted soil layer that will permit not more than 4 inches of percolation per year. These are minimum requirements. The final cover system (i.e., soil and vegetation) will be optimized to maximize evapotranspiration and minimize percolation. Special materials and/or a geosynthetic layer may also be used as part of the final cover system to further reduce percolation, if necessary.

2. The two-foot soil layer will be comprised of a 6-inch topsoil layer (minimum) and an 18-inch select fill layer that shall meet specific requirements for organic content, pH, and texture (i.e., grain size) in order to support vegetative growth.

3. The 6-inch topsoil layer will meet criteria for “clean fill” as defined by contaminant concentrations that are <100 mg/kg lead, <100 mg/kg zinc, <100 mg/kg arsenic, <5 mg/kg cadmium, and <5 mg/kg antimony. The 18-inch select fill layer shall not have contaminant concentrations that exceed 1000 mg/kg lead (this should permit a wider range of source areas for final capping material, including some material segregated from incoming waste streams, while not compromising the integrity of waste containment in the repository).

4. Topsoil shall receive a suitable seed mix that will result in appropriate vegetative cover. The plant species selected should provide protection from erosion; not be an attractant to ungulate wildlife species; and be stable and capable of regeneration while minimizing long-term maintenance requirements. Shrubs and trees should not be planted unless they are incorporated into the function of the final cover design.

Table 3-1
Summary of Repository Design

Design Component	Description
Property owner	State of Idaho has acquired the property from Sunshine Precious Metals, Inc.
Current site use	Not currently used -- former tailings pond
Capacity	Approximately 250,000 cubic yards
Total repository footprint area	Approximately 22 acres
Area of waste placement	Approximately 15 acres
Expected operating life	Approximately 10 years
Transportation corridors	Access via Big Creek Road, approximately 0.25 mile south of I-90
Utilities	Overhead electrical power lines and natural gas pipeline. 30 feet clearance will be provided for overhead power lines. 13 kV line will be raised; 115 kV lines will not be relocated. Natural gas pipeline is adjacent to southern boundary of site and will not be disturbed.
Final cover system	2 feet thick, including a 6-inch thick clean soil surface layer; the cover will be designed to limit percolation to a maximum of 4 inches per year
Sideslope erosion protection	Additional armoring will be provided within the "critical reach" to limit potential for erosion of tailings pond side slopes by Big Creek
Storm water management system	Designed for excess runoff compared to pre-project conditions resulting from peak 100-year, 24-hour precipitation event.

Table 3-2
Summary of HELP Modeling

Area	Estimated Percentage of Precipitation[1] that will Percolate to Alluvial Aquifer	
	Existing Conditions (no cover soil)	**2' Cover Soil ($K=10^{-5}$ cm/sec)**
North	39.0%	12.9%
Central	36.6%	13.0%
South	20.6%	14.6%
Average	32%	13%
Reduction Compared to Existing Conditions	Not applicable	60%

Notes
[1] Average annual precipitation = 32.5 inches
HELP = Hydrologic Evaluation of Landfill Performance
K = hydraulic conductivity
cm/sec = centimeters per second