Final

Smoky Canyon Mine
Pole Canyon Overburden Disposal Area
Early Action

Engineering Evaluation/Cost Analysis

J.R. Simplot Company

April 2012

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LIST OF ACRONYMS/ABBREVIATIONS

AMSL	Above Mean Sea Level
ARARs	Applicable and/or Relevant and Appropriate Requirements
BLM	Bureau of Land Management
BMP	Best Management Practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
C.F.R.	Code of Federal Regulations
COPCs	Contaminants of Potential Concern
CVF	Cross Valley Fill
CWA	Clean Water Act
DSR	Data Summary Report
EE/CA	Engineering Evaluation/Cost Analysis
EIS	Environmental Impact Statement
ET	Evapotranspiration
IDEQ	State of Idaho Department of Environmental Quality
GCLL	Geosynthetic Clay Laminate Layer
GM	Geomembrane
HELP	Hydrologic Evaluation of Landfill Performance
ICs	Institutional Controls
MCLs	Maximum Contaminant Levels
NCP	National Contingency Plan
NFS	National Forest System
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NTCRA	Non-Time Critical Removal Action
ODA	Overburden Disposal Area
O&M	Operations and Maintenance
PRSC	Post Removal Site Control
PVC	Polyvinyl Chloride
RAIWP	Removal Action Implementation Work Plan
RAOs	Removal Action Objectives
RDR	Removal Design Report
RI/FS	Remedial Investigation/Feasibility Study

SARA	Superfund Amendments and Reauthorization Act
SEIS	Supplemental Environmental Impact Statement
SI	Site Investigation
SRE	Streamlined Risk Evaluation
TBC	To-Be-Considered
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Department of Agriculture Forest Service
USFWS	U.S. Fish and Wildlife Service
VDM	Visual Delineation Method

EXECUTIVE SUMMARY

The J.R. Simplot Company prepared this Engineering Evaluation/Cost Analysis (EE/CA) to identify and evaluate Non-Time-Critical Removal Action (NTCRA) alternatives for addressing conditions at the Pole Canyon Overburden Disposal Area (ODA) at the Smoky Canyon Mine.

Brief Discussion of the Early Action Site

The Pole Canyon ODA is a 120-acre cross-valley fill containing approximately 26 million cubic yards of material. The ODA is delineated by the physical presence of overburden from historical mining operations as well as drainage features that direct water toward Pole Canyon Creek.

The Pole Canyon ODA was subject to a previous NTCRA ("2008 NTCRA"), which focused on reducing water inflow to the ODA from Pole Canyon Creek and run-on from the adjacent hillside. The 2008 NTCRA is estimated to have reduced water inflow to the ODA by 94%. This has resulted in the reduction of selenium concentrations in the downstream portion of Pole Canyon Creek (downstream of the diversion pipe discharge) from approximately 1.5 mg/L to undetected at 0.001 mg/L.

The 2008 NTCRA did not address infiltration into the ODA from direct precipitation and snowmelt, or risks due to the potential for ingestion of ODA surface materials or associated vegetation containing elevated contaminant concentrations.

Threat Posed By the Pole Canyon ODA

The streamlined risk evaluation contained in this EE/CA includes comparison of measured selenium concentrations in source media (i.e., ODA materials and vegetation growing on the ODA) with applicable risk-based screening-level benchmarks. Based on these comparisons, the streamlined risk evaluation concludes that:

- Selenium concentrations in downgradient groundwater and in surface water emanating from the toe of the ODA contain selenium at concentrations above risk-based screening-level benchmarks for human receptors (surface water and groundwater) and ecological receptors (surface water).

- Selenium concentrations are above ecological screening-level benchmarks in vegetation (e.g., the hyper accumulators) and in ODA materials. Therefore, depending on exposure, potential risk to domestic livestock and wildlife may exist through the ingestion pathway (for vegetation and ODA materials).

- Selenium concentrations are above human health screening-level benchmarks in ODA materials. Therefore, depending on exposure, potential risk to human health may exist through the ingestion and direct contact pathways (for ODA materials).

- Human health screening-level benchmarks are not available for vegetation; however, based on the occurrence of elevated selenium concentrations in ODA materials, potential risk to human health may exist through the vegetation ingestion pathway.

Based on the potential risks identified in the streamlined risk evaluation, a NTCRA at the Pole Canyon ODA is warranted. Additionally, 40 C.F.R. 300.415(b)(2) lists the removal action factors (factors i, ii, iv, and v) that justify a Removal Action at the ODA.

Scope and Objective of the NTCRA

The following are the Removal Action Objectives for the NTCRA:

- Reduce or eliminate the amount of water that infiltrates into the ODA due to direct precipitation.

- Reduce or eliminate the potential for ecological risk due to ingestion of vegetation on the ODA.

- Reduce or eliminate the potential for risk to human receptors due to ingestion of vegetation, and ingestion of and direct contact with ODA materials.

- Eliminate the release of COPCs from the ODA through sediment transport.

Four NTCRA alternatives were developed for the Pole Canyon ODA:

- Alternative 1: No Further Action

- Alternative 2: A cover of 1 foot of Dinwoody over a minimum 4 feet of chert/limestone cover

- Alternative 3: A cover of 3 feet of Dinwoody over a minimum 2 feet of chert/limestone cover

- Alternative 4: Geosynthetic Cover System

Per U.S. Environmental Protection Agency guidance, the criteria used to evaluate the NTCRA alternatives included: effectiveness, implementability, and cost.

Recommended Alternative

Based on the comparative analysis, Alternative 3 is the preferred NTCRA alternative for the Pole Canyon ODA. Alternative 3 includes minor grading of the ODA, placement of a 2-foot-thick chert/limestone cover with a 3-foot-thick Dinwoody cover, installation of stormwater runoff controls, and revegetation with non-selenium-accumulating species. A unique window of opportunity currently exists at Smoky Canyon Mine regarding the availability of Dinwoody material. Dinwoody material is not present at all phosphate mines in southeastern Idaho, or if present, it may be in limited quantities. Also, the proposed use of Dinwoody material as an infiltration reduction cover material for the NTCRA would utilize the same cover concept (while the specific cover design is different, the concept is the same) as that approved for on-going mining in the Record of Decision for the Smoky Canyon Mine Panel F.

Alternative 3 meets all of the Removal Action Objectives. It is predicted to reduce infiltration significantly (reduction of 78% compared to current conditions) due to the vegetated cover and surface water run-on/runoff controls. As discussed above, the 2008 NTCRA has already reduced water inflow to the ODA by 94%. The additional 78% reduction predicted for Alternative 3 would reduce the water inflow by a total of 98.7% compared to the pre-2008 NTCRA conditions (i.e. 78% of the 6% remaining after the 2008 NTCRA). The 5-foot-thick cover[1] will prevent the potential for direct contact with ODA materials and the potential for uptake of selenium by plants.

Alternative 3 will be protective of human health and the environment. Additionally, it will meet the action- and location-specific applicable and/or relevant and appropriate requirements (ARARs) and will contribute toward meeting the chemical-specific ARARs. This alternative is effective in both the long- and short-term, and would not be inconsistent with the long-term remedy to be developed for the Site as a result of the Remedial Investigation/Feasibility Study process. However, it may be necessary to augment the NTCRA with additional response actions in the future as a result of information from the Remedial Investigation/Feasibility Study and/or performance monitoring. Alternative 3 is implementable from both a technical and administrative standpoint, and is the most cost-effective alternative for reducing infiltration and release of selenium and other contaminants of potential concern.

[1] Some areas of the cover may be thicker than 5 feet because additional chert/limestone may be utilized during re-grading to achieve a 3:1 slope in portions of the ODA. This could result in an additional thickness of chert/limestone on certain portions of the ODA. An average of 2 feet of chert/limestone will be placed over the entire ODA.

1.0 INTRODUCTION

The J.R. Simplot Company (Simplot) has prepared this Engineering Evaluation/Cost Analysis (EE/CA) to identify a potential Early Action to address conditions at Pole Canyon Overburden Disposal Area (ODA) at the Smoky Canyon Phosphate Mine (Mine or Site), in Caribou County, Idaho (Figure 1-1), within the Southeast Idaho Phosphate Mining Resource Area. The mine is located approximately 24 miles due east of Soda Springs, Idaho and is accessed by traveling approximately 15 miles generally west from Afton, Wyoming.

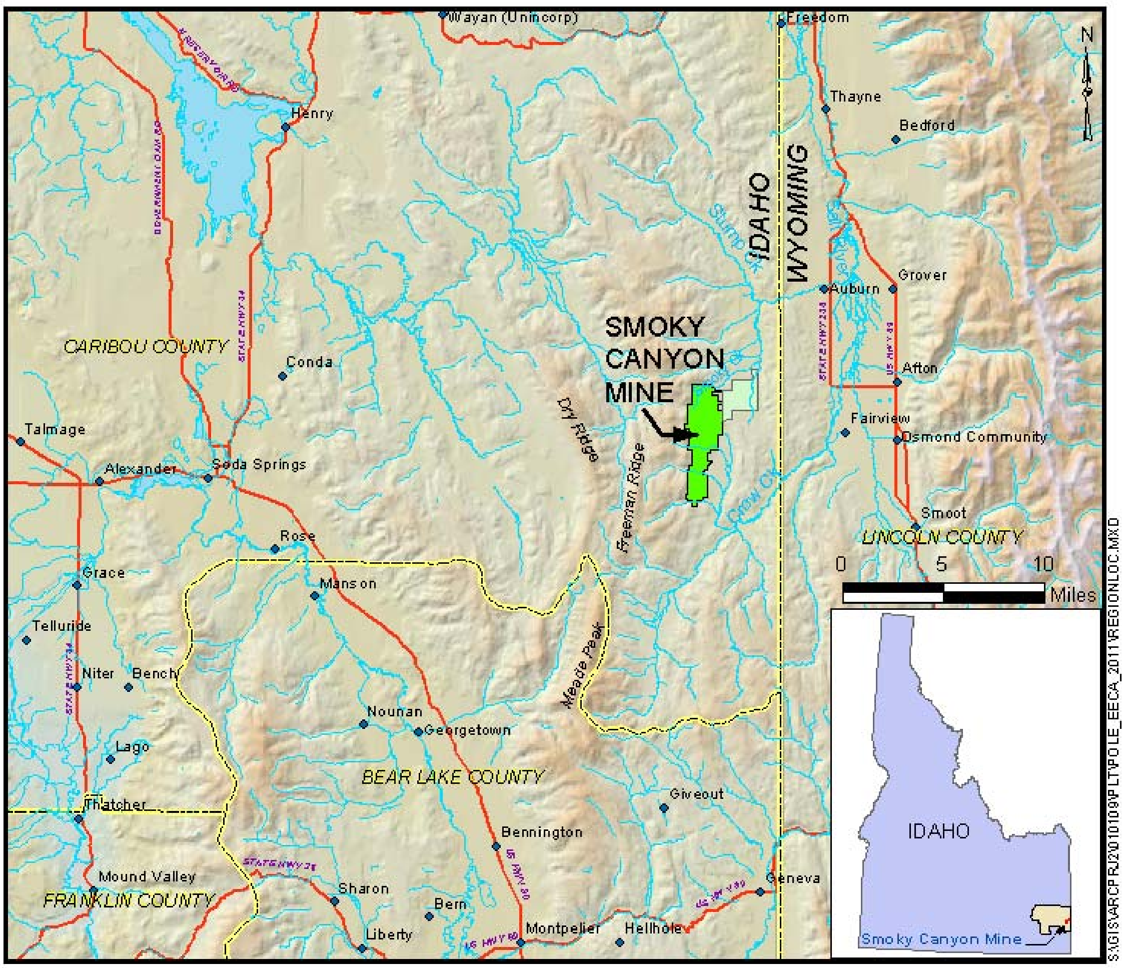


Figure 1-1: Location of the Smoky Canyon Mine

The Site is the subject of an Administrative Settlement Agreement and Order on Consent/Consent Order for Remedial Investigation/Feasibility Study (RI/FS; Settlement Agreement/CO) entered into by Simplot, the U.S. Department of Agriculture Forest Service (USFS), the U.S. Environmental Protection Agency (USEPA), and the State of Idaho

Department of Environmental Quality (IDEQ) (USFS, USEPA, and IDEQ, 2009). The RI is on-going and an Early Action has been identified as appropriate for the Pole Canyon ODA to address additional pathways for the release or threatened release of hazardous substances (USFS, 2011a).

The Pole Canyon ODA is a cross valley fill (CVF) comprised of seleniferous waste rock that covers a portion of Pole Canyon Creek (Figure 1-2). The Pole Canyon Creek watershed above the ODA is approximately 1,100 acres. Before the ODA was constructed, a significant portion of Pole Canyon Creek flow was lost to the underlying bedrock where the creek crossed the permeable Wells Formation (Ralston, 1979).

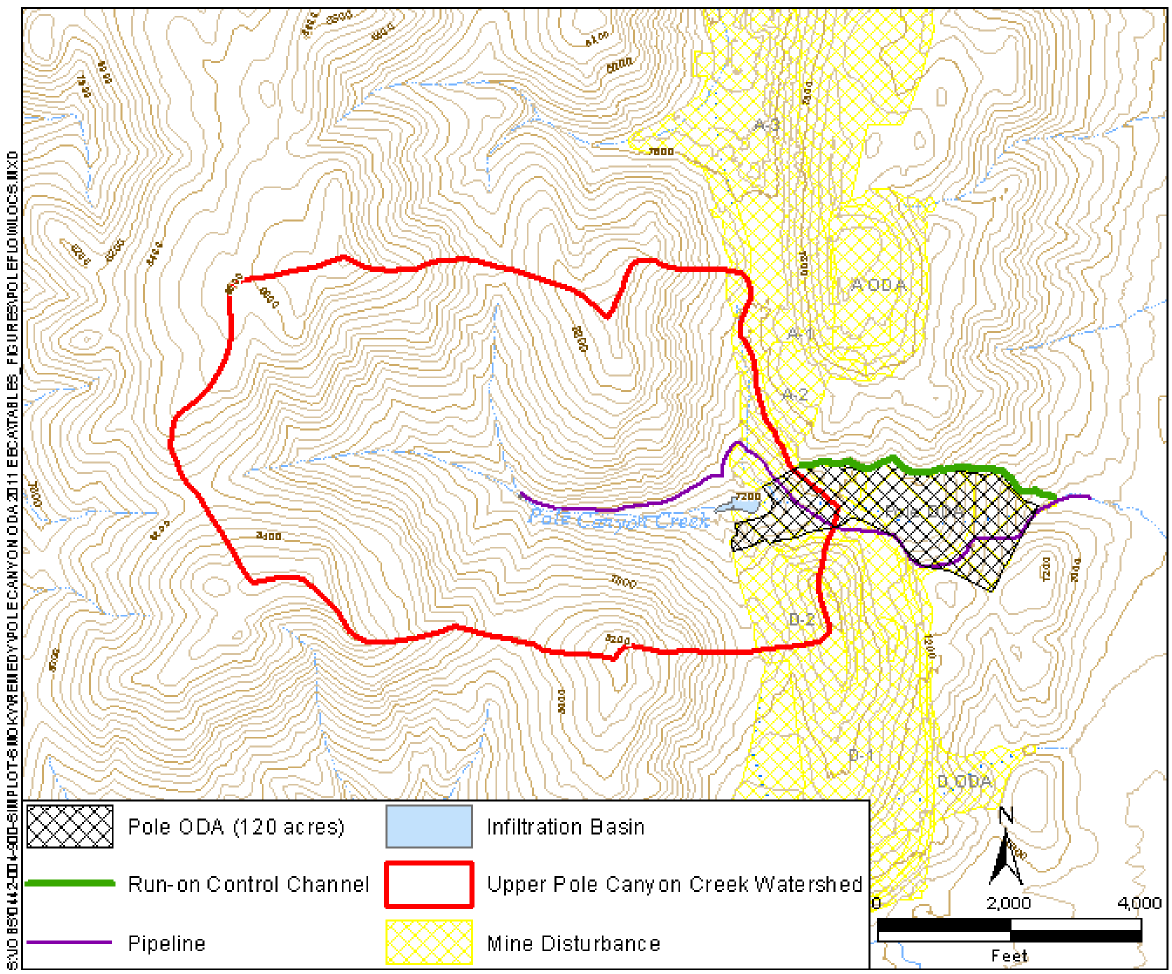


Figure 1-2: Upper Pole Canyon Creek Watershed and 2008 NTCRA Components

Upon construction of the ODA in Pole Canyon, Pole Canyon Creek water entered the upstream side of the ODA and then was either lost to Wells Formation bedrock and alluvial deposits beneath the ODA or discharged at the downstream end, or toe, of the ODA. During the relatively dry months from late summer through early spring, most of the creek flow was lost under the ODA. Any creek water that did emerge from the ODA was quickly lost to alluvial deposits before the creek crossed Sage Valley. During the fall of very dry years, all Pole Canyon Creek flow was lost below the ODA, with no flow emanating at the toe of the ODA. During typical spring runoff (i.e., high-flow) conditions, discharge from the toe of the ODA flowed into Sage Valley where it was still lost to alluvial deposits; occasionally however, a portion of the creek discharge from the ODA flowed across Sage Valley to eventually join with the north fork of Sage Creek. Selenium concentrations in the water discharged from the toe of the ODA were typically in the range of 0.5 to 2 mg/L.

To reduce the water flow into the Pole Canyon ODA, Simplot completed a Non-Time-Critical Removal Action (NTCRA termed "2008 NTCRA" in this report, because construction was completed in 2008) in accordance with the October 2006 Settlement Agreement (USFS, USEPA, and IDEQ, 2006).

The key element of the 2008 NTCRA was the routing of Pole Canyon Creek around the ODA via a diversion pipeline. The pipeline was completed in September 2007 and has remained operational since completion. A second element, the infiltration basin, was also completed in 2007. The infiltration basin was designed to capture the portion of Pole Canyon Creek water that is not diverted into the pipeline and direct that water into the Wells Formation aquifer on the upstream side of the ODA. A third element of the 2008 NTCRA, the run-on control channel, was constructed and completed in late 2008. The channel was designed to divert run-on from the adjacent hillside and convey it to Pole Canyon Creek below the ODA. The locations of these components are shown on Figure 1-2. The predicted long-term effect of the 2008 NTCRA is shown in Table 1-1.

Table 1-1. Effect of 2008 NTCRA on Reducing Water Inflow to the Pole Canyon ODA

Source of Inflow to ODA	**Without 2008 NTCRA**		**With 2008 NTCRA (Current Conditions)**	
	acre-ft/yr	**% of total**	**acre-ft/yr**	**% of total**
Surface water from upper Pole Canyon	669	84.6%	0	0%
Alluvial groundwater	36	4.6%	0	0%
Direct infiltration via ODA surface	49	6.2%	49	6%
Run-on from hill slope north of Pole Canyon ODA	37	4.7%	0	0%
Total	**791**	**100%**	**49**	**6%**

Notes:
1. Water balance estimates are based on long-term hydrologic modeling using the SCS Curve Number method and/or the HELP model (Schroeder et al., 1994).
2. Estimated inflow for alluvial groundwater is based on previous models for the ODA (SI Report; NewFields, 2005).

As shown, the 2008 NTCRA reduced the water flow into the Pole Canyon ODA by 94%. This is important to provide context for actions evaluated in this document that further reduce water inflow to the ODA. The alternatives in this EE/CA address the remaining 6% of water inflow to the ODA.

1.1 Purpose

The purpose of the EE/CA is to identify and evaluate NTCRA alternatives to address conditions at the Pole Canyon ODA. Factors that are considered in determining whether an NTCRA is appropriate are described in 40 Code of Federal Regulations (C.F.R.) 300.415 (b)(2). The key factors for the Pole Canyon ODA are:

> (i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants;
>
> (ii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;
>
> (iv) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate;
>
> (v) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released;

Section 4 of this report discusses the actual or potential risk to humans and ecological receptors. The Pole Canyon ODA is a source of contamination to groundwater that discharges to surface water at the Site, as discussed in Section 3. Section 3 also describes elevated levels of contaminants of potential concern (COPCs) in downgradient portions of Pole Canyon Creek, related to releases from the ODA.

The NTCRA described in this EE/CA will be conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). This EE/CA has been prepared in accordance with the National Contingency Plan (NCP) and USEPA's *Guidance on Conducting Non-Time-Critical Removal Actions* under CERCLA (USEPA, 1993).

1.2 Scope

This EE/CA identifies and evaluates a range of options to address the following: 1) infiltration of water into the ODA from direct precipitation and snowmelt, 2) the potential for risk to ecological and human receptors due to direct contact with ODA surface materials, or 3) potential for risk to ecological and human receptors from ingestion of ODA surface materials or vegetation.

The Pole Canyon ODA area is shown on Figure 1-3. The Pole Canyon ODA is defined as any area where overburden was placed on original ground which drained to Pole Canyon Creek (i.e., the area that would be affected by direct precipitation contacting the ODA). Reclaimed pit backfills such as Panel A to the north and Panel D to the south are excluded as infiltrating water would not contribute to Pole Canyon Creek. Similarly, the external fills southeast of Panel D are excluded as they would also not contribute to Pole Canyon Creek. Panel A and Panel D are being evaluated under the RI/FS and will be addressed by separate remedial actions, if necessary.

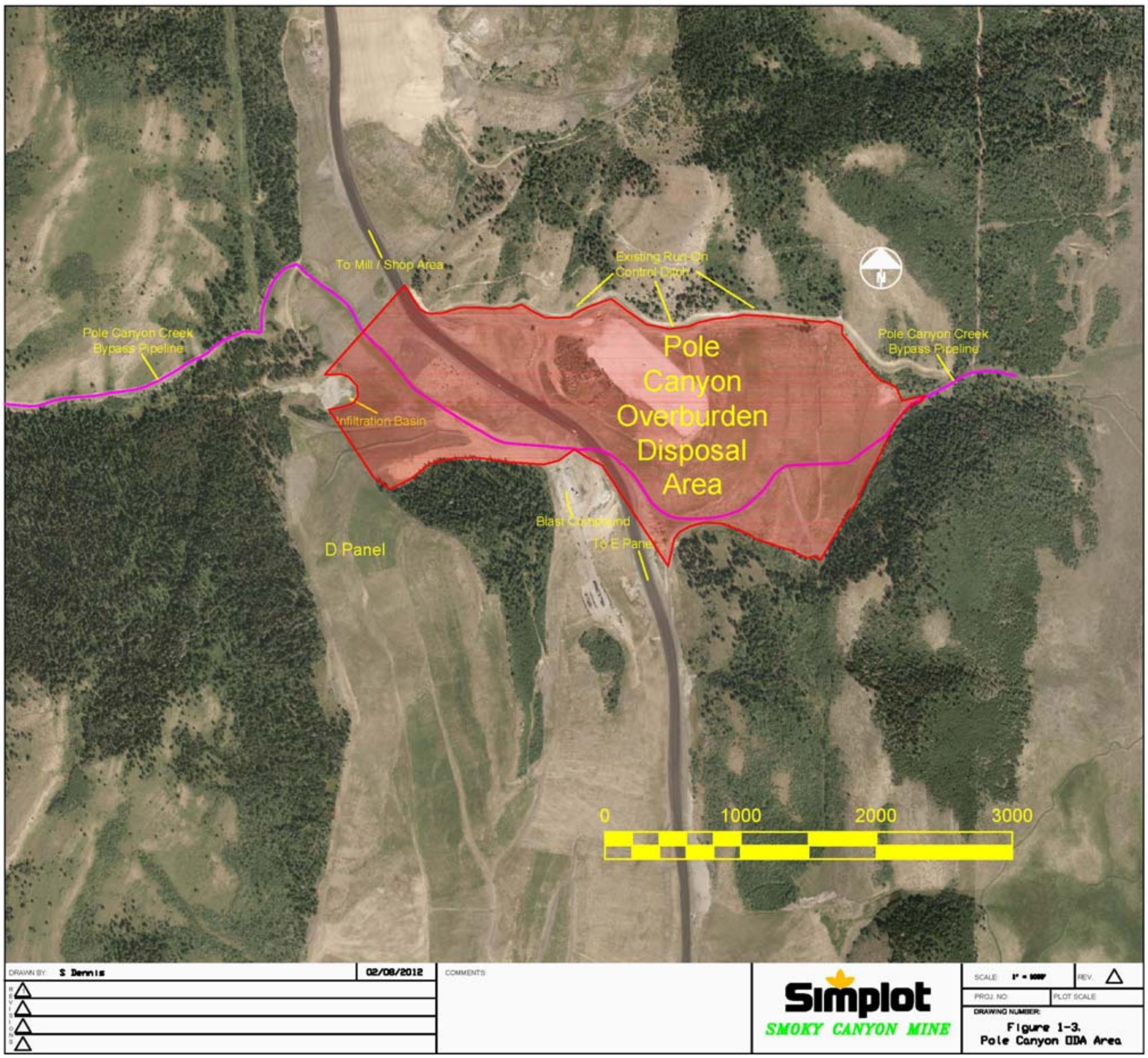


Figure 1-3: Pole Canyon ODA Area

1.3 Document Organization

This report is organized as follows:

- Section 1 – Introduction: A general description of the purpose and scope of the EE/CA as well as the content/organization of the document.

- Section 2 – Site Setting: A description of the physical setting and land use in the Pole Canyon ODA area.

- Section 3 – Pole Canyon ODA History and Characteristics: A description of the Pole Canyon ODA history and a summary of the Site model and characterization describing the nature and extent and fate and transport of COPCs related to the ODA.

- Section 4 – Streamlined Evaluation of Potential Risk: A summary of current potential human health and ecological risks made through comparisons of data to conservative risk-based screening-level benchmarks.

- Section 5 – Identification of Removal Action Objectives (RAOs) and Applicable and/or Relevant and Appropriate Requirements (ARARs): Presentation of the RAOs as well as ARARs and risk-based goals.

- Section 6 – Technology Screening: A summary of technologies screened and justifications as to why some technologies are not carried forward into the NTCRA alternatives.

- Section 7 – Identification and Analysis of NTCRA Alternatives: Identification of the NTCRA alternatives based on the technologies that remained after the screening step. Evaluation of the effectiveness, implementability, and cost of each alternative.

- Section 8 – Comparative Analysis of NTCRA Alternatives: Comparison of the NTCRA alternatives based on criteria presented in the USEPA (1993) *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA*.

- Section 9 – Recommended NTCRA Alternative: Identification of the recommended NTCRA alternative, based on the results of the comparative analysis.

- Section 10 – References Cited: A summary of the documentation referenced in the EE/CA.

2.0 SITE SETTING

The Pole Canyon Creek watershed area above the ODA is approximately 1,100 acres. The upper watershed lies upon the Triassic Dinwoody and Thaynes Formations, which are comprised of shales, sandstones, and limestone. Approximately 500 feet above the ODA, the creek crosses over the low permeability Meade Peak Formation (i.e., Rex Chert member, upper ore zone, middle waste shale, and lower ore zone), and the ODA sits over an outcrop of the Wells Formation (comprised mostly of limestone). Before the ODA was constructed, a significant portion of Pole Canyon Creek flow was lost to the underlying bedrock where the creek crossed the permeable Wells Formation (Ralston, 1979).

Information on the climate, hydrology, geology and seismicity, hydrogeology, and ecology of the Smoky Canyon Mine area, and the Pole Canyon ODA specifically as available, is summarized in the following subsections.

2.1 Climate

The Pole Canyon ODA is located along the eastern slope of the north-south trending Webster Range just west of Sage Valley (Figure 2-1). The area has a cool and dry climate, with typical prevailing winds and weather patterns moving from west to east. Annual precipitation of 20 to 35 inches occurs in the vicinity of the ODA, with the most abundant rainfall occurring in the spring and early summer. In the winter months, snowfall in the vicinity of the ODA averages 100 inches annually, and snow cover typically remains on the ground from November to March or April. Summer temperatures in the region normally range from 44 to 82 degrees Fahrenheit, while winter temperatures typically range from 4 to 28 degrees Fahrenheit (Mariah, 1988).

2.2 Hydrology

The slopes of the Smoky Canyon Mine, and Pole Canyon ODA, generally drain eastward with streams flowing into the Salt River. The Salt River joins the Snake River and ultimately the Columbia River. The Pole Canyon ODA, along with Panels D and E and a portion of Panel A, are located in the Sage Creek basin, whereas, portions of the mine to the north (i.e., Panels B and C and a portion of Panel A) are located in the Tygee Creek basin. The Sage Creek basin headwaters extend up to an elevation of approximately 8,458 feet above mean sea level (AMSL). The mouth of Sage Creek is located about 10.3 miles downstream of the headwaters at the confluence with Crow Creek (at an elevation of about 6,391 feet AMSL). Crow Creek then flows approximately 18.8 miles from the confluence with Sage Creek to its confluence with the Salt River near Afton, Wyoming. The area of the Sage Creek basin is approximately 24 square miles, and the basin has an average gradient of about 0.045 feet/foot.

The water resources of the Sage Creek basin are primarily used for agriculture. Significant portions of Pole Canyon Creek and Sage Creek are used to irrigate private agricultural lands in Sage Valley during the spring and summer. Springs present along the east and west sides of Sage Valley are used for stock watering. The streams within the Sage Creek basin are subject to IDEQ's water quality criteria (standards) for specific, designated uses. All surface waters draining from the mine are designated for cold-water biota use. Water quality conditions are generally characterized by moderate hardness, low concentrations of suspended solids, and circum-neutral pH. In general, stream flows are low and do not transport large quantities of sediment except during spring runoff conditions when creeks may become more turbid.

The Clean Water Act (CWA) requires the State of Idaho to regularly assess streams to determine whether or not they support their designated beneficial uses. The State recommends streams not meeting beneficial uses to USEPA for listing as impaired under CWA Section 303(d). The State of Idaho's 2008 Section 303(d) list of impaired waters includes the lower portions of Pole Canyon Creek, Sage Creek, and South Fork Sage Creek. All three of these streams were listed due to impairment by selenium.

Sediment conditions are generally characteristic of headwater creeks with benthic strata ranging from near bedrock to sand and cobbles covered by small boulders. Many creeks have notable amounts of fine particles, which result in moderate to high embeddedness of cobbles and small boulders. Mining operations do not generally affect sediment conditions because sediment catch basins and erosion fences are utilized to inhibit off-site migration of particulates. Due to two washouts/failures of the ODA in the 1990s, lower Pole Canyon Creek and portions of Sage Creek may potentially contain sediments from mined areas.

2.3 Geology and Seismicity

The general surface geology and structural features in the area of the Smoky Canyon Mine are shown on Figures 2-1 and 2-2. The mine is located in the overthrust belt of the middle Rocky Mountain Physiographic Province, which is characterized by northwest trending ridges and valleys. The overthrust belt is a zone of thrust faulting that extends through much of western North America in a general north-south direction. Movement on thrust-fault systems was generally from west to east. The easterly movement resulted in anticlinal and synclinal folds with axes that roughly parallel the north-south trend of the thrust faults. The thrust faulting occurred in the Cretaceous and early Tertiary geologic periods (Conner, 1980).

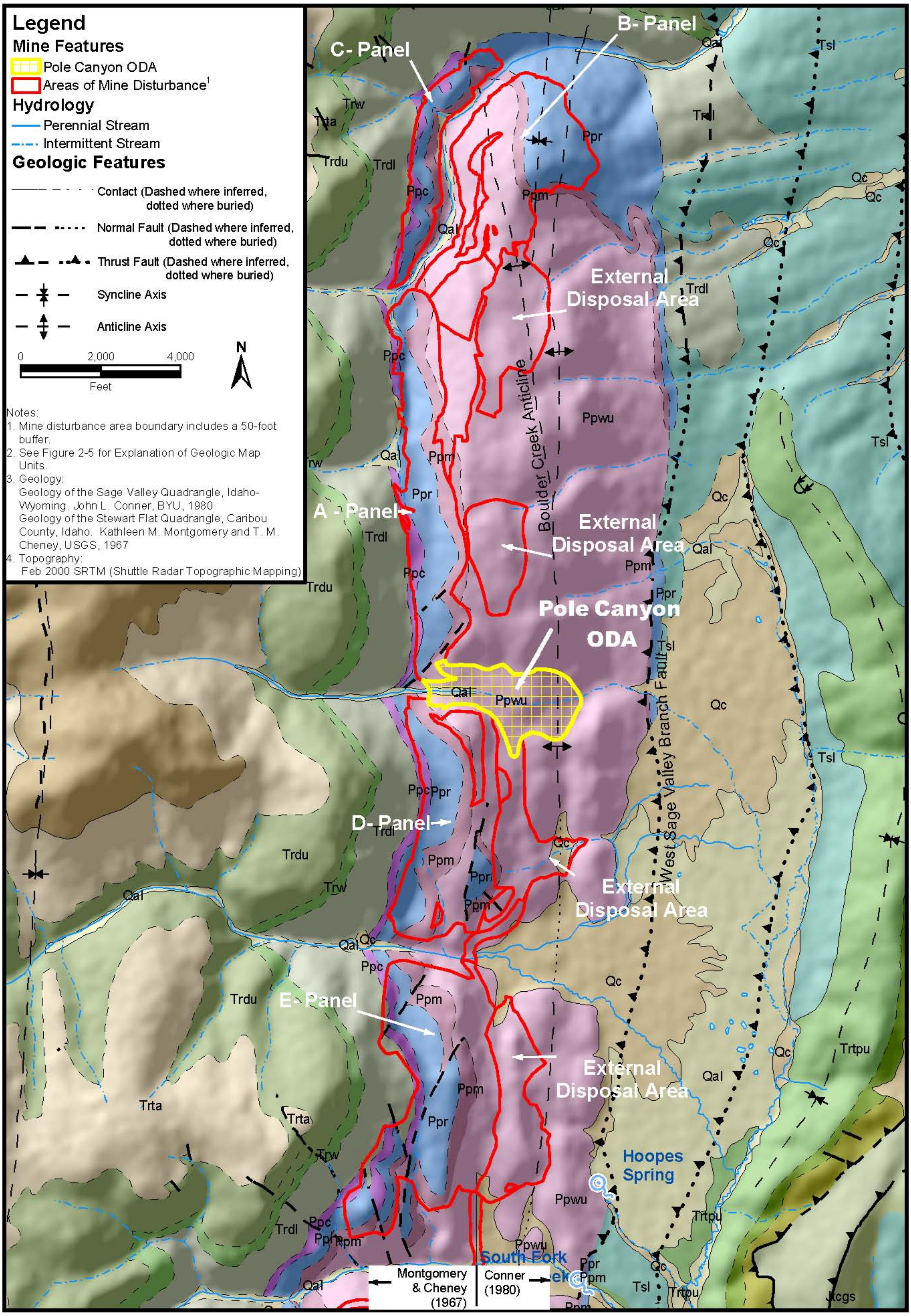


Figure 2-1: Geologic Map

EXPLANATION FOR GEOLOGIC MAP

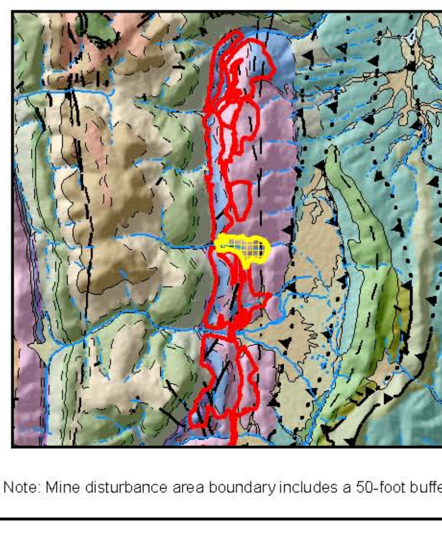
Geologic Map Units and Symbols

Age	Formation	Map Symbol	Description
Quaternary		Qt	Travertine
		Qc	Colluvium
		Qal	Alluvium
Tertiary	Salt Lake	Tsl	Salt Lake Formation
	Unconformity		
Jurassic	Nugget Sandstone	Jn	Nugget Sandstone
Triassic	Thaynes	Trtpu	Upper Portneuf Limestone Member
		Tral	Ankareh Formation - Lane Tongue
		Trtpl	Lower Portenuf Limestone Member
		Trtc	Thaynes C Member
		Trtb	Thaynes B Member
		Trta	Thaynes A Member
	Dinwoody	Trdu	Upper Dinwoody Formation
	Woodside	Trw	Woodside Formation
	Dinwoody	Trdl	Lower Dinwoody Formation
Permian	Phosphoria	Ppc	Cherty Shale Member
		Ppr	Rex Chert Member
		Ppm	Meade Peak Member
Pennsylvanian/Permian	Park City & Wells	Ppwu	Grandeur Member of Park City and Upper Wells Formations
	Wells	Ppwl	Lower Wells Formation

Geologic Map Symbols

- Contact (Dashed where inferred, dotted where buried)
- Normal Fault (Dashed where inferred, dotted where buried)
- Thrust Fault (Dashed where inferred, dotted where buried)
- Syncline Axis
- Anticline Axis

See Figure 2-4 for Detailed Geology Map



Note: Mine disturbance area boundary includes a 50-foot buffer.

Figure 2-2: Explanation for Geologic Map

Sedimentary rocks of Pennsylvanian through Tertiary ages are present in the area. The oldest units are exposed along the core of the Boulder Creek Anticline, whose axis trends north-south along the eastern side of the Webster Range (Figure 2-1). The Pennsylvanian/Permian upper Wells Formation forms the core of the anticline and is exposed along its axis. The upper Wells Formation is approximately 1,500 feet thick. The Permian Phosphoria Formation, which is the source of phosphate ore for the mine, typically overlays the upper Wells Formation. The Grandeur Limestone Member (<75 feet thick) of the Permian Park City Formation is present above the upper Wells Formation, although it is typically mapped with the upper Wells Formation. In the vicinity of the Smoky Canyon Mine, the Phosphoria Formation is approximately 400 feet thick and contains the Cherty Shale Member (100 feet), Rex Chert Member (150 feet), and Meade Peak Member (130-170 feet) (Figure 2-3). Rex Chert and Meade Peak shales are the primary types of overburden rock that are removed during phosphate ore mining and, after mining, are permanently disposed in pits and external ODAs, including the Pole Canyon ODA. The Triassic Dinwoody Formation overlies the Cherty Shale Member of the Phosphoria Formation.

Immediately east of the mine, along the western side of Sage Valley, thrust faulting displaces older rock units against younger rock units. The Tygee Creek and Sage Creek valleys to the east of the active mining operations are underlain by younger Triassic units as well as the much younger Tertiary Salt Lake Formation (BLM and USFS, 2002).

The Pole Canyon ODA and the mine lie within a Zone III seismic region extending from northern Arizona through the Wasatch Front in Utah to the Yellowstone and Hebgen Lake regions in Wyoming and Montana (Uniform Building Code, 1991). The Idaho Geological Survey has mapped the southeastern part of Idaho, east of the Snake River Plain, as having the highest of three seismic shaking rankings (USFS and BLM, 2007). From 1880 through 1994, approximately 20 earthquakes capable of damaging structures (i.e., greater than 5.0 on the Richter Scale) have occurred within this seismic region (USFS and BLM, 2007). Although several earthquakes have occurred in recent years, there is no reported evidence that they have caused surface features such as scarps, displacement of streams, or creation of sag ponds (USFS and BLM, 2007). The earthquake activity in the near-future is expected to be similar to observations during the past 100 years (BLM and USFS, 2002).

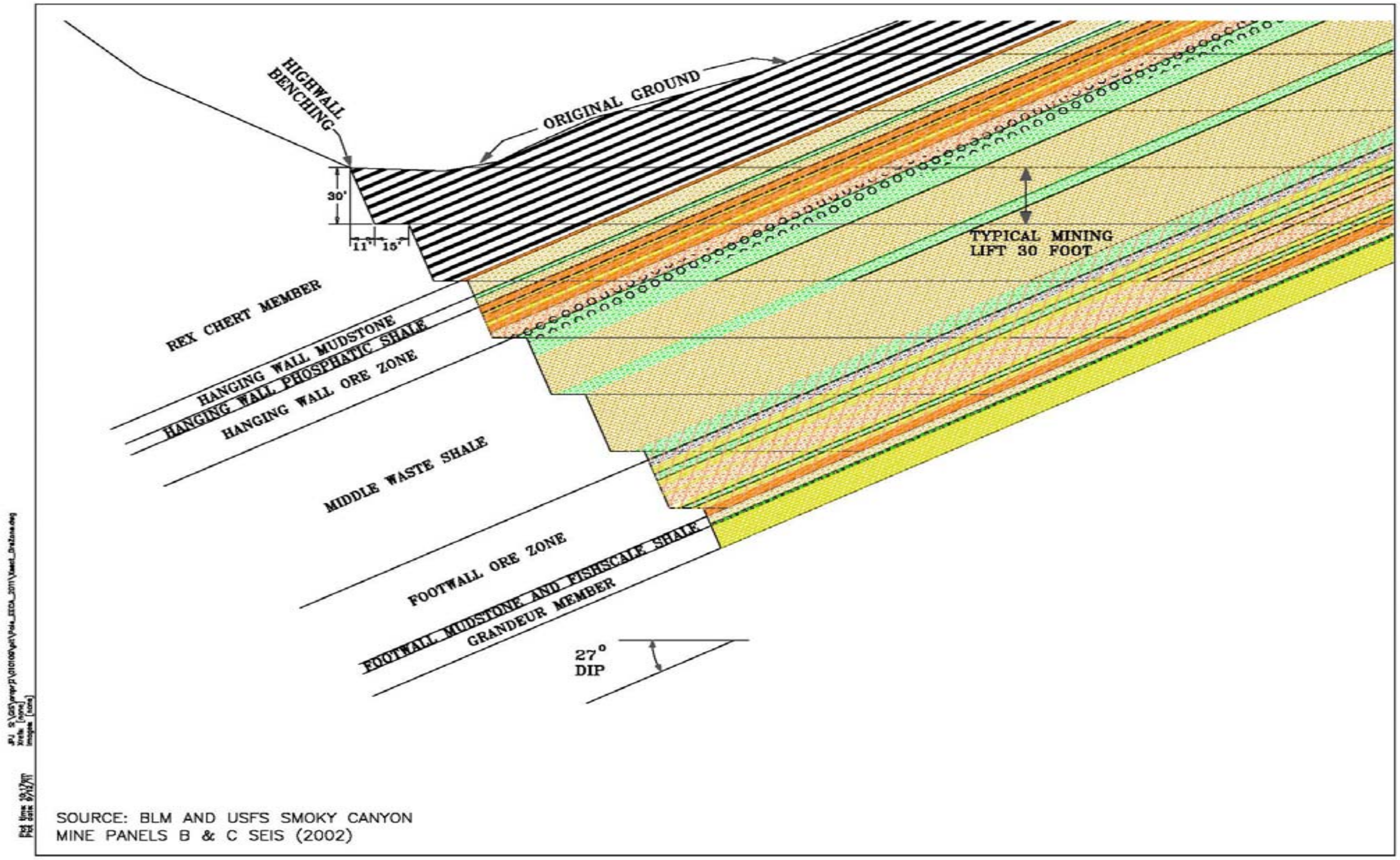


Figure 2-3: Typical Phosphoria Formation Cross-Section

2.4 Hydrogeology

Ralston, et al. (1979) conducted a comprehensive evaluation of water resource conditions for the southeastern Idaho phosphate mining region. This study examined groundwater flow patterns, stream gain-loss characteristics, and the hydrology of existing phosphate mines and waste piles. Additionally, geologic, hydrogeologic, and topographic conditions as well as the availability of recharge control groundwater flow directions in the region were investigated. Conceptual models for groundwater flow systems and the interactions of phosphate mining and water resources were developed for that study, and those concepts provide a basis for understanding the hydrogeologic setting at the Smoky Canyon Mine.

The Wells Formation regional aquifer receives most of its recharge in outcrop areas west of the mine. The regional groundwater flow pattern is controlled by: (1) the elevation of recharge areas on Freeman Ridge (Snowdrift Anticline) and Dry Ridge (Dry Ridge Anticline) to the west and Meade Peak to the south (see locations on Figure 1-1), (2) the elevations of two major discharges from the aquifer – Hoopes Spring and South Fork Sage Creek springs – located on the eastern portion of the mine, and (3) the effects of local structural features, such as the West Sage Valley Branch Fault. The Wells Formation aquifer is the only regional groundwater flow system that receives local recharge in the immediate vicinity of the mine (see outcrop area and stratigraphic position in Figures 2-1 and 2-2). The recharge originates from two sources: (1) incident precipitation in outcrop areas and (2) infiltration from streams crossing the outcrop areas. In the vicinity of the mine, streams flowing eastward generally gain flow as they cross the Dinwoody outcrop west of the mine, remain constant in terms of flow across the Phosphoria Formation, and then lose flow as they cross the outcrop of the Wells Formation (Figure 2-1).

Surficial alluvial and colluvial deposits comprise more local and shallow groundwater flow systems. These deposits also receive recharge from the surface in the vicinity of the mine. The shallow alluvial flow system consists of thin (up to 50 feet thick) and narrow (100 to 300 feet wide) unconsolidated, surface deposits that are locally present along the natural stream channels that transect the mine area. Along the west side of Sage Valley, these local stream channel deposits transition to much thicker and laterally extensive colluvial and alluvial deposits that cover the floor of northern Sage Valley and fill in between bedrock highs in lower Sage Valley (Figures 2-1 and 2-2).

In the vicinity of the Pole Canyon ODA, two groundwater systems are present: (1) a shallow alluvial system associated with the Pole Canyon Creek channel that underlies the ODA and (2) the deeper Wells Formation aquifer. The latter groundwater system is estimated to be present at depths of 250 to 400 feet below the western (upstream) end of the Pole Canyon ODA based on comparison of topographic and potentiometric maps of the Pole Canyon area. The Wells Formation aquifer is estimated to be at least 150 feet below the eastern (downstream) end of the ODA based on water-level measurements in monitoring well GW-16.

The Pole Canyon ODA is distinct from the other Smoky Canyon Mine ODAs because of its canyon backfill setting and the presence of an underlying shallow alluvial groundwater system associated with Pole Canyon Creek.

Currently, infiltrating water generally moves vertically downward to the base of the ODA. The water then moves either along the former Pole Canyon Creek channel at the interface of the overburden and alluvial deposits or vertically downward through an estimated 150 to 400 feet of unsaturated bedrock to enter the Wells Formation aquifer. Wells Formation groundwater below Pole Canyon flows generally east from the ODA toward the West Sage Valley Branch Fault, which acts as a boundary to further eastward flow. Wells Formation groundwater then flows south and is discharged at Hoopes Spring. The work proposed under this NTCRA will address infiltration into the ODA from rainfall and snowmelt. Section 3.4 provides further discussion of infiltration in the context of the site model.

A small amount of infiltration water discharges at a seep (LP-1) located at the toe of the ODA. The magnitude of flow at this seep is typically small, but appears to increase briefly each spring likely in response to snowmelt on the ODA surface. Seep flows during these brief occurrences of increased discharge sometimes reach and mix with water discharging from the pipeline. Surface water flow in lower Pole Canyon Creek is typically lost to alluvial deposits and the Sage Valley alluvial aquifer. During high flow conditions, surface water can flow farther into the valley, where it is diverted for irrigation purposes, or joins Sage Creek.

2.5 Ecology

General vegetation or habitat types of aspen, conifer, aspen/conifer, mixed shrub, sagebrush, disturbed, and riparian/wetland have been identified within and around the Smoky Canyon Mine (Maxim, 2000). Maxim (2002) identified these vegetation or habitat types through environmental baseline studies to support preparation of the Supplemental Environmental Impact Statement (SEIS) for the Panels B&C project. To complete the baseline studies, they conducted a comprehensive literature review (including wetland maps, soil maps, special status species information, etc.), analyzed aerial imagery, and performed field studies. The field studies included forest and upland mapping, wetland delineation and assessment, vegetation sampling, special status plant surveys, and riparian surveys.

Vegetation composition is dependent primarily on elevation and aspect, with higher elevation areas and north and west aspects at the mine receiving sufficient moisture to support species such as subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*) with an understory component. Douglas-fir (*Pseudotsuga menziesii*) and aspen (*Populus tremuloides*) also with an understory component represent mid-elevation areas in the mine area. Forest openings contain a mixed shrub component that includes species such as mountain snowberry (*Symphoricarpos oreophilus*) and antelope bitterbrush (*Purshia tridentata*) with an understory component. Mixed shrub communities such as mountain big sagebrush (*Artemisia tridentata*) and grassland species such as bluebunch wheatgrass (*Agropyron spicatum*), Kentucky bluegrass (*Poa pratensis*), and western needlegrass (*Stipa occidentalis*) typify the warmer and drier lower elevation areas and south aspects. Forbs commonly found in this cover type include silky lupine (*Lupinus sericeus*) and arrowleaf balsamroot (*Balsamorhiza sagittata*). Willows (*Salix* spp.), Nebraska sedge (*Carex nebrascensis*), aquatic sedge (*Carex aquatilis*), beaked sedge (*Carex utriculata*), and bluejoint reedgrass (*Calamagrostis canadensis*) dominate riparian areas.

The diverse vegetation types found in the mine area provide habitat for a variety of wildlife species. Mammal species include bats, lagomorphs (rabbits), rodents, carnivores (such as black bear [*Ursus americanus*], mountain lion [*Felis concolor*], and others), and ungulates (mule deer [*Odocoileus hemionus*], elk [*Cervus elaphus*], and moose [*Alces alces*]). Numerous species of birds occur in the area, including raptors (bald eagle [*Haliaeetus leucocephalus*], red-tailed hawk [*Buteo jamaicensis*], and others), passerines, waterfowl, and shorebirds. Most raptors are expected to nest in aspen or conifer stands, although some raptors prefer to nest and hunt in grassland habitat near meadows and marshes. Game birds also are commonly found in the mine area; Sage Grouse (*Centrocercus urophasianus*) preferentially utilize sagebrush vegetation while Blue Grouse (*Dendragapus obscurus*) and Ruffed Grouse (*Bonasa umbellus*) typically are found in dense conifer and aspen stands. Other bird species that utilize the project area at times during the year include Hairy Woodpecker (*Picoides villosus*), American Robin (*Turdus migratorius*), Tree Swallow (*Tachycineta bicolor*), and others.

Although Pole Canyon Creek downstream from the ODA does not contain fish species, perennial streams in and adjacent to the mine area contain several species of fish and a wide variety of aquatic macroinvertebrates. Overall, in other streams in the mine area, the fishery currently appears to be in fair to good condition at most locations with adequate fish densities, good condition factors, few abnormalities, multiple life stages, and expected species diversity (NewFields, 2009). While the uppermost portion of Smoky Creek does not have fish, lower reaches contain Snake River Fine spotted cutthroat trout (*Oncorhynchus clarkii* spp.), brook trout (*Salvelinus fontalis*), longnose dace (*Rhinichthys cataractae*), and sculpins (*Cottus* spp.) (BLM and USFS, 2002). Seven species of fish were collected in the August 2000 sampling of Tygee Creek: cutthroat trout, brook trout, longnose dace, sculpin, redside shiner (*Richardsonius balteatus*), Utah chub (*Gila atraria*), and leatherside chub (*Gila copei*) (BLM and USFS, 2002). Mariah (1988) stated that mottled sculpin (*Cottus bairdi*) and speckled dace (Rhinoichthys osculus) were present in Tygee Creek and are likely present in the Sage Creek drainage as well. Other fish that occur in the general area are brook trout (*Salvelinus fontinalis*), rainbow trout (*Onchorhyncus mykiss*), brown trout *(Salmo trutta*), and mottled sculpin (*Cottus bairdii*), as well as other minnow species (Mariah, 1988). Amphibian and reptile species known to occur in the mine area include tiger salamander *(Ambystoma tigrinum*), boreal chorus frog (*Pseudacris maculata*), rubber boa (*Charina bottae*), and western terrestrial garter snake (*Thamnophis elegans*).

Downstream from the Pole Canyon ODA in lower Sage Creek and Crow Creek, brown trout (*Salmo trutta*) is the predominant salmonid species, followed by Yellowstone cutthroat trout, and mountain whitefish (*Prosopium williamsoni*). Paiute sculpin (*Cottus beldingi*) has been almost exclusively found, with occasional mottled sculpins collected intermittently. Predominant cyprinid species include two species of dace: Longnose (*Rhinicthys cataractae*) and Speckled (*Rhinichthys osculus*). Dace species are typically found in the lower elevation Crow Creek areas whereas sculpin are predominant in the upper elevation reaches of Sage and Crow Creeks. Redside shiner (*Richardsonius balteatus*) is more commonly found at the lower elevation Crow Creek area. In the Crow Creek drainage, Catostomids are entirely comprised of Utah Sucker (*Catostomus ardens*). In the lower elevation reaches of Sage Creek, Utah Sucker are also present. One leatherside chub was found in 2008 in an upper reach of Crow Creek.

The only federal-listed threatened and endangered (T/E) species listed for Caribou County is the threatened Canada lynx (*Lynx canadensis*) (USFWS, 2009). Although potential "linkage" habitat for the lynx is present, surveys for lynx indicate that this species is not present (Maxim, 2002, Maxim, 2004a, USFS/BLM, 2005).

The bald eagle (*Haliaeetus leucocephalus*) and wolf (*Canis lupus*) have been recently removed from federal T/E listings. The gray wolf (*Canis lupus*) was recently (October 2010) reinstated in the northern Rocky Mountains as an endangered species except in Idaho and Montana in areas south of Interstate 90. As a result, any gray wolf in the vicinity of the Site would be considered part of the experimental, non-essential population and not as an endangered species.

The Idaho Department of Fish and Game (IDFG) lists several T/E species for the state. State-listed threatened species potentially found in Caribou County include: bald eagle (*Haliaeetus leucocephalus*) and Canada lynx (*Lynx canadensis*). The bald eagle was recommended by IDFG biologists for delisting from T/E species to big-game and non-game wildlife species; recommendations were reportedly to be made to their commission on July 23, 2009 (pers. comm., R. Sallabanks at IDFG, July 21, 2009).

A small number of Western toads (*Bufo boreas*), which is a State species of concern, were identified south of the Smoky Canyon Mine during baseline studies for the Panels F and G EIS (Maxim, 2004b). Western toad habitats are found in the Site, but no recent survey within the Site has identified Western toad. Surveys by Shive et al. (2000) in and around the Site area did not find Western toads (as reported in JBR, 2001).

2.6 Land Use and Ownership

The predominant land uses in the vicinity of the Smoky Canyon Mine are associated with agriculture and natural resources, and include crop production (primarily hay) on private lands along with cattle and sheep ranching on private and public lands. Phosphate mining, while not a dominant land use in terms of acreage, is economically important and accounts for approximately 40 percent of the wages and salaries for Caribou County, Idaho. On USFS lands, recreational activities include hunting, fishing, camping, hiking, skiing, and snowmobiling, among others. Recreational use of public lands is another important aspect of the local economy. Additionally, the mine area may be used for Tribal hunting, fishing, and ceremonial activities consistent with their heritage.

Much of the land at the Smoky Canyon Mine is National Forest System land (NFS land), including the leased areas occupied by the mine panels. The Pole Canyon ODA consists of NFS land. Simplot constructed the Pole Canyon ODA partially under a lease from the BLM with the remainder under a special use permit from the USFS. Private ranch land, owned by Simplot, is located in Sage Valley immediately to the east of the Pole Canyon ODA and Panels A, D, and E. Other private lands (ranches and vacation homes) are located in the Crow Creek Valley, to the south and southeast of the mine.

The closest population center to the mine is the Star Valley community, which includes the town of Afton, Wyoming and is approximately 10 miles directly east of the mine. The town of Afton has a population of approximately 1,800 (U.S. Census Bureau, 2001).

The anticipated future land use at Smoky Canyon Mine, including the Pole Canyon ODA, includes recreational activities, grazing, and Tribal activities consistent with their heritage.

3.0 POLE CANYON ODA HISTORY AND CHARACTERISTICS

This section summarizes how and when the Pole Canyon ODA was constructed, provides details and the effect of the 2008 NTCRA, and includes descriptions of the source and the nature and extent of elevated concentrations of selenium and other COPCs.

Characterization is focused on selenium as the indicator COPC based on a review of analytical results for data collected in 2010 as part of the Smoky Canyon Mine RI/FS (presented and discussed in the Revised Draft 2010 Data Summary Report [DSR], Formation, 2011a). The review involved comparison of COPC concentrations for each environmental medium to the corresponding screening-level benchmarks. As discussed in greater detail in the Revised Draft 2010 DSR, the results of these comparisons indicate that selenium is the COPC with the widest spatial distribution at concentrations that exceeded a screening-level benchmark in groundwater, surface water, sediment, and soil. Therefore, selenium can be considered a conservative indicator for the extent of contamination at the Pole Canyon ODA and useful for identification of transport pathways from the different source areas.

3.1 Background Information on Mining and Pole Canyon ODA History

At the Smoky Canyon Mine, phosphate ore is extracted from a series of open pits, referred to as mine panels, located on the eastern slope of the Webster Range between Smoky Canyon and South Fork Sage Creek (Figure 3-1). To extract the ore, Simplot removes and disposes the overburden nearby; the Pole Canyon ODA, which no longer accepts overburden material, is one of those former disposal areas. Mining activities began at the Smoky Canyon Mine in 1983 and, since then, have progressed through a series of six panels (A through F). Four of these areas have been mined out and have undergone at least partial reclamation (Panels A, C, D, and E). The mill and administrative and maintenance facilities are located just south of Smoky Canyon near the northern end of the mining operations (Figure 3-1). Tailings ponds are located on Simplot's private property about 3.2 miles northeast of the mill site in the Tygee Creek drainage. The mill is connected to the tailings ponds with a pipeline that runs from west to east along Smoky Creek through Smoky Canyon.

The location of the Pole Canyon ODA is shown on Figure 3-1 and current reclamation status is shown on Figure 3-2. The Pole Canyon ODA is an external disposal area that covers approximately 120 acres. It was constructed as a CVF beginning in 1985 in the valley of Pole Canyon Creek between Panels A and D, just upstream of its entry into Sage Valley. Initially, only chert material was placed in the ODA to limit the amount of fine-grained material that entered the Pole Canyon Creek flow. Natural sorting of those materials by gravity due to end-dumping resulted in predominantly coarse materials filling the narrow canyon bottom first and creation of a zone of higher hydraulic conductivity, referred to as a "French drain," through which Pole Canyon Creek flowed prior to diversion of the creek around the ODA in 2007. Most of the overburden in the Pole Canyon ODA originated from Panel A mining from 1985 to 1990. In 1997, a much smaller quantity of overburden from Panel D (Pit D-2) was placed on the west side of the Pole Canyon ODA. The western (upstream) portion of the ODA extends approximately 150 feet above the Pole Canyon Creek bed while the eastern (downstream) portion rises about 500 feet above the creek bed. The disposal area extends approximately 4,600 feet from the western toe to the eastern toe. The disposal area width (north to south direction) ranges from approximately 1,000 feet up to 1,700 feet. A comparison of pre-mining to current topography indicates that approximately 26 million cubic yards of material are present in the ODA.

The plateau top and steeper east face of the ODA were reclaimed in 1989 and 1990 by seeding applied directly to the re-graded overburden. In the mid-1990s, the west face of the ODA was reclaimed using center waste shale and seeding along with some use of topsoil. The current reclamation status is shown on Figure 3-2. The presence of run-of-mine overburden (containing some center waste shale) at or near the surface of the ODA has resulted in elevated levels of selenium that need to be addressed by an additional response action.

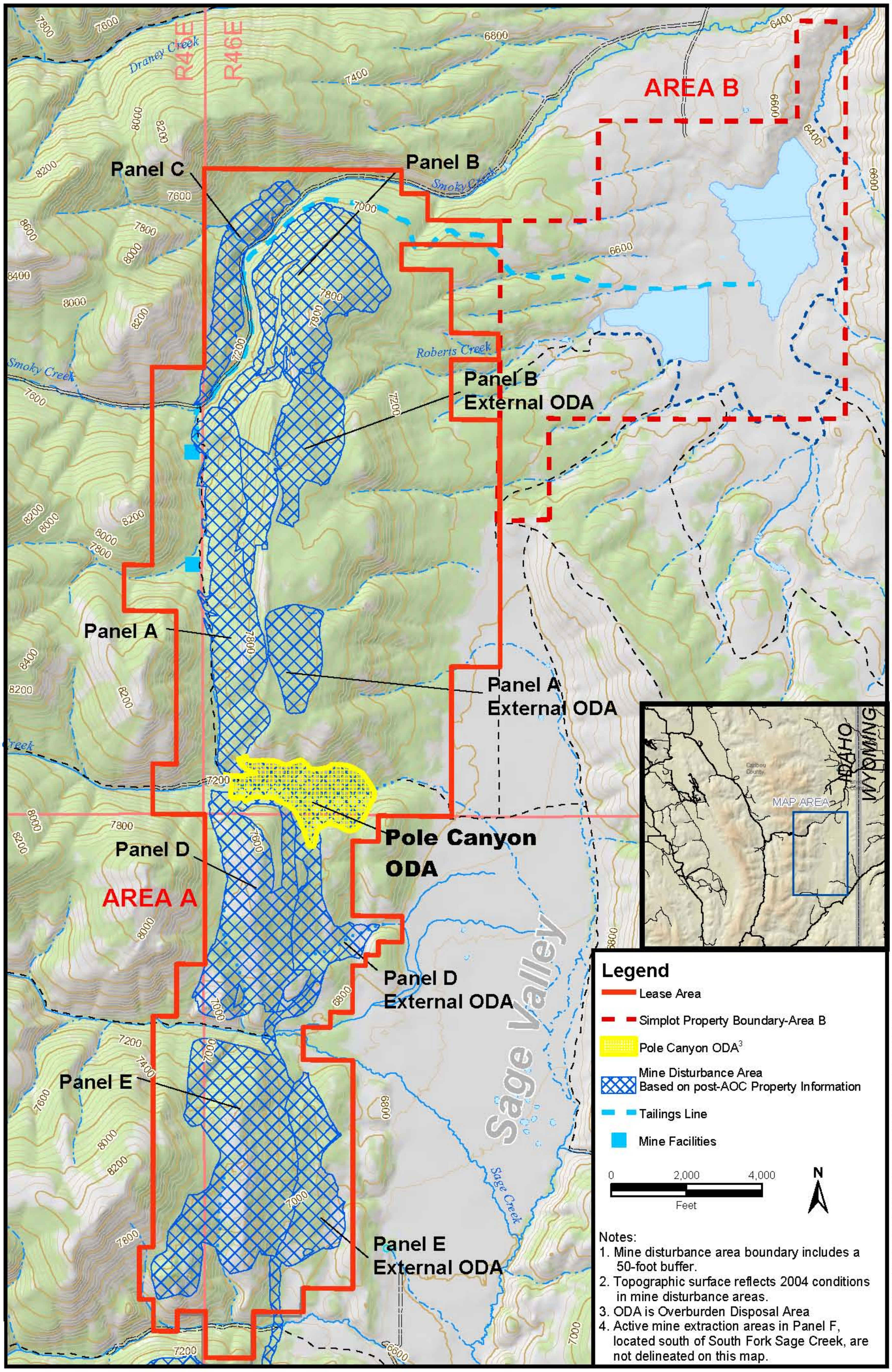


Figure 3-1: Smoky Canyon Mine Features Panels A-E

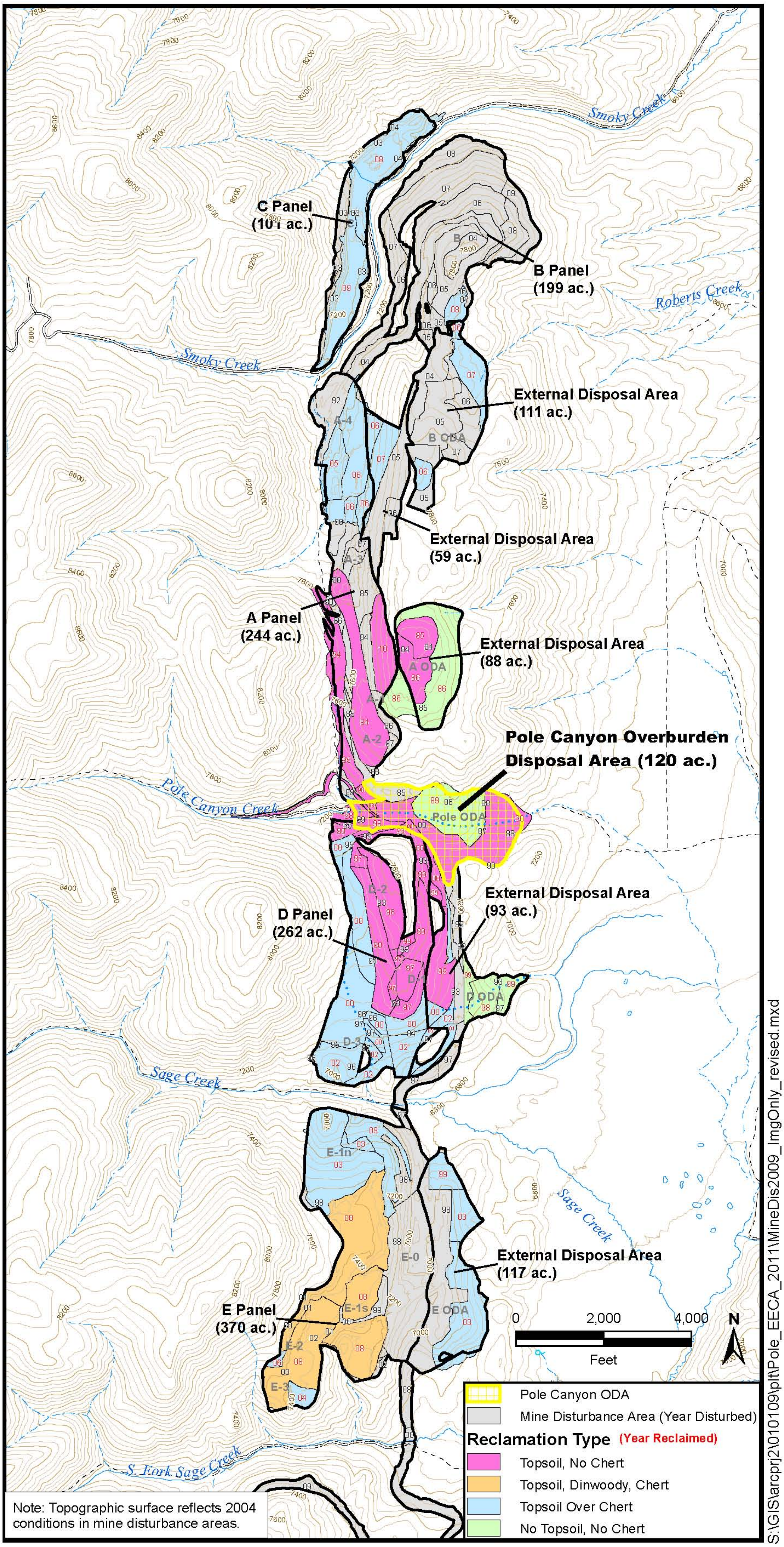


Figure 3-2: Smoky Canyon Mine Disturbance Areas and Reclamation Activities

3.2 2006 EE/CA and 2008 NTCRA

In 2006, Simplot prepared an EE/CA for the Smoky Canyon Mine Site in accordance with the requirements of a 2003 Administrative Order on Consent/Consent Order entered into by IDEQ, USFS, EPA, and Simplot (IDEQ, USFS and EPA, 2003). The 2006 EE/CA identified and evaluated NTCRA alternatives for all source areas at the Site, including distinct alternatives for the Pole Canyon ODA.

Based on the 2006 EE/CA analysis, the USFS selected a NTCRA to reduce the transport of selenium, and other overburden constituents, from the Pole Canyon ODA to groundwater and surface water. The USFS, EPA, IDEQ, and Simplot entered into an Administrative Settlement Agreement and Order on Consent/Consent Order (Settlement Agreement/CO) for a NTCRA for the Smoky Canyon Phosphate Mine in October 2006 (USFS, USEPA, and IDEQ, 2006). In this EE/CA, the actions completed as a result of the 2006 NTCRA are referred to as the 2008 NTCRA. Details regarding the 2008 NTCRA are presented in the Removal Design Report (RDR; NewFields, 2007a), the Removal Action Implementation Work Plan (RAIWP; NewFields, 2007b), and the Final Construction Completion Report (NewFields et al, 2009).

Prior to implementation of the 2008 NTCRA, Pole Canyon Creek water entered the upstream side of the ODA and then was either lost to Wells Formation bedrock and alluvial deposits beneath the ODA or discharged at the downstream end, or toe, of the ODA. During the relatively dry months from late summer through early spring, most of the creek flow was lost under the ODA. Any creek water that did emerge from the ODA was quickly lost to alluvial deposits before the creek crossed Sage Valley. During the fall of very dry years, all Pole Canyon Creek flow was lost below the ODA, with no flow emanating at the toe of the ODA. During typical spring runoff (i.e., high-flow) conditions, discharge from the toe of the ODA flowed into Sage Valley where it was still lost to alluvial deposits; occasionally, however, a portion of the creek discharge from the ODA flowed across Sage Valley to eventually join with the north fork of Sage Creek. Selenium concentrations in the water discharged from the toe of the ODA were typically in the range of 0.5 to 1.5 mg/L.

According to the 2006 EE/CA, the estimated water inflow to Pole Canyon ODA prior to the 2008 NTCRA was 47.6 million cubic feet per year on average (NewFields, 2006). Under these conditions, the water balance generated in 2006 indicated an average of approximately 44.2 million cubic feet of water per year was contributed to the ODA from Pole Canyon Creek (NewFields, 2006). Surface water run-on and direct infiltration contributed approximately 2.2 and 1.2 million cubic feet of water, respectively, to the Pole Canyon ODA (NewFields, 2006). Figure 3-3(a) provides a hydrologic schematic of the Pole Canyon ODA prior to implementation of the 2008 NTCRA.

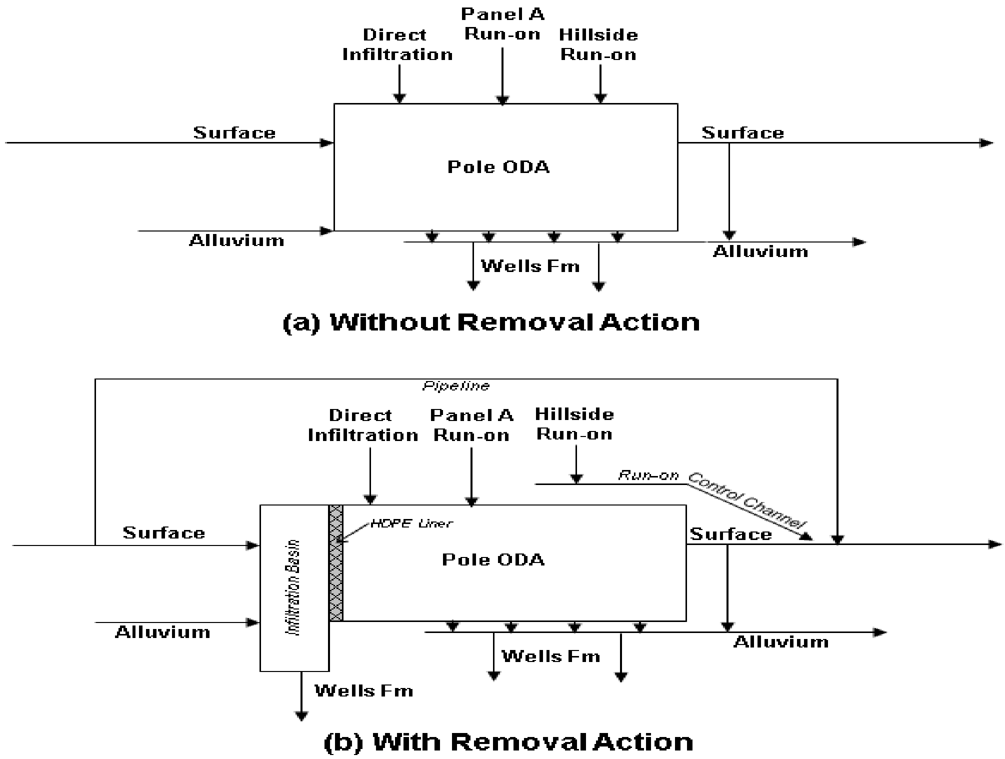


Figure 3-3: Schematic of the Pole Canyon ODA (a) Before the 2008 NTCRA was Implemented and (b) After the 2008 NTCRA was Implemented (i.e Current Conditions)

The selenium transport pathways from the ODA before implementation of the 2008 NTCRA included the surface water pathway via lower Pole Canyon Creek flow out of the eastern end of the ODA, the alluvial groundwater pathway, the Wells Formation groundwater pathway, and direct precipitation into the ODA. The 2008 NTCRA was designed to reduce selenium loading into Pole Canyon Creek, the alluvial aquifer, and the Wells Formation aquifer by preventing Pole Canyon Creek water from entering the overburden through the construction of three major components:

- A bypass pipeline to route upper Pole Canyon Creek (containing water from approximately 60% of the upper Pole Canyon Creek watershed) around the ODA such that it no longer enters the ODA;

- An infiltration basin to direct remaining Pole Canyon Creek water flow (approximately 40% of the watershed) into the Wells Formation aquifer upstream of the CVF; and

- A run-on control channel to collect storm flows and snowmelt from the adjacent northern hillside slope (approximately 100 acres) and direct them away from the ODA to lower Pole Canyon Creek below the ODA.

Construction of the bypass pipeline and infiltration basin concluded in 2007. The run-on control channel was constructed and completed in late 2008. Figure 1-2 shows the locations of the diversion pipeline, infiltration basin, and run-on control channel. A hydrologic schematic of the Pole Canyon ODA after implementation of the 2008 NTCRA is provided in Figure 3-3(b).

The 2006 EE/CA analysis estimated that through implementation of the 2008 NTCRA, approximately 97.5% (i.e. 46.4 of 47.6 million cubic feet of water per year) of the inflow to the Pole Canyon ODA would be removed. Note that, as discussed below and in detail in Appendix A, the analysis performed in 2006 used inputs from Site data collected in the early 2000s. This analysis has been updated in this EE/CA to use long-term conditions and to modify the areal extent of the ODA (now estimated at 120 acres, compared to 112 acres previously). The new analysis estimates that the 2008 NTCRA removes 94% of the inflow to the ODA based on long-term average conditions. This analysis is summarized in Table 1-1.

3.3 Site Characterization

Data collection has been performed in the Pole Canyon ODA area, as part of the RI (Formation, 2011b) and the Pole Canyon Effectiveness Monitoring Program (Formation, 2011c). These data are being collected to support Site characterization and to evaluate the effectiveness of the 2008 NTCRA. Routine spring, fall, and quarterly monitoring and sample collection of surface water and groundwater in the Pole Canyon area are on-going. The sample results from each media type are described below.

3.3.1 Soil and Vegetation Conditions

A total of 44 soil samples were collected from the surface of the Pole Canyon ODA to a depth of 13 inches from 1997 to 2010. Soils in the ODA are comprised primarily of overburden. In some areas, topsoil that was utilized for previous reclamation is mixed with the overburden. Selenium concentrations in the soil samples ranged from a minimum of 0.7 mg/Kg to a maximum of 148 mg/Kg with a mean of 24 mg/Kg. Soil selenium results are shown by concentration and are grouped by sample depth in Figure 3-4(a) and spatially in Figure 3-4(a). There is no apparent selenium concentration trend with respect to depth. Spatially, however, selenium concentrations in the soil were higher on the eastern portion of the ODA (i.e., east of the haul road) compared to the western portion of the ODA (see Figure 3-5(a)). This is consistent with the known reclamation practices used. On the east side, vegetation was planted directly on ODA materials. On the west side, topsoil was placed prior to revegetation.

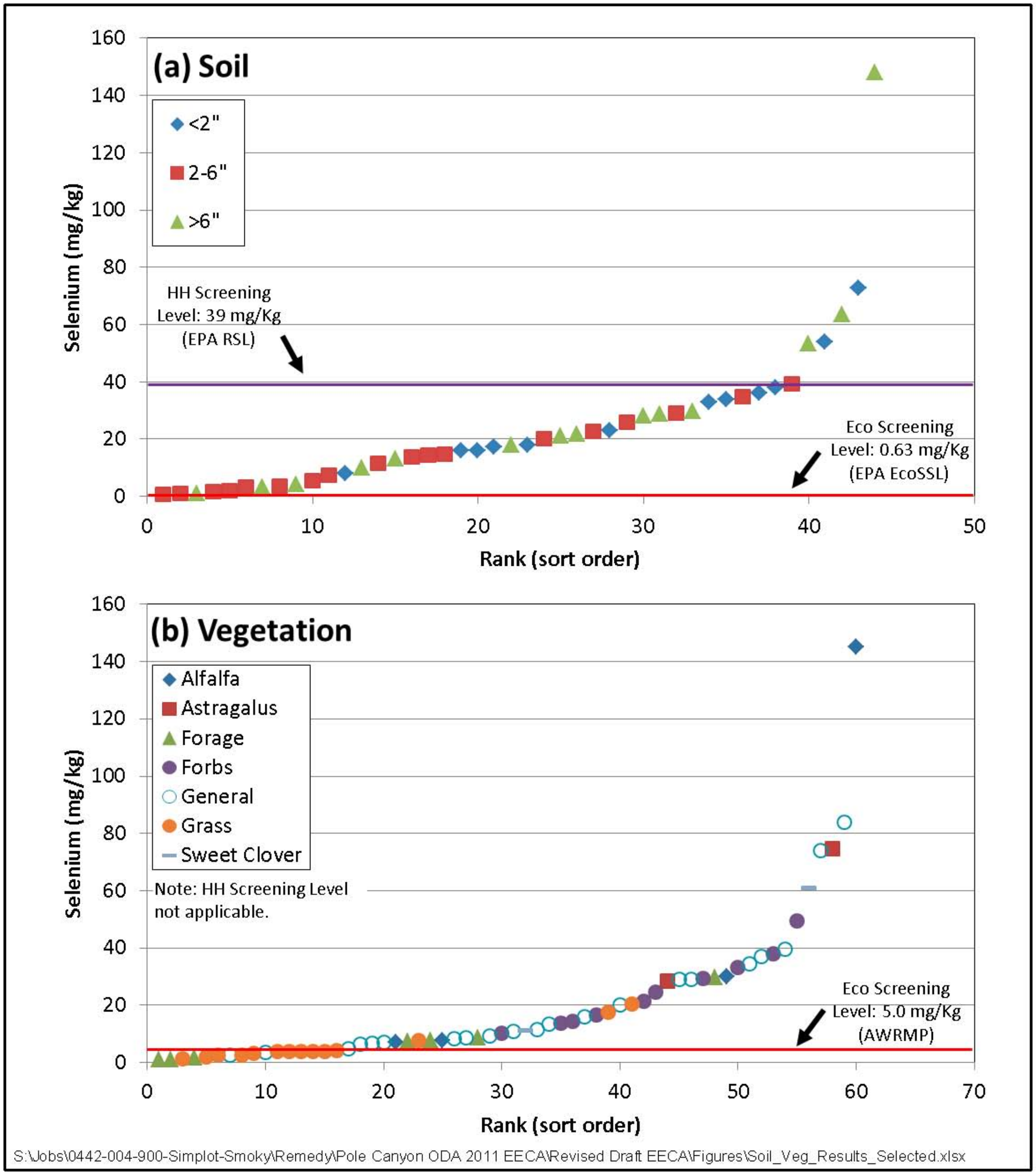


Figure 3-4: Selenium Concentrations in Soil and Vegetation on the Pole Canyon ODA

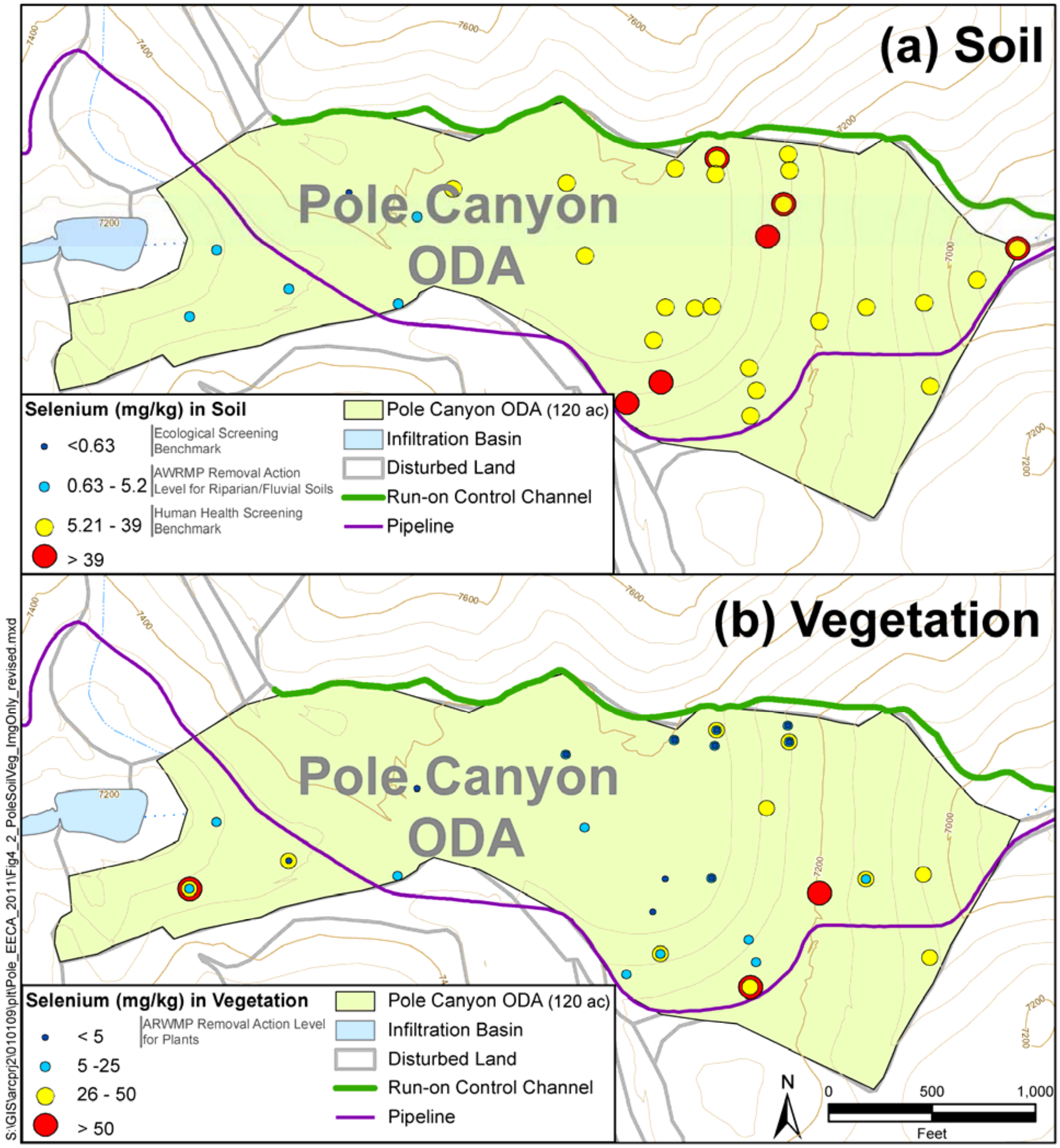


Figure 3-5: Selenium Concentrations (Spatial) in Soil and Vegetation on the Pole Canyon ODA

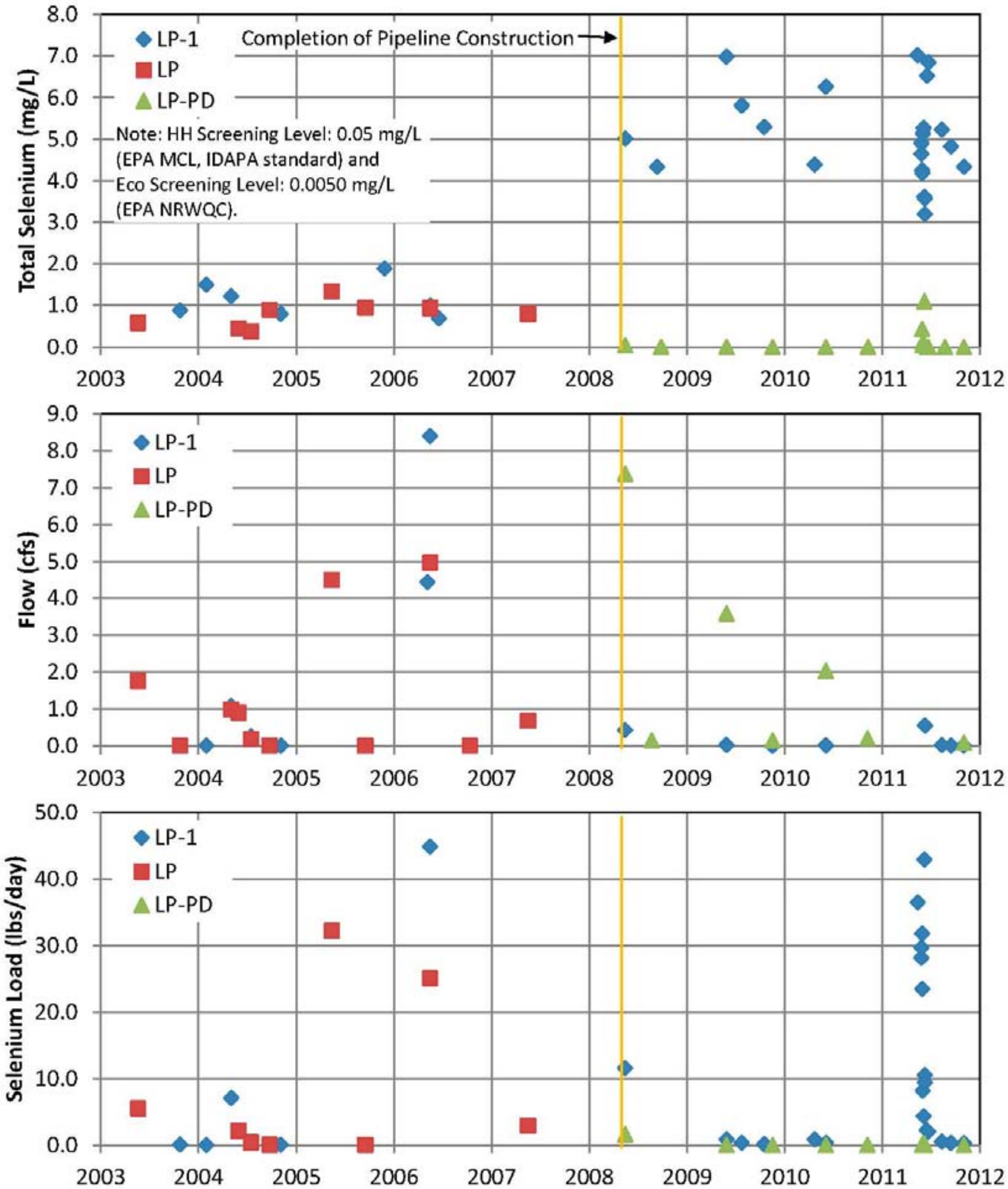
A total of 60 vegetation samples were collected on the Pole Canyon ODA from 1998 to 2010. Vegetation samples collected and analyzed over this time period were sometimes segregated into individual species or vegetation type to further assess the potential for hyper-accumulation within specific species. Selenium concentrations (based on dry weight) in the vegetation samples ranged from a minimum of 1.1 mg/Kg to a maximum of 145 mg/Kg with a mean of 20 mg/Kg. Vegetation selenium results are shown by concentration and are grouped by vegetation type in Figure 3-5(b). Forage and grasses had the lowest concentrations while forbs generally had higher concentrations. There were no distinct spatial trends on the Pole Canyon ODA with respect to selenium concentrations in vegetation (Figure 3-5(b)).

3.3.2 Surface Water Conditions

Surface water potentially impacted by the release of selenium and other COPCs from the Pole Canyon ODA includes lower Pole Canyon Creek.

Since implementation of the 2008 NTCRA, only direct infiltration and run-on from adjacent areas (e.g., newly reclaimed area on Panel A, which is addressed separately from this EE/CA) enters the ODA and has the potential to transport selenium and other COPCs via the surface water and groundwater pathways.

Surface water samples and flow measurements have been collected from lower Pole Canyon Creek at three locations (LP-1, LP, and LP-PD) between 1979 and 2011. Total selenium concentrations, flow measurements, and mass loading, for results from 2003 through 2011, calculated for these locations are shown in Figure 3-6, and locations are shown on Figure 3-7. LP-1 is located immediately downstream of the toe of the ODA (less than 100 feet), LP is located approximately 700 feet downstream, and LP-PD is located approximately 1,000 feet downstream and below the outlet of the pipeline carrying clean surface water from the upper Pole Canyon Creek drainage basin.



Notes:
1. LP-1 represents the ODA toe seep, and LP and LP-PD represent lower Pole Canyon Creek flows before and after pipeline construction as part of the removal action.
2. Flows shown in flow graph were manually collected.
3. Selenium loads were calculated by multiplying total selenium concentration by manual flow measurement, when available. If manual flow measurements were not available, daily average flow rate measured at flume was used. During November 2010, manual flow measurement was collected two days before selenium sample. During June 2011, flow at LP-PD was based on flow measured at UP-PD because LP-PD flume was not logging flow data.

J.R. SIMPLOT COMPANY SMOKY CANYON MINE		
FIGURE 3-6 **SELENIUM CONCENTRATIONS, FLOWS, AND MASS LOADING IN THE SURFACE WATER AT THE TOE OF THE POLE CANYON ODA AND LOWER POLE CANYON CREEK**		
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Figure 3-6: Selenium Concentrations, Flows, and Mass Loading in the Surface Water at the Toe of the Pole Canyon ODA and Lower Pole Canyon Creek

After implementation of the 2008 NTCRA, from 2008 through 2010, the total selenium concentration below the pipeline discharge point (LP-PD) decreased to less than 0.001 mg/L with peak spring flow rates ranging from approximately 2 cfs to 7 cfs. Above the pipeline discharge point, at the ODA toe seep (LP-1), total selenium concentrations increased after implementation of the RA to a range of 4.3 mg/L to 7.4 mg/L. While the total selenium concentrations increased during this period, the flows emanating from the ODA toe decreased substantially. All flows, including the peak spring flows of less than 0.5 cfs measured at LP-1, infiltrated into the underlying alluvial aquifer immediately downstream from the toe (upstream of the confluence of the channel with the pipeline discharge point). In the spring of 2011, increases in flow from LP-1 and brief increases in selenium concentration at LP-PD were observed. This resulted from a test which was conducted, starting in the fall of 2010, during which the bypass pipeline was operated outside of its design by diverting all of the low-flow water to the infiltration basin. This test was conducted, in agreement with the Agencies, to observe effects from the addition of clean recharge water on Wells Formation groundwater at downgradient monitoring locations. Simplot continued diverting all of the upper Pole Canyon Creek flow to the infiltration basin into early June 2011, even as the creek flows increased to rates far exceeding peak flow measurements of previous years. The high flows entering the infiltration basin were substantially greater than the infiltration capacity of the basin, resulting in a large amount of impounded water within the basin for an extended period of time. Some of this impounded water infiltrated into and through the overburden, exiting at the ODA toe seep with larger magnitude flows than previously recorded at the toe seep since completion of the 2008 NTCRA, but selenium concentrations similar to previous measurements. A portion of the ODA toe seep flow reached lower Pole Canyon Creek and caused the briefly elevated concentrations of selenium at LP-PD (Figure 3-6). Further investigations and evaluations of water quality during this period have been conducted as part of the 2008 NTCRA effectiveness monitoring program and the RI (Formation, 2012).

Selenium mass loading calculated from the selenium concentration and flow data show generally low mass loads at the ODA toe seep (LP-1) after implementation of the 2008 NTCRA, with the exception of the higher loads for a brief period during the spring of 2011 (Figure 3-6). For the same period, however, the selenium mass load in lower Pole Canyon Creek (at LP-PD) was low (Figure 3-6). This shows that, even for this unusual condition, the large mass loads at the seep were generally not impacting lower Pole Canyon Creek. The majority of the seep flow, and accompanying selenium mass load, typically infiltrates into the alluvium just downgradient from the ODA toe seep (LP-1) and does not reach the creek channel (LP-PD). Although seepage is a transport pathway to alluvial/Wells Formation groundwater, it has no effect on downstream Pole Canyon Creek surface water quality.

3.3.3 Sediment Conditions

During RI sampling in 2010, sediment samples were collected along three transects located across the lower Pole Canyon Creek drainage upstream of Sage Valley and at surface water sampling location LP-PD (Figure 3-7). These three transects were sampled to represent channel and overbank sediments and/or residual overburden deposited downgradient from the ODA toe as a result of two past slope failures (prior to 1996 and in spring 1996) (Formation, 2011b). Two of the three transects were located between surface water sampling locations LP-1 and LP-PD, and the third transect was located approximately 200 feet downstream from LP-PD.

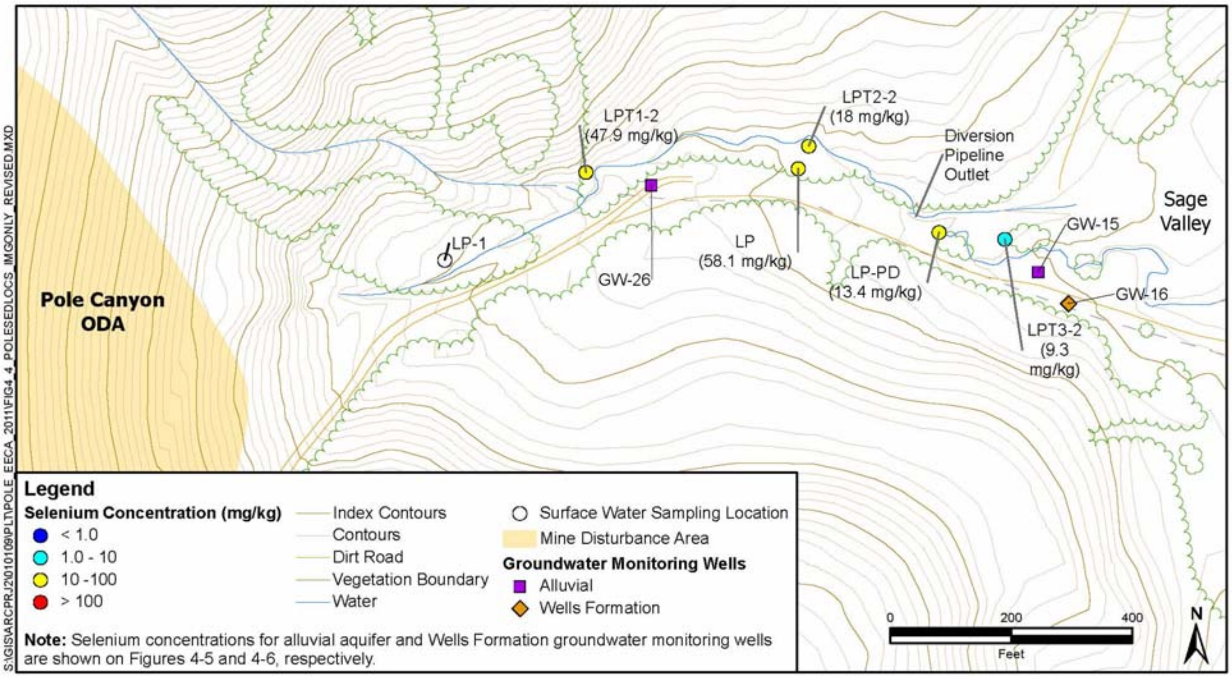

Figure 3-7: Lower Pole Canyon Surface Water, Groundwater, and Sediment Monitoring Locations, and Sediment Selenium Concentrations

Three composite samples were collected along each transect, one in the streambed and the other two in the adjacent overbank areas. The sediment selenium concentrations decreased with increasing distance from the ODA toe. The streambed sediment sample collected from the first transect (approximately 400 feet downstream of the ODA toe) had a selenium concentration of 47.9 mg/Kg, similar to an earlier sample collected during the Site Investigation (SI). The selenium concentration within the sediment decreased to 18 mg/Kg at the second transect location (approximately 700 feet downstream of the ODA toe), 13.4 mg/Kg immediately below the pipeline discharge point (at surface water sampling location, LP-PD), and 9.3 mg/Kg in the transect approximately 100 feet downgradient from LP-PD (Figure 3-7). These data indicate transport from the ODA from historical erosion of overburden materials and possibly from sorption of dissolved COPCs to downstream sediments.

3.3.4 Groundwater Conditions

Two monitoring wells are installed within the alluvial aquifer immediately downgradient of the Pole Canyon ODA (GW-15 and GW-26) (Figure 3-7). GW-15 was installed in 2003 approximately 1,000 feet downgradient of the ODA toe with the screen extending from 15 ft to 45 ft below the ground surface. GW-26 was installed in 2009 approximately 400 feet downgradient of the ODA toe with the screen extending from 9.5 ft to 29.5 ft below the ground surface. Total selenium concentrations and groundwater elevations for these two alluvial wells are shown in Figure 3-8. Since implementation of the 2008 NTCRA, total selenium concentrations at GW-15 have remained lower with the exception of a spike during spring 2009. The cause of the temporarily elevated selenium concentrations at this well is not known, but it may be linked to a change in availability of clean recharge water from the pipeline to lower Pole Canyon for some period of time in spring 2009 (Formation 2011d). The creek water discharged from the pipeline to lower Pole Canyon could have been diverted for irrigation use by the private land owner using an irrigation diversion that is present just upstream of GW-15 or pipeline discharge to lower Pole Canyon may have dropped in March and early April 2009 due to freezing and narrowing of the pipeline inlet above the ODA. In either case, less clean recharge water would be available to the alluvial aquifer upgradient of GW-15, and the effect on the alluvial groundwater flow system at GW-15 would be relatively lower water levels and higher selenium concentrations. Total selenium concentrations at GW-26, which is closer to the ODA toe than GW-15 and upstream of the pipeline discharge point, have continued to climb since installation in 2009. The groundwater elevation at GW-26 over time shows a sharp increase in the spring season followed by a slow decrease during the remainder of the year. The groundwater elevation at GW-26 is approximately 25 to 30 feet higher than at GW-15.

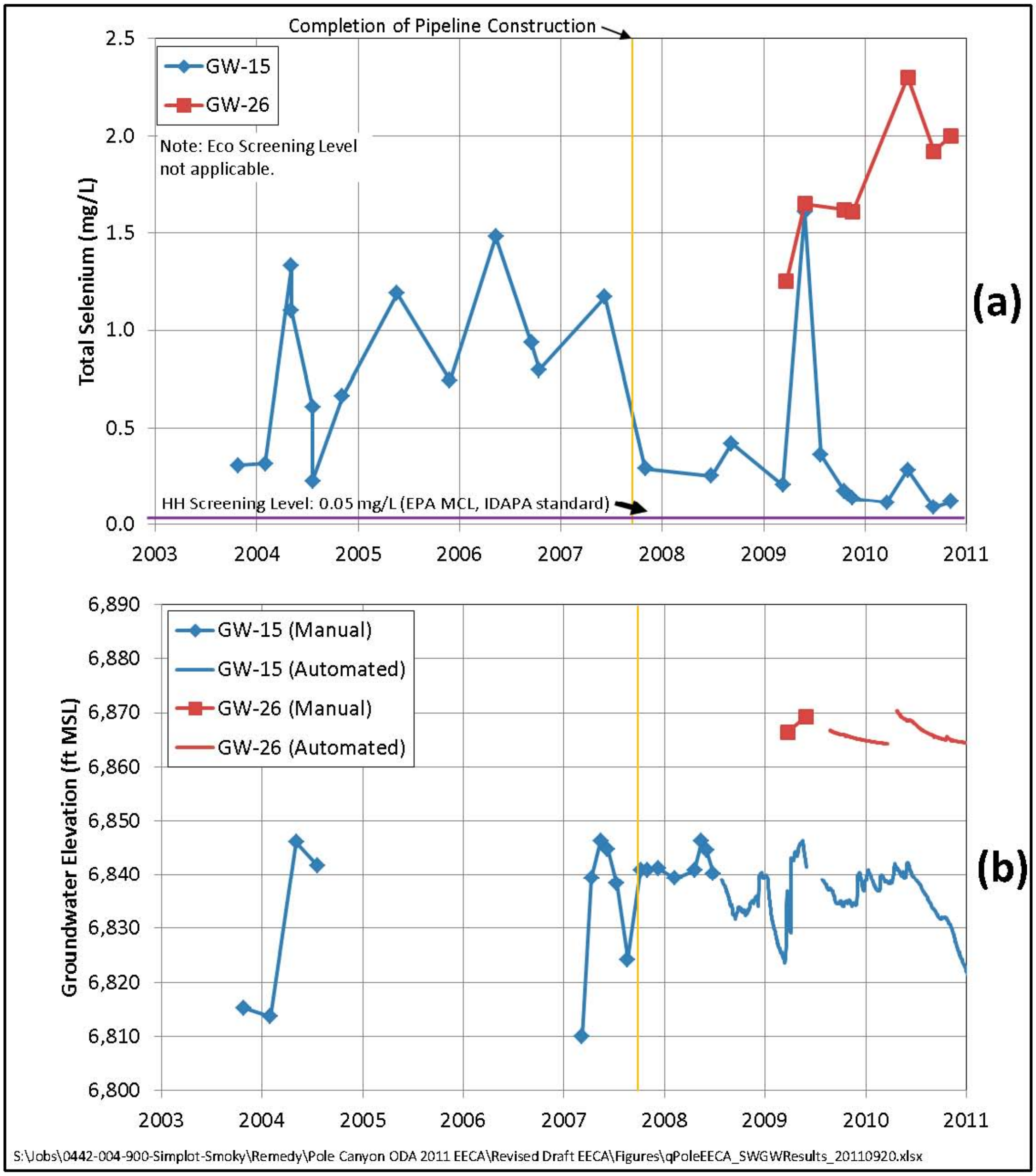

Figure 3-8: Selenium Concentrations and Water Levels in the Alluvial Aquifer Downgradient of the Pole Canyon ODA

Monitoring well GW-16 is installed within the Wells Formation aquifer immediately downgradient of the Pole Canyon ODA (Figure 3-7). GW-16 was installed in 2003 approximately 1,000 feet downgradient of the ODA toe with the screen extending from 229 ft to 279 ft below the ground surface. Total selenium concentrations and groundwater elevations for GW-16 are shown in Figure 3-9. Total selenium concentrations at GW-16 increased from 2003 through 2007. After implementation of the 2008 NTCRA, there was a spike in total selenium concentrations during 2008, but concentrations have remained similar to pre-2008 NTCRA concentrations since then.

Groundwater elevations at GW-16 fluctuate seasonally with an annual amplitude of approximately 6 feet. Minimum groundwater elevations in the Wells Formation occur in late winter/early spring and maximum groundwater elevations occur in late summer.

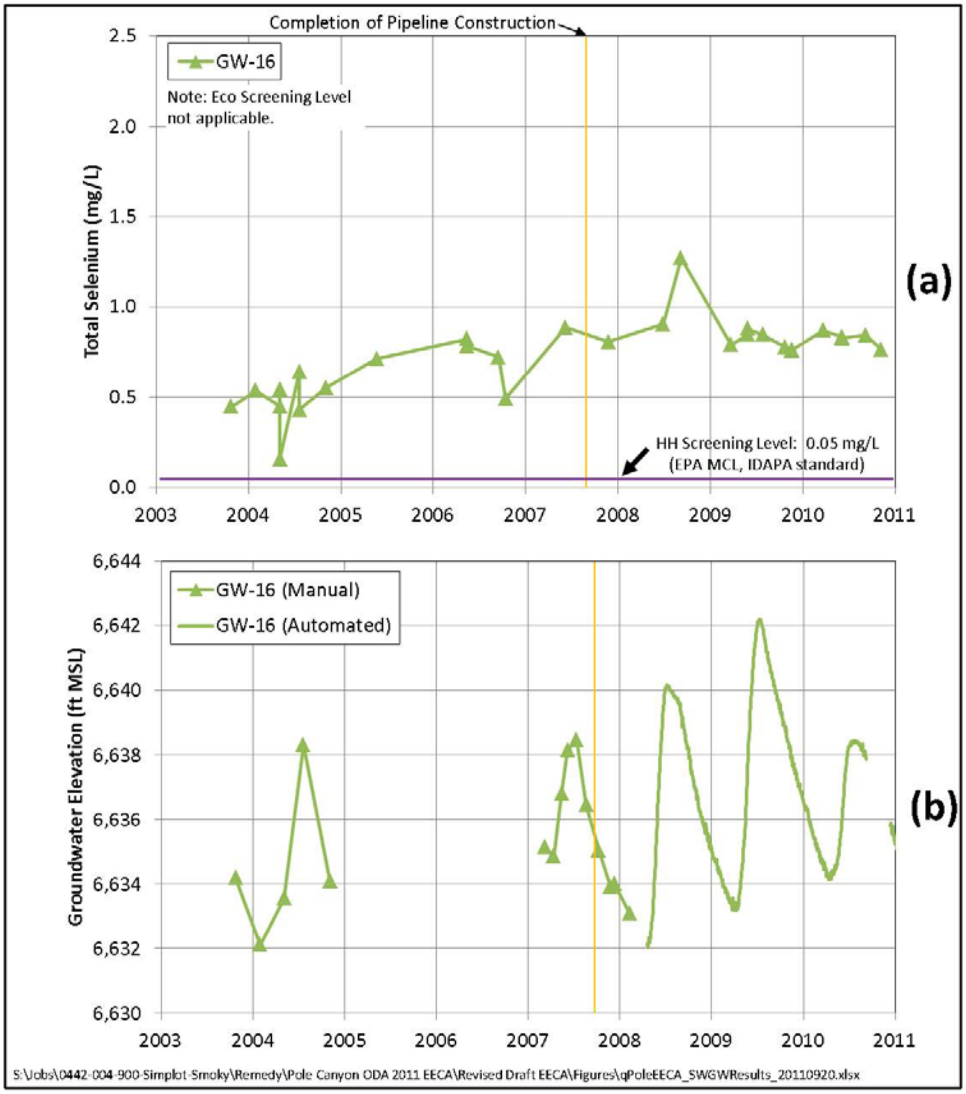

Figure 3-9: Selenium Concentrations and Water Levels in the Wells Formation Aquifer Downgradient of the Pole Canyon ODA

3.4 Site Model

Weathering releases selenium from the overburden material in the ODA. Once mobilized, selenium can be transported from the Pole Canyon ODA along several possible pathways. Potential transport pathways, as described in the RI/FS Work Plan (Formation, 2011b), include:

- Wind dispersion and air deposition;

- Erosion/sediment transport; and
- Flow of pore water from within the ODA to surface water or groundwater.

Secondary transport pathways also include direct uptake by plants, ingestion, and direct contact (Formation, 2011b). The proposed NTCRA will address the key transport pathways that include pore water flow (i.e., infiltration of precipitation into the ODA) to surface water and groundwater, direct uptake by plants, ingestion, and direct contact. By addressing the pore water flow pathway to surface water, stream sediments are also expected to benefit. The streamlined risk evaluation (SRE) presented in Section 4 provides further discussion of the transport pathways and potential threats to human and ecological receptors associated with the current condition of the Pole Canyon ODA.

Dust generation by wind erosion or vehicle traffic on the Pole Canyon ODA can mobilize overburden materials and transport them to undisturbed areas downwind. However, the overburden materials are coarse and are not readily mobilized and transported via this pathway.

Runoff generated from precipitation and snowmelt cause erosion at the Pole Canyon ODA. Additionally, run-on from adjacent areas (e.g., Panel A) may also contribute to erosion. Runoff can also transport dissolved selenium and other COPCs, produced from weathering, to surface water.

Vegetation growing on the ODA is rooted directly into the overburden material over the majority of the Pole Canyon ODA. Plant uptake, although not a physical transport pathway, represents a potential exposure pathway to terrestrial ecological and human receptors.

Pore water within the ODA contains dissolved selenium that has been mobilized from the overburden material via weathering. Infiltrating precipitation and snowmelt that migrates below the evapotranspiration (ET) zone can displace the existing pore water containing selenium. Displaced pore water leaves the ODA via three primary pathways:

- seepage at the toe of the ODA;
- alluvial groundwater; and
- Wells Formation groundwater.

The volume of water and quality of water leaving the ODA via each of these pathways will be discussed in detail in the following section. Other sources of water to the ODA that can displace the pore water include run-on from adjacent areas (e.g., Panel A) and infrequent, brief periods when the infiltration basin capacity is exceeded which results temporarily standing water in the basin (NewFields, 2007a).

4.0 STREAMLINED EVALUATION OF POTENTIAL RISK

An SRE was performed to assess the potential threats to human and ecological receptors associated with the Pole Canyon ODA and to evaluate potential benefits of the NTCRA alternatives discussed in this EE/CA. The SRE focused on selenium as the indicator COPC, as discussed in Section 3.

Potentially complete significant exposure pathways for ecological receptors (e.g., terrestrial, riparian, and aquatic species) in the vicinity of the Pole Canyon ODA (Formation, 2011b) include:

- Ingestion of surface water and incidental ingestion of overburden soil, riparian soil, and sediment;
- Plant uptake of COPCs from overburden soil, riparian soil, sediment, and surface water;
- Dermal contact with surface water (fish and non-fish aquatic life);
- Dermal contact with sediment (non-fish aquatic life only); and
- Dietary uptake (food web transfer).

Potentially complete significant exposure pathways for human receptors in the vicinity of the Pole Canyon ODA (Formation, 2011b) include:

- Incidental ingestion of, dermal contact with, and radiation from overburden materials;
- Inhalation of overburden-derived particulates;
- Ingestion of wild game and fish;
- Incidental ingestion of and dermal contact with sediments;
- Ingestion of and dermal contact with surface water and groundwater;
- Ingestion of homegrown produce, terrestrial plants, and aquatic plants;
- Ingestion of Site-derived livestock (beef and/or mutton); and
- Ingestion of teas brewed from Site-derived terrestrial plants (Native American).

To provide a conservative assessment of potential risks to human and ecological receptors, concentrations of selenium in each of the media were compared to appropriate human and ecological risk-based benchmarks (Table 4-1). The conservative risk-based benchmarks represent concentrations believed to provide for adequate protection of potential receptors. Therefore, the potential for risk to human or ecological receptors is indicated when selenium concentrations exceed risk-based screening benchmarks[2] for complete exposure pathways. It should be noted that the exposure assumptions used to develop screening benchmarks could overstate risk for receptors using the Pole Canyon ODA area. The data were evaluated for usability consistent with the approach set forth in the RI/FS Work Plan (Formation, 2011b). Only Level 4 data, or Level 3 data fully usable for risk assessment (Level 4 data uses), were used in this SRE. This includes data collected as part of the Smoky Canyon Mine RI/FS (Formation, 2011b) and the SI (NewFields, 2005). The following subsections present the SRE.

4.1 Concentrations of Risk-Driving COPCs

The following sub-sections describe how concentrations (Table 4-1) of selenium, the indicator COPC for risk-driving COPCs, are clearly elevated with respect to background levels typical of the region. Additionally, selenium concentrations exceed State and Federal standards as well as screening levels for human and ecological receptors exposed to the media in and around the Pole Canyon ODA. The plausibility and potential for exposure is highest for ecological receptors using the Pole Canyon ODA area. Therefore, for the purpose of this EE/CA, screening results described in the following subsections focus on the potential ecological risks from exposure to Site media including source materials (i.e., overburden on the ODA) and vegetation growing on the ODA as well as downgradient vegetation, sediment, surface water, and groundwater. Complete risk estimates for all reasonably anticipated exposure scenarios will be evaluated during the RI.

[2] The human health soil benchmarks used for screening are based on one tenth the non-carcinogenic screening level.

Table 4-1. Summary of Risk-Driving Selenium Concentrations in Pole Canyon ODA Media[1]

	Selenium in Soil[2] (mg/Kg)			**Selenium in Vegetation[3] (mg/Kg)**			**Selenium in Sediment (mg/Kg)**			**Selenium in Surface Water (mg/L)**			**Selenium in Groundwater (mg/L)**		
	HH - 39 mg/Kg (EPA RSL) ECO - 0.63 mg/Kg (EPA EcoSSL)			**HH - NA ECO - 5.0 mg/Kg (AWRMP)**			**HH - 39 mg/Kg (EPA RSL) ECO - 2.42 mg/Kg (AWRMP)**			**HH - 0.05 mg/L (EPA MCL, IDAPA standard) ECO - 0.0050 mg/L (EPA NRWQC)**			**HH - 0.05 mg/L (EPA MCL, IDAPA standard) ECO - NA**		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Pole Canyon ODA	1.1	**148**	19.3	1.1	145	17.4	NA			NA			NA		
Pole Canyon Toe	NA			15.7	87.7	47.2	**58.1[a]**			**0.303**	**7.24**	**3.32**	NA		
Lower Pole Canyon	NA			42			9.3	**47.9**	22.2	0.0002 U	**1.091[b]**	0.0055 (excludes outlier)	**0.0897[c]** **0.157[d]**	**2.3[c]** **1.27[d]**	**0.82[c]** **0.712[d]**

Notes:

BOLD - indicates exceedance of HH screening level

Highlight - indicates exceedance of ECO screening level

Risk-Based Preliminary Regional Screening Levels are reflective of the most conservative value of the various risk-based action levels. Screening Level sources are presented in parenthesis. Human health screening benchmarks are based on a non-cancer hazard quotient of 0.1.

Screening-level benchmark information is presented and discussed in the Final Smoky Canyon Mine RI/FS Work Plan (Formation, 2011b) and the Draft 2010 Smoky Canyon Mine RI/FS DSR (Formation, 2011a). Refer to these documents for further supporting information.

1 - Based on data from the SI Report (NewFields, 2005), Pole Canyon Effectiveness Monitoring Program (Formation, 2011c), and Draft 2010 DSR (Formation, 2011a).

2 - Includes results within the 0- to 12-inch depth (SI) and 0- to 6-inch depth

3 - Includes riparian and terrestrial vegetation sample results at ODA toe, and terrestrial vegetation sample results on ODA.

a - A single value in a row indicates that only one result is available for that location and medium type.

b - The maximum concentration was observed in a sample collected at LP-PD during spring 2011 high flow, when flow into the pipeline was diverted into the infiltration basin, which filled and caused increased flows from the ODA toe seep (LP-1). Some of these larger seep flows reached the lower Pole Canyon Creek channel at LP-PD during periods of minimal or no pipeline discharges, thus temporarily increasing the selenium concentrations in lower Pole Canyon Creek (Formation, 2012).

c - Based on data collected from alluvial aquifer wells GW-15 and GW-26.

d - Based on data collected from Wells Formation well GW-16.

4.1.1 Pole Canyon ODA

The source materials addressed by this EE/CA are located at the Pole Canyon ODA. The soil and vegetation data for the Pole Canyon ODA show that selenium is present at concentrations exceeding screening benchmarks (Table 4-1) considered protective of human health and ecological receptors in both media. However, of the 24 ODA soil samples collected during the SI and RI, only two samples exceeded the human health benchmark for selenium (39 mg/Kg), whereas, all samples exceeded the ecological benchmark for selenium (0.63 mg/Kg). Also, of the 50 vegetation samples collected on the ODA, 33 samples exceeded the ecological benchmark for selenium (5.0 mg/Kg).

Although the screening benchmarks do not equate to cleanup levels and natural background levels have not been considered in this SRE, the elevated selenium concentrations in the overburden material could potentially affect ecological receptors. Specifically, elevated selenium concentrations in vegetation (e.g., the hyper accumulators) and ODA materials can pose potential risk to livestock and wildlife through the ingestion pathway, depending on exposure.

Selenium concentrations were observed above human health screening-level benchmarks in ODA materials. Therefore, potential risk to human health may exist through the ingestion and direct contact pathways (for ODA materials), depending on exposure. Human health screening-level benchmarks are not available for vegetation; however, based on the occurrence of elevated selenium concentrations in ODA materials, potential risk to human health may exist through the vegetation ingestion pathway.

4.1.2 Pole Canyon ODA Toe Seep

Vegetation, sediment, and surface water data are available at the Pole Canyon ODA toe seep for comparison with screening-level benchmarks. The elevated selenium concentrations in these media immediately downgradient from the Pole Canyon ODA (i.e., at the toe seep) indicate releases and transport from the ODA.

Vegetation – The selenium concentrations for the six vegetation samples collected in the vicinity of the toe seep exceed the ecological benchmark of 5.0 mg/Kg (Table 4-1).

Sediment – The selenium concentration (58.1 mg/Kg) in the one sediment sample collected downgradient of the toe seep exceeds the human health and ecological benchmarks of 39 and 2.42 mg/Kg, respectively (Table 4-1).

Surface Water – The selenium concentrations for the surface water samples collected at the toe seep before and after implementation of the 2008 NTCRA exceed the human health and ecological benchmarks of 0.05 and 0.0050 mg/L, respectively (Table 4-1).

The elevated selenium concentrations in the media immediately downgradient of the ODA can have the potential to adversely affect ecological receptors in the area. Specifically, elevated selenium concentrations in vegetation (e.g., the hyper accumulators), sediment, and surface water (i.e., seep water) can pose potential risk to livestock and wildlife frequenting the area. Potential risk may also exist for human receptors due to ingestion of sediment and surface water in the toe seep area.

4.1.3 Lower Pole Canyon Area

Vegetation, sediment, surface water, and groundwater data are available for the lower Pole Canyon area, between the toe seep and Sage Valley, for comparison with screening-level benchmarks. The elevated selenium concentrations in the vegetation, sediment, and groundwater media downgradient from the Pole Canyon ODA indicate releases and transport from the ODA.

Vegetation – The selenium concentration (42 mg/Kg) for the vegetation sample collected along Pole Canyon Creek downstream from the ODA exceeds the ecological benchmark of 5.0 mg/Kg (Table 4-1).

Sediment – The selenium concentrations in the four streambed sediment samples collected in Pole Canyon Creek downstream from the ODA exceed the ecological benchmark of 2.42 mg/Kg, and one of the samples exceeds the human health benchmark of 39 mg/Kg (Table 4-1).

Surface Water – With the exception of several samples collected during the spring 2011 high-flow period, only one of the surface water samples collected downstream from the ODA and also downstream from the pipeline outlet (which routes upper Pole Canyon Creek flow around the ODA) exceeded the human health and ecological benchmarks of 0.05 and 0.0050 mg/L, respectively (Table 4-1). This exceedance occurred around the time of completion for the 2008 NTCRA and, since then, selenium concentrations in surface water at this location have been an order of magnitude lower than the benchmarks. The exception in spring 2011, noted above, occurred when the bypass pipeline was operated outside of its design, in agreement with the Agencies, as discussed above for characterization of surface water conditions (Section 3.3.2). As noted, further investigations and evaluations of water quality during the spring of 2011 have been conducted as part of the 2008 NTCRA effectiveness monitoring program and the RI (Formation, 2012).

Groundwater – The selenium concentrations for the groundwater samples collected downgradient from the ODA, in lower Pole Canyon, exceed the human health benchmark of 0.05 mg/L (Table 4-1).

The significantly elevated selenium concentrations in the vegetation, sediment, and surface water in lower Pole Canyon, downgradient from the ODA, may adversely affect ecological receptors in the area. Also, the elevated selenium concentrations in alluvial and Wells Formation groundwater, and sediment, in the area downgradient from the ODA source materials can adversely affect human health, depending on exposure.

4.2 Streamlined Potential Risk Evaluation Conclusion

Complete exposure pathways likely exist for the receptors (e.g., aquatic biota, livestock, wildlife, and humans) frequenting the area in and around the Pole Canyon ODA. With consideration of the most reasonably anticipated exposure scenarios in the vicinity of the Pole Canyon ODA, selenium concentrations were measured in the overburden at concentrations exceeding the screening-level benchmarks for human receptors. Also, selenium concentrations were measured in the overburden and ODA vegetation at concentrations greater than screening-level benchmarks for ecological receptors. Therefore, the selenium concentrations in ODA overburden (i.e., source) materials indicate the potential to pose current and future potential risk to human and ecological receptors, if not addressed. Additionally, the elevated selenium concentrations in vegetation, sediment, surface water, and groundwater downgradient of the Pole Canyon ODA indicate transport of mine-related contaminants has occurred, which could pose potential unacceptable risk to human and ecological receptors. Releases of COPCs, if not addressed by implementing an NTCRA, will continue and, based on the screening-level assumptions provided in this streamlined assessment, may present potentially unacceptable risks to human health and the environment.

5.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES AND APPLICABLE AND/OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section presents the RAOs and potential ARARs for the Pole Canyon ODA. The presence of elevated concentrations of the potential risk-driving COPCs in the environmental media at and downgradient of the Pole Canyon ODA indicate potential for risk to human and ecological receptors. Current conditions at the ODA contribute to continued releases and migration of selenium and other COPCs.

Based on the potential risks identified in the SRE, above, an NTCRA at the Pole Canyon ODA is warranted. Additionally, 40 C.F.R. 300.415 lists removal action factors (factors i, ii, iv, and v) that justify an NTCRA at the ODA.

The selected NTCRA will be consistent with a potential final remedy to be developed for the Site by the RI/FS process. However, it may be necessary to augment the NTCRA with additional response actions in the future as a result of information from the RI/FS and/or performance monitoring. The NTCRA will meet ARARs to the extent practicable.

5.1 Removal Action Objectives

The following are the RAOs for the NTCRA:

- Reduce or eliminate the amount of water that infiltrates into the ODA due to direct precipitation.

- Reduce or eliminate the potential for ecological risk due to ingestion of vegetation on the ODA.

- Reduce or eliminate the potential for risk to human receptors due to ingestion of vegetation, and ingestion of and direct contact with ODA materials.

- Eliminate the release of COPCs from the ODA through sediment transport.

By addressing the RAOs, releases and migration of selenium and other COPCs to the environment, and ecological and potential human health risks, will be reduced. The NTCRA alternative selected will address the RAOs and meet or contribute to meeting ARARs.

5.2 ARARs

The development of NTCRA alternatives under CERCLA relies, in part, on the identification of the ARARs which any action must meet to the extent practicable. Similarly, the final (remedial) action must meet ARARs, unless specific ARARs qualify for a waiver and are waived. Applicable requirements are cleanup standards; standards of control; and other substantive requirements, criteria, or limitations promulgated under Federal or State laws that specifically address a hazardous substance, constituent, removal action, location, or other circumstance found at a site. Relevant and appropriate requirements, while not applicable to a hazardous substance, pollutant, contaminant, removal action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the site such that their use is well-suited (40 C.F.R. 300.5).

In addition to ARARs, many Federal and State environmental and public health programs also have criteria, advisories, and guidance that are not legally binding but may provide useful information or recommended procedures. These To-Be-Considered (TBC) standards complement ARARs and are identified for use in guiding remedial actions.

In the Smoky Canyon Mine RI/FS Work Plan (Formation, 2011b), Simplot conducted a preliminary identification of potential ARARs (chemical-specific, location-specific, and action-specific). This analysis has been refined relative to specific conditions found in the Pole Canyon and the scope of potential actions to be performed. A summary of potential ARARs and TBCs are presented in Tables 5-1 and 5-2, respectively.

The source-control action at the Pole Canyon ODA will reduce the release of selenium and other COPCs to groundwater, surface water and sediments downgradient of the ODA. It is intended to reduce the potential for risks to wildlife and livestock from direct contact and ingestion. The goal of the Early Action is not necessarily to meet the chemical-specific ARARs identified in Table 5-1. If chemical-specific or location-specific ARARs are not achieved by the Early Action, then additional actions to meet these ARARs will be addressed as part of the RI/FS.

Table 5-1. Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs)

	Standard, Limitation, or Requirement Criteria	Citation	Description	Comments	Category[1]
Federal					
Chemical-Specific	Safe Drinking Water Act	42 U.S.C. §§ 300f et seq.	Protection of public water systems and underground sources of drinking water	Groundwater downgradient of the Pole Canyon ODA is not a current drinking water source. Wells Formation groundwater outside the area affected by the Pole Canyon ODA is a source of drinking water at the Smoky Canyon Mine. Wells Formation groundwater is the typical source of drinking water in domestic wells, but no such wells are present in the area affected by Pole Canyon.	Relevant and Appropriate
	National Primary Drinking Water Regulations	40 C.F.R. Part 141	Establishes health-based standards (Maximum Contaminant Levels, MCLs) for public water systems	MCLs and nonzero Maximum Contaminant Level Goals (MCLGs) may be applicable or relevant and appropriate as groundwater contaminant concentration goals depending on whether the water in question is to be used for drinking water supply. MCLs are applicable if the water is or will be used for drinking. MCLs are relevant and appropriate if the water could be used for drinking. MCLGs set above zero levels are relevant and appropriate for current or potential sources of drinking water.	Relevant and Appropriate
	Clean Water Act	33 U.S.C. §§ 1251 et seq.	Water pollution prevention and control		Applicable
	Water Quality Standards	40 C.F.R. Part 131	Sets criteria for water quality based on toxicity to aquatic organisms and human health		Applicable
	National Recommended Water Quality Criteria November 2002	Section 304(a) of CWA EPA-822-R-02-047	Recommended water quality criteria for the protection of aquatic life and human health in surface water		Applicable
	National Emission Standards for Hazardous Air Pollutants	40 C.F.R. 61	Recommended air pollutant restrictions		Relevant and Appropriate
	National Pollutant Discharge Elimination System (NPDES) Permit Regulations	40 C.F.R. § 122 to 125	Permitting requirements for the discharge of "pollutants" from any "point source"	No discharge permit is contemplated under the Early Action	Relevant and Appropriate
Action-Specific	Surface Mining Control and Reclamation Act	30 U.S.C. § 1201 30 C.F.R. Part 816 30 C.F.R. Part 784	Permanent program performance standards for surface mining activities. Minimum requirements for reclamation and operations.		Relevant and Appropriate
	Resource Conservation and Recovery Act	42 U.S.C. §§ 6901 et seq. 40 C.F.R. Parts 260-265 and 268	Sets criteria for hazardous waste management	Would be applicable if hazardous wastes were identified in the Early Action area. Based on sampling data and site history, none have been identified.	Applicable
	Archaeological and Historic Preservation Act	40 C.F.R. § 6.301(c) 16 U.S.C. 469 et seq.	Data recovery and preservation activities		Applicable
	National Historic Preservation Act (NHPA), Archaeological Resources Protection Act, and National Historic Landmark Regulations	16 U.S.C. §§ 470 et seq. 43 C.F.R. 7 36 C.F.R. 60, 63, 65 & 800 40 C.F.R. 6.301(b & c)	Section 106 of NHPA process balances needs of Federal undertaking with effects the undertaking may have on historic properties		Applicable
	Historic Sites, Buildings, Objects, and Antiquities Act	16 U.S.C. § 461 et seq. 40 C.F.R. 6.301(a) 36 C.F.R. 62	Procedures to preserve archaeological or historical sites		Applicable
	Migratory Bird Treaty Act	16 U.S.C. §§ 703 et seq.	Taking, killing, possessing migratory birds and migratory game birds	Substantive requirements are applicable. However, the taking of game is not anticipated for this NTCRA.	Applicable
	Fish and Wildlife Coordination Act	16 U.S.C. § 661 et seq. 16 U.S.C. 1531 - 1544 40 C.F.R. 6.302(g)	Fish and wildlife protection: requires Federal agencies involved in actions that will result in the control or structural modification of any natural stream or body of water for any purpose, to take action to protect the fish and wildlife resources that may be affected by the action.	Substantive requirements are applicable to on-site actions.	Applicable
	Endangered Species Act	7 U.S.C. 136 16 U.S.C. 460 16 U.S.C. §§ 1531 et seq. 50 C.F.R. Part 402 40 C.F.R. § 6.302	Substantive requirements include prohibition against taking an endangered or threatened species. If such species are present, the Fish and Wildlife Service will be consulted.	Substantive requirements are applicable to on-site actions.	Applicable
	Bald and Golden Eagle Protection Act	16 U.S.C. §§ 668 et seq. 50 C.F.R. 22	Protection of the Bald and Golden Eagles		Applicable
	Clean Air Act	40 C.F.R. 50 42 U.S.C. 7401 et seq.	Protection of the nation's air quality		Relevant and Appropriate

Table 5-1. Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs) (Con't)

	Standard, Limitation, or Requirement Criteria	Citation	Description	Comments	Category[1]
Location-Specific	Protection of Floodplains	40 C.F.R. § 6.302 40 C.F.R. 6 Appendix A	Regulates construction in floodplains	No floodplains present in Early Action area.	Not an ARAR
	Protection of Wetlands	40 C.F.R. § 6.302 40 C.F.R. 6 Appendix A	Wetlands Protection: Executive Order 11990 requires agencies conducting certain activities to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.	No wetlands present in Early Action area	Not an ARAR
	2003 Revised Forest Plan for the Caribou National Forest & 1997 Revised Forest Plan – Targhee National Forest		Provides guidance for all natural resource management activities and establishes management standards within the Caribou-Targhee National Forest.		Applicable
	National Forest Management Act of 1976 and Forest and Rangeland Renewable Resources Planning Act of 1971	16 U.S.C. 1600 36 C.F.R. 219	Guidance for natural forest system land management and resource planning		Applicable
	Federal Land Policy and Management Act of 1976 (FLPMA)	43 U.S.C. 1701 - 1771; 1782	Public lands and their resources are periodically and systematically inventoried and their present and future use is projected through a land use planning process. The land will be managed for use and protection of the land and its natural resources.		Not likely to be an ARAR for most land administered by the Forest Service
	Considering Wetlands at CERCLA Sites Guidance	OSWER 9280.03	Guidance to evaluate potential impacts on wetlands	No wetlands present in Early Action area.	Not an ARAR
State of Idaho					
Chemical-Specific	Idaho Water Quality Standards	IDAPA 58.01.02	Water quality standards and wastewater treatment requirements, including but not limited to: Administrative policy for protection of waters of the State (.050.02); Antidegradation policy (.051); Mixing zone policy (.060); Violation of water quality standards (.080); Analytical procedures (.090); Surface water use designations and nondesignated surface waters (.100 to .101); Designations of surface waters found within Salmon Basin (.130); General surface water quality criteria (.200); Surface water quality criteria for aquatic life, recreation, water supply, wildlife and aesthetics use designations (.250 to .253); Variances from water quality standards (.260); and Site-specific surface water quality criteria (.275)		Applicable
	Public Drinking Water Systems Rules	IDAPA 58.01.08	Control and regulate the design, construction, operation, maintenance, and quality control of public drinking water systems to provide a degree of assurance that such systems are protected from contamination and maintained free from contaminants which may injure the health of the consumer.	No public drinking water systems are present downgradient of Pole Canyon. Would be applicable if one were constructed.	Applicable
	Idaho Ground Water Quality Rule	IDAPA 58.01.11.200	Numerical and narrative standards that apply to all groundwater of the State		Applicable
	Rules and Standards for Hazardous Waste	IDAPA 58.01.05	Rules and standards for hazardous waste		Applicable
	Idaho Hazardous Substance Emergency Response Act	Idaho Code §§39-7101 to 7115	Facilitates emergency response planning and requires expedient response and/or containment for hazardous substance release.		Relevant and Appropriate
Action-Specific	Solid Waste Management Rules	IDAPA 58.01.06	Establishes requirements applicable to all solid waste and solid waste management facilities		Applicable
	Idaho Surface Mining Act	Idaho Code, Title 47, Chapter 15	Procedures for reclamation and vegetative planning		Relevant and Appropriate
	Exploration and Surface Mining Rules	IDAPA 20.03.02	Best management practices and reclamation for surface mining operations		Relevant and Appropriate
	Air Pollution Control Rules	IDAPA 58.01.01	These rules provide for the control of air pollution in Idaho		Relevant and Appropriate
	Idaho Classification and Protection of Wildlife Rule	IDAPA 13.01.06.300	Classifies fish and wildlife species, identifies species of special concern, and protection of wildlife species from taking and possessing.		Applicable
	Protection of Animals and Birds	Idaho Code §36-1101 to 1103	Prohibits taking of wildlife, birds and fur-bearing animals. Declares exceptions.		Applicable
Location-Specific	Preservation of Historical Sites	Idaho Code Title 67, Chapters 46 and 41	Guidance to preserve historical, archeological, architectural, and cultural heritage		Applicable
	Safety of Dams Rules	IDAPA 37.03.06	Guidance to establish acceptable standards for construction and to provide for safety evaluation of new or existing dams.	No dams are present in Early Action area.	Not an ARAR
	Stream Channel Alteration Rules	IDAPA 37.03.07	Prevent alterations which will be a hazard to the stream channel and its environment.	No stream channel alteration will occur in Early Action area.	Not an ARAR
	Idaho Water Quality Act	Idaho Code, Title 39, Chapter 36	Procedures to preserve water quality		Applicable
	Mine Tailings Impoundment Structure Rules	IDAPA 37.03.05	Applies to structures upon which construction, lift construction, enlargement, or alteration is underway on or after July 1, 1978. Establishes design criteria.	No tailings impoundments are present in Early Action area	Not an ARAR

Note: 1. The determination of whether an ARAR is applicable, relevant and appropriate, or a TBC is preliminary, and the final determination will be made by the USFS as part of the Action Memorandum.

Table 5-2. To Be Considered Documents

	Standard, Limitation, or Requirement Criteria	Citation	Description	Comments	Category[1]
Federal					
Chemical-Specific	NOAA Freshwater Sediment Benchmarks	(Buchman, 1999)	Benchmarks for freshwater sediments	Benchmarks are not promulgated and therefore do not rise to the level of an ARAR.	TBC
Action-Specific	American Indian Religious Freedom Act	42 U.S.C. §§1996 et seq.	Protection of traditional culture and religious rights and practices of Native Americans		TBC
Location-Specific	Pocatello Field Office Proposed Resource Management Plan and Final Environmental Impact Statement	U.S. BLM FES 10-12	This Proposed Resource Management Plan and Final Environmental Impact Statement describe and analyze the impacts of four alternatives for managing the public lands administered by the Pocatello Field Office in southeastern Idaho.		TBC
	Native American Graves Protection and Repatriation Act	25 U.S.C. §§ 3001 et seq. 43 C.F.R. 10	Protects Native American cultural items including human remains, funerary objects, sacred objects, and objects of cultural patrimony		TBC
State of Idaho					
Chemical-Specific	Secondary Drinking Water Regulations	IDAPA 58.01.08.400	Establishes welfare-based standards (secondary MCLs as defined in 40 C.F.R. Part 143) for public water systems.		TBC
Action-Specific	Idaho Non-Point Source Management Plan		Guidance to protect or restore (where possible) the beneficial uses of the State's surface and groundwater		TBC
	Catalog of Stormwater Best Management Practices for Idaho Cities and Counties		Procedures to control erosion and sediment during and after construction		TBC
Location-Specific	Selenium Area Wide Investigation Area Wide Risk Management Plan		Discretionary guidance document to assist in mine-specific risk management		TBC

Note: 1. The determination of whether an ARAR is applicable, relevant and appropriate, or TBC is preliminary, and the final determination will be made by the USFS as part of the Action Memorandum.

6.0 TECHNOLOGY SCREENING

This section uses the information provided in previous sections to identify and preliminarily evaluate technologies to be used in the development of the NTCRA alternatives. Technologies selected for evaluation were based on potential application to conditions at the Pole Canyon ODA and experience implementing the technologies at other similar sites. Technologies presented in the *Best Management Practices Guidance Manual for Active and Future Phosphate Mines* (Montgomery Watson, 2000) and in *Selenium Management Practices* (USFS et al, 2005) were also considered. The discussion is structured by the technology types evaluated for specific conditions at the Pole Canyon ODA. Fundamental considerations regarding the selection of technologies for NTCRA alternative development are presented, including general implementability, effectiveness, and cost.

6.1 Excavation and Disposal

Overburden could potentially be excavated from the Pole Canyon ODA and transported to an off-site location for disposal; there are no suitable on-site locations to dispose the approximately 26 million cubic yards of material. Excavation and transport to an off-site facility is likely to be implementable and effective with minimal need for post-removal site controls (PRSCs). However, costs associated with this alternative are substantial when considering equipment, staff, transportation, and disposal costs. Removal and relocation of the overburden from the Pole Canyon ODA would be costly to implement. However, it may reduce long-term exposure to overburden materials. Overburden removal using 150-ton capacity haul trucks was calculated to require approximately 300,000 trips to move the estimated 26,000,000 cubic yards of material. A substantial equipment fleet would be required to load, transport, haul, distribute, and reclaim such a large volume of material in a reasonable time. For another CVF in the phosphate mining area of southeast Idaho, the USFS estimated a cost of $63 per ton to transport material, assuming a travel distance of 50 miles to the landfill (USFS, 2011b). Using that value, the anticipated cost to remove the overburden would exceed $1,500,000,000. In addition, short-term risks would be increased due to the volume of truck traffic. The National Highway Traffic Safety Administration has calculated that there were 1.14 fatalities per 100 million miles driven in the US in 2009 (NHTSA, 2011). For the off-site disposal of overburden described above, trucks would have to drive 3,000,000 miles, equating to approximately 3% chance of a fatality during transportation using the average statistic.

Removing the overburden material from Pole Canyon ODA is not retained for further evaluation due to the high cost of implementation and likelihood of this option creating additional environmental impacts to the region through excessive truck traffic.

6.2 Surface Water Management

Surface water management technologies are commonly used as a component of source control technologies for remediation of mining wastes. There is a comprehensive set of controls for the development of phosphate mining sites in southeast Idaho, including the management of water to reduce infiltration through overburden, thus reducing releases of selenium to the environment. Several surface water management controls already implemented at the Pole Canyon ODA are described below.

Diversion Ditches for Run-on and/or Runoff Control – A diversion ditch is constructed to divert an influx of surface water runoff away from or around an area or to reduce the surface erosion potential from runoff resulting from excess precipitation on a land or closure surface. A diversion ditch was installed as part of the 2008 NTCRA to collect run-on from the adjacent hillside to the north and convey it to Pole Canyon Creek below the ODA. Diversion ditches may be used, in combination with grading and reshaping, to minimize contact with ODA materials by reducing pooling and infiltration into the ODA and to protect a cover system by reducing erosion. Diversion ditches for run-on control were implemented in the 2008 NTCRA and are not retained for future actions. Runoff control technologies (i.e., as part of a cover system) are retained for the development of NTCRA alternatives.

Stream Alteration – Altering a stream refers to obstructing, diminishing, modifying, or otherwise relocating the natural existing shape or direction of flow of any stream channel within or below the mean high watermark. Stream alteration or diversion can be considered when natural flow needs to be diverted away from a mine pit, overburden pile, sedimentation pond, or other mine facility. Stream alteration was a key element of the 2008 NTCRA (routing of Pole Canyon Creek flow in a pipeline around the ODA, and infiltration of the portion of Pole Canyon flow that is generated between the pipeline inlet and the ODA). This technology is not retained for the development of NTCRA alternatives.

6.3 Grading and Reshaping

Grading and reshaping technologies are commonly used as a component of surface water management in remediation of mining wastes and in other applications in remediation of mining waste. As referenced above, there is a comprehensive set of controls for the development of phosphate mining sites in southeast Idaho, including slope shaping and terracing of slopes to reduce slope lengths. These controls improve runoff and reduce erosion potential. Several grading and reshaping technologies are described below.

Slope Shaping – Slope shaping involves modifying cut and fill slopes to reduce soil erosion and potential erosion from surface water runoff. This technology can be highly effective and practical when applied correctly. For the best application of slope shaping, grading should result in slopes and lengths that will be stable, with minimal erosion, in the long term. Slope lengths should be minimized and areas with low slopes maximized to control erosion potential in areas of slope shaping. Where slopes steeper than 3:1 are unavoidable, other erosion control measures may be required such as contour terracing, benches, and erosion control/turf reinforcement mats. Slope shaping is retained for the development of NTCRA alternatives.

Contour Terraces – Contour terraces are earth embankments and channels constructed along the contour on the slope face. This technology is primarily intended to reduce overland runoff flow lengths, thus decreasing the potential for erosion on long hill slopes and/or in highly erodible soils. Contour terraces can be designed as benches, steps, or serrations. In addition to providing reduced erosion potential, contour terraces can provide access for maintenance equipment after reclamation. These terraces should be constructed to allow runoff to freely occur by including a slight gradient to prevent flow accumulation or ponding. Contour terraces can be used on any slope, but are increasingly effective for areas with steeper slopes. The contour terrace option is retained for the development of NTCRA alternatives.

6.4 Surface Modification and Cover

Surface modification and cover refer to actions on source areas that provide a physical barrier to reduce exposure of ODA materials to weathering conditions, prevent contact with materials of concern, or modify surface conditions to address environmental concerns. At Pole Canyon ODA, surface modification could reduce water infiltration or the potential for selenium-accumulating vegetation to take up selenium. These actions are applicable to large surface areas such as the surface of ODAs. These actions can be used alone or in conjunction with the surface water management and grading and reshaping technologies discussed above. Several surface modification and cover actions are described below.

Capping – There are a variety of capping technologies that are available for reclamation of overburden. Cover systems can be simple or complex, consist of one or multiple layers, and can be designed with natural or synthetic materials. Examples include soil cover, geosynthetics such as geomembrane (GM) and geosynthetic clay laminate liner (GCLL), or local materials such as fragments of Chert, Dinwoody Formation, and/or Salt Lake Formation (a detailed discussion of locally available Dinwoody as a cover material is provided, below, in Section 6.5). Such covers can prevent direct contact in situations where source materials are present at the surface. A GCLL includes a layer of bentonite clay inserted between two geotextile layers. The top geotextile layer is laminated with a polyethylene geomembrane layer, providing an additional layer of protection against dessication and ion exchange degradation. If a low permeability cover such as GM or GCLL is used, an overlying natural or geosynthetic drainage layer must be placed just below the soil or rock cover and the closure slope generally needs to be flatter than 3:1 to achieve stability of the cover over the geosynthetic materials. If a GM is selected, it must have high internal shear strength to provide stability on side slopes steeper than 5:1. Final slopes of 4:1, or flatter, are not feasible for a significant portion of the ODA; therefore, geosynthetics would need to be designed for final side slopes of 3:1. For side slopes of 3:1, additional anchoring of the geosynthetics is also required and angular gravel or rock is required above a geotextile for stability of this layer. The use of geosynthetics is retained as a possible cover technology for the Pole Canyon ODA.

Chert/limestone barriers are used as a Best Management Practice (BMP) in current phosphate mining in southeast Idaho. When installed directly above the run-of-mine overburden, chert/limestone provides an additional thickness of non-seleniferous overburden within the cover profile to prevent vegetation from rooting in overburden materials higher in selenium (i.e. center waste shale) to prevent vegetative uptake and potential risk to grazing or foraging animals. Additionally, its coarse texture and corresponding low water-holding capacity result in unfavorable conditions for root advancement through the chert/limestone and into the run-of-mine overburden. Chert may also help prevent small mammals from burrowing into the overburden material. Chert/limestone is available from current mining at Panel F, and has a generally coarse composition dominated by gravels with some sands and few fines.

Potential use of chert/limestone for cover material was evaluated as part of the EE/CA process. Due its coarse textural composition, chert/limestone is unfavorable as a growth medium without additional amendments (i.e., would not support vegetation growth); if used as a surface cover material, chert/limestone would actually result in increased infiltration compared with the existing overburden due to its high saturated hydraulic conductivity. Therefore, use of chert/limestone was considered only as a non-seleniferous layer between the growth medium and run-of-mine overburden. In this position in the cover system, the thickness of the chert/limestone cover does little to influence the amount of net percolation into the underlying overburden. Therefore, the thickness of chert/limestone should be determined based on its function as a non-seleniferous material; a minimum thickness of 2 feet is recommended. The rate of generation and availability of chert/limestone is a key factor in the scope and timing of implementation. This option is retained for development of NTCRA alternatives.

Soil Cover – Two types of soil covers are considered – an ET cover and a conventional soil cover. An ET cover is a soil cover that functions as a “reservoir” in which soil moisture can be replenished during wet periods (e.g., snowmelt) and stored for later use by vegetation. This type of cover is typically 4 feet or more in thickness. An ET cover usually has a thick enough soil layer to provide adequate growth material for plant roots. It is common, but not required, for the thickness of ET covers to prevent roots, and possibly burrowing animals, from entering into underlying layers.

A conventional soil cover can provide a physical barrier between the vegetation root zone and ODA materials, thus reducing the potential for selenium uptake by selenium-accumulating plants along with preventing direct contact and ingestion by potential receptors. As a component of a capping system, a soil cover should be designed to provide a suitable growth medium for long-term sustainability of vegetative cover as described below. Conventional soil covers with vegetation are 12 to 18 inches in thickness. The conventional soil cover and thicker

ET cover are retained for the development of NTCRA alternatives. These covers would be constructed of Dinwoody material, as discussed above.

Vegetative Cover – Establishing vegetative cover is a standard surface reclamation technology for backfilled pits and external ODAs. In addition to stabilizing surface materials by reducing erosion potential, a well-vegetated cover increases ET at the surface and reduces water infiltration into overburden and subsequent release of selenium. The 2006 Smoky Canyon Mine EE/CA (NewFields, 2006), suggested that infiltration may be decreased by as much as roughly 50 percent by establishing a well-vegetated cover on poorly vegetated overburden. Although this 50 percent reduction was not determined from modeling, it was applied to several alternatives to roughly estimate the potential benefits of establishing a good vegetative cover.

Planting of native species that have low affinity for selenium uptake may be effective in reducing potential risks to grazing livestock and ecological receptors. Also, a vegetative cover improves aesthetics. Vegetative cover is retained for development of NTCRA alternatives.

Soil Amendment and Fertilization – The use of soil amendments and fertilizers, in combination with proper seedbed preparation, topsoiling, planting methods, selection of species, and soil moisture storage, greatly enhance the chance of revegetation success. Fertilizers add nutrients to soils, facilitate plant establishment, accelerate plant growth, and maintain plant productivity.

Direct amendment and fertilization of overburden shales involves incorporation of amendments and application of fertilizer directly to these materials. This can accelerate the production of biomass, which provides long-term nutrients that enhance vegetative growth and potentially result in a decrease in infiltration.

Simplot conducted several pilot studies since 2004 involving evaluation of productivity and selenium uptake of vegetation growing in amended Smoky Canyon Mine impoundment materials and overburden. Simplot also initiated a greenhouse study in June 2004 to evaluate grasses growing in Smoky Tailings impoundment material amended with various mixtures of organic amendment (cow manure) and soil (NewFields and Redente, 2005). Selenium concentrations in the tailings ranged from 14 to 25 mg/Kg. The grass species in the greenhouse study included:

- Big bluegrass (*Poa ampla*)
- Bluebunch wheatgrass (*Pseudoroegneria spicatum*)
- Great Basin wildrye (*Elymus cinereus*)
- Idaho fescue (*Festuca idahoensis*)

The main treatments included tailings only, 6 inch soil cover over 18 inches of tailings, 12 inch layer of tailings mixed with soil (50:50 and 75:25) over 12 inches of tailings, and soil control (24 inches of soil). All treatments included the addition of inorganic fertilizer (nitrogen, phosphorus and potassium). Results show that the addition of organic amendment (as cow manure) yielded lower concentrations of selenium in plant tissue among the plant species tested. Vegetation from treatment plots without manure amendment consistently had selenium concentrations that exceeded the 5 mg/Kg level.

Simplot initiated an additional greenhouse study in June 2006 to evaluate grasses growing in amended Pole Canyon overburden material (NewFields, 2008). The grass species in the greenhouse study included:

- Slender wheatgrass (*Elymus trachycaulus*)
- Bluebunch wheatgrass
- Great Basin wildrye
- Mountain brome *(Bromus marginatus)*

Overburden material for this study was treated with various rates of organic amendment (cow manure) and inorganic fertilizer (nitrogen, phosphorous, and potassium). Results show that treatments with manure amendment had lower selenium concentrations than the non-amended control, and selenium concentrations decreased with increasing amounts of manure amendment.

In 2007, a long-term (5-year) field-scale pilot study was conducted to evaluate grasses growing in amended tailings at Smoky Tailings impoundments (NewFields and Redente, 2006). Selenium concentrations in the tailings treated with various amendments ranged from 11 to 16 mg/Kg. The following grass species were seeded in the pilot study test plots:

- Mountain brome
- Bluebunch wheatgrass
- Slender wheatgrass
- Western wheatgrass (*Pascopyrum smithii*)
- Idaho fescue
- Sheep fescue (*Festuca ovina*)

- Great Basin wildrye
- Western yarrow (*Achillea millefolium*)
- Small burnet

The tailings were treated with various rates of manure, wood, or straw amendments, and tillage depths. For the first four years of data, treatments with each of the amendments yielded plants with low selenium concentrations (<1.0 mg/Kg). Also, amended treatments produce sustainable coverage of desired species with low selenium concentrations.

While these studies show decreased uptake of selenium by plants and increased vegetative growth for amended and fertilized tailings or overburden, direct amendment and fertilization do not address the ingestion and direct contact exposure pathways. Therefore, direct amendment and fertilization of overburden shales is not retained for development of NTCRA alternatives. However, the soil amendment and fertilization option is retained for development of NTCRA alternatives in the context of improving the growth potential for Dinwoody or other soil materials when used for caps or covers.

Species Modification – Modifying the vegetation to reduce the proportion of selenium-accumulator species would help reduce the average selenium content in vegetation. Higher concentrations of selenium in forage samples collected from the Pole Canyon ODA may result from the presence of selenium-accumulating species in the samples (Kabata-Pendias, 2001). Long-term monitoring of seeded areas is required to maintain an appropriate and diverse vegetation community and prevent invasion of undesirable species; in some cases, application of selective herbicide may be needed to control weeds. Reducing or eliminating the presence of selenium-accumulator species, and replacement with non-accumulating species, is retained for development of NTCRA alternatives. The use of non-selenium accumulating species to revegetate graded areas is consistent with future actions to be considered at the Smoky Canyon Mine. Selenium uptake in vegetation for the rest of the site will be fully addressed in the RI/FS. It is expected that the selenium uptake in vegetation for the Pole Canyon ODA will be fully addressed through this EE/CA.

6.5 Dinwoody as a Cover Material

There is a distinct, site-specific opportunity to utilize a natural and locally available cover of Dinwoody at the Pole Canyon ODA. The quantity and relative availability of Dinwoody at the Smoky Canyon Mine for CERCLA response actions is unique in the Southeastern Idaho Phosphate Mining District due to on-going mining and also the close proximity of potential Dinwoody borrow sources in the on-lease area.

The Dinwoody Formation covers a large area and extends throughout the Smoky Canyon Mine (Figures 2-1 and 2-2). Although there is some variability in the composition and material properties of Dinwoody in the area, it is generally comprised of interbedded siltstone, shale, and limestone that grade into a calcareous shale and siltstone with depth. Typically, Dinwoody is a well-graded, fine-textured material with a low saturated hydraulic conductivity and a high moisture storage capacity.

Investigation of Dinwoody material as part of on-going mining at Panel F has indicated that there are two distinct types: Type A and Type B. These two types of Dinwoody are weathered to different extents; with the more highly weathered Type A overlying the less weathered Type B. However, it has been observed that Type B material weathers quickly once exposed to the elements. Figure 6-1 shows the Visual Delineation Method (VDM) that the mine engineers have developed to identify Dinwoody cover material in Panel F. A typical cross section is shown on Figure 6-2.

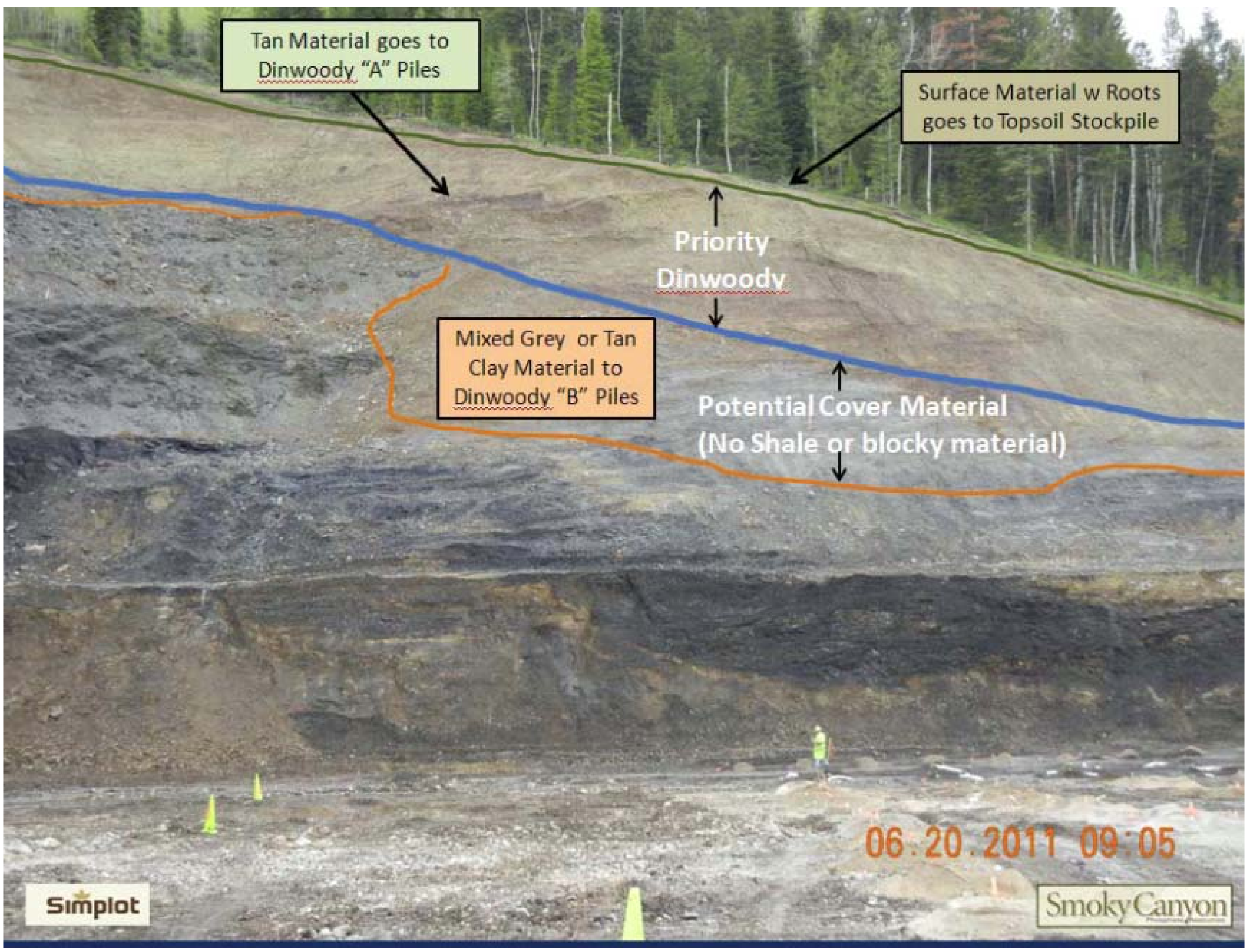

Figure 6-1: Visual Delineation of Dinwoody Material in Panel F.

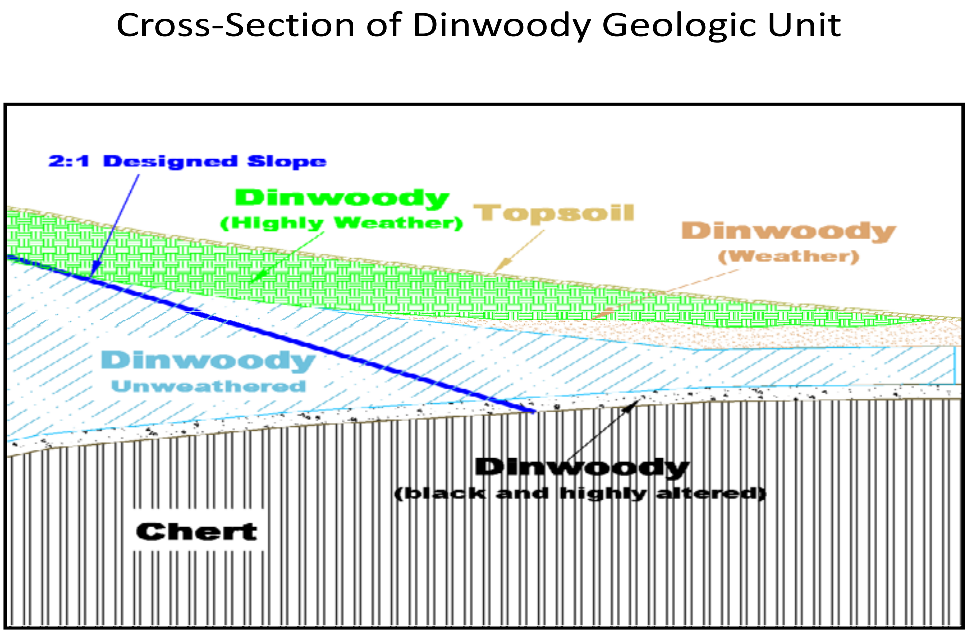

Figure 6-2: Cross Section of Dinwoody Geologic Unit

As shown, the Type A material follows the surface topography, whereas, the total Dinwoody geologic unit follows the general dip of the Meade Peak formation in the region. The Type A material is approximately 40 feet thick across the mine area. A recent drilling program confirmed that the weathered portion of the Dinwoody unit follows the surface topography. During recent drilling programs, Simplot logged cuttings and identified several distinct geologic layers such as the Dinwoody unit which included specification of Dinwoody by type, a 10- to 15-foot-thick layer of material below the Dinwoody that was typically very hard and blocky, and a layer of chert underlying the blocky material.

6.5.1 Material Properties and Use of Dinwoody

The properties of Dinwoody material generally result in its suitability for use as a cover material. The gradation and texture of Dinwoody provide a growth medium that can support vegetation, and its low saturated hydraulic conductivity reduces net infiltration.

Material testing and database reviews of Dinwoody indicate a typical particle size distribution of 19% gravels, 23% sands, and 58% fines, and saturated hydraulic conductivity, K_{sat}, typically ranging from $1.0x10^{-6}$ to $1.6x10^{-4}$ cm/sec (O'Kane Consultants, 2006). Depending on the extent of weathering, Dinwoody soil textures range from clay to loam, including sandy clay loam.

Typical soil-water characteristic curve data show Dinwoody with a field capacity (-33 kPa) at 34% moisture content and wilting point (-1,500 kPa) at 23% moisture content (O'Kane Consultants, 2006). Additional information on Dinwoody characteristics is provided in the report entitled "Smoky Canyon Mine Proposed "F" and "G" Panels Expansion – Material Characterizations used for the Modeling of Soil Cover System Alternatives" (O'Kane Consultants, 2006). Also, material property data from recent testing of Dinwoody material for use in a soil cover at the Mine are presented in the report entitled "Dinwoody Cover QA/QC Phase I Test Program Report – Draft Final Report" (O'Kane Consultants, 2010).

To improve the suitability of Dinwoody material as a growth medium, addition of fertilizer and an organic material amendment may be needed based on the results of agronomic soil tests for Dinwoody from specific sources. Agronomic testing for Dinwoody used in Panel E (in 2007) show organic matter content ranging from 1.4 to 2.5% and nitrate-N, phosphorus, and potassium averaging 4, 15, and 195 ppm, respectively. The Dinwoody material types and sources for use in the Pole Canyon ODA cover will be characterized for agronomic properties as part of preliminary/pre-design work.

Another benefit of using Dinwoody material is its effectiveness in reducing infiltration when used as a cover material. To assess the relative effect of varying thicknesses of Dinwoody cover on reducing infiltration, the U.S. Army Corps of Engineers (USACE) Hydrologic Evaluation of Landfill Performance (HELP) Model was run using a constant saturated hydraulic conductivity, K_{sat}, for a range of thicknesses (assuming all material is from the same source). As shown in Table 6-1, there is minimal additional reduction in predicted infiltration for Dinwoody covers thicker than 3 feet.

Table 6-1. Comparison of Material Volume and Net Percolation for Various Thicknesses of Dinwoody Covers

Thickness of Dinwoody Cover (feet)	Required Volume of Dinwoody Material (cubic yards)	Predicted Average Annual Net Percolation (inches)	% Reduction in Net Percolation Compared to Current Conditions
0	0	4.86	0%
1	193,500	2.80	42%
2	387,000	1.84	62%
3	580,500	1.06	78%
4	774,000	1.04	79%
5	967,500	1.04	79%

Note: For comparison of Dinwoody cover thicknesses, material properties were kept constant (saturated hydraulic conductivity, Ksat, was set at $1x10^{-4}$ cm/sec). This enables comparisons of the effects from varying only the material thickness.

6.5.2 Site-Specific Experience with Dinwoody Covers

In the mid- to late-2000s, Simplot constructed cover systems at Panel E utilizing Dinwoody material. Also, Simplot has conducted technical evaluations and prepared plans for constructing the permitted store-and-release cover system, which utilizes Dinwoody material, at Panels F and G as specified in the Final EIS (BLM, USFS, and IDEQ [2007]). The cover system selected for reclamation at Panels F and G was subject to considerable agency review and public comment. Recent field studies (described below) have proven the effectiveness of the Dinwoody material for infiltration reduction.

6.5.2.1 Demonstration at Panel E

Simplot has demonstrated the effectiveness of utilizing Dinwoody for cover systems on Panel E. In particular, the Dinwoody cover placed on Panel E has provided stable reclamation surfaces and resulted in successful growth of vegetation. Areas covered included more than 45 acres in the Panel E Pit E-2, Pit E-3, and external ODA in 2007; more than 202 acres in the Panel E Pits E-1s, Pit E-2, and Pit E-3 in 2008; and more than 4 acres at the Panel E external ODA in 2010. The covers placed in 2008 consisted of 0.5 to 1 foot of topsoil over 2 feet of Dinwoody over 2 feet of chert. In 2010, the same general cover system was placed with the exception that the thickness of topsoil was 1 foot and Dinwoody was increased to 3 feet. Prior to its first use as a cover material in 2007, Dinwoody material was sampled from two locations in Panel E and analyzed for moisture, grain size distribution, density, and permeability (Buck, 2007). As expected from previous sampling, the samples showed that Dinwoody is a fine-grained, low permeability material. Additionally, Dinwoody material characteristics met the general recommendations for a soil moisture storage layer, as part of a cover system, by its properties of fine-textured material with high water retention, low saturated hydraulic conductivity, low shrink-swell potential, low erosivity, high shear strength, and appropriate agronomic properties (Buck, 2007).

After placement of Dinwoody covers on Panel E areas, on-site observations by Simplot personnel indicate its effectiveness at shedding water and, thereby, reducing infiltration. In addition, visual observations indicate that vegetation growth in areas with Dinwoody covers is similar to growth in other reclaimed areas.

6.5.2.2 Permitted Future Use at Panels F and G

The substantial reviews conducted for the Panels F and G Final EIS supports the use of Dinwoody material in cover systems at the Smoky Canyon Mine. In October 2007, the USFS, BLM, and IDEQ released the Final EIS for Panels F and G at the Smoky Canyon Mine. The Final EIS identifies a preferred alternative for covering all areas of seleniferous overburden with a store-and-release cover. The store-and-release cover would consist of 1 to 2 feet of topsoil over 3 feet of Dinwoody over 2 feet of chert. The cover was designed to effectively reduce net percolation through overburden into the groundwater, reduce vegetation uptake of selenium, and isolate the seleniferous overburden from direct exposure by humans and ecological receptors.

Simplot conducted considerable hydrologic and geotechnical studies of the cover system to improve its potential performance and address concerns identified from review of the previously submitted Draft EIS. Each of the materials in the cover system and underlying material (i.e. topsoil, Dinwoody, chert, and run-of-mine center waste shale) was tested for its hydraulic and moisture retention properties. Dinwoody was determined to have a low permeability and high water-holding capacities. Different cover configurations were also analyzed using one- and two-dimensional unsaturated zone water infiltration models.

6.5.3 Availability of Dinwoody

Simplot has unique access to Dinwoody at the Smoky Canyon Mine for use in CERCLA response actions due to the excavation of large volumes of Dinwoody to access phosphate ore as part of active mining. The quality of Dinwoody available from these mining operations varies depending on mine sequencing and blending constraints that are independent of the Pole Canyon ODA cover needs. The first priority for Dinwoody mined from Panel F is to conduct a suitability analysis for its potential use to meet requirements for the Deep Dinwoody cover that is required by the BLM Record of Decision for Smoky Mine Panels F&G EIS for reclamation at Pit E-0 and Panel F. Based on the potential availability of Dinwoody from mining at Panel F and the stockpile at the Pole Canyon ODA (Figure 6-3), and the expected volume of Dinwoody required for cover material at Pit E-0 and Panel F, mine operations currently commit to provide the equivalent of 1 foot of Dinwoody material (193,500 cubic yards) from Panel F for the Pole Canyon ODA cover. Any additional needs for Dinwoody, beyond the volumes available from Panel F in the future, can be met by developing the wide aerial extent of the Dinwoody Formation in on-lease areas (Figures 2-1 and 2-2). One specific potential source of additional Dinwoody material is a new borrow site, currently proposed adjacent to Panel D (Figure 6-4). This borrow source is expected to ensure availability of high quality Dinwoody during the time frame needed for capping purposes on the Pole Canyon ODA.

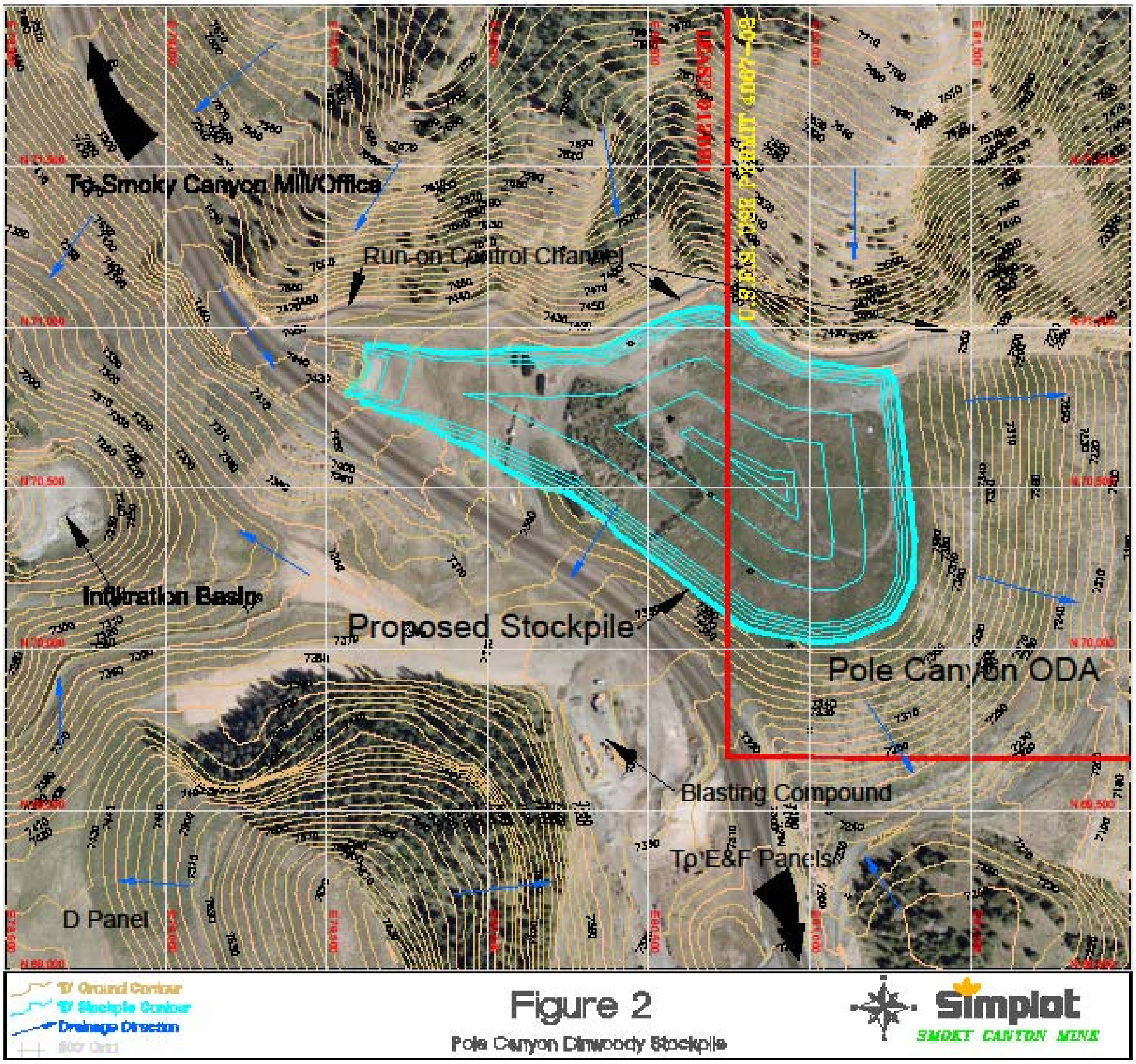

Figure 6-3: Dinwoody Stockpile – Mine Plan Modification Application

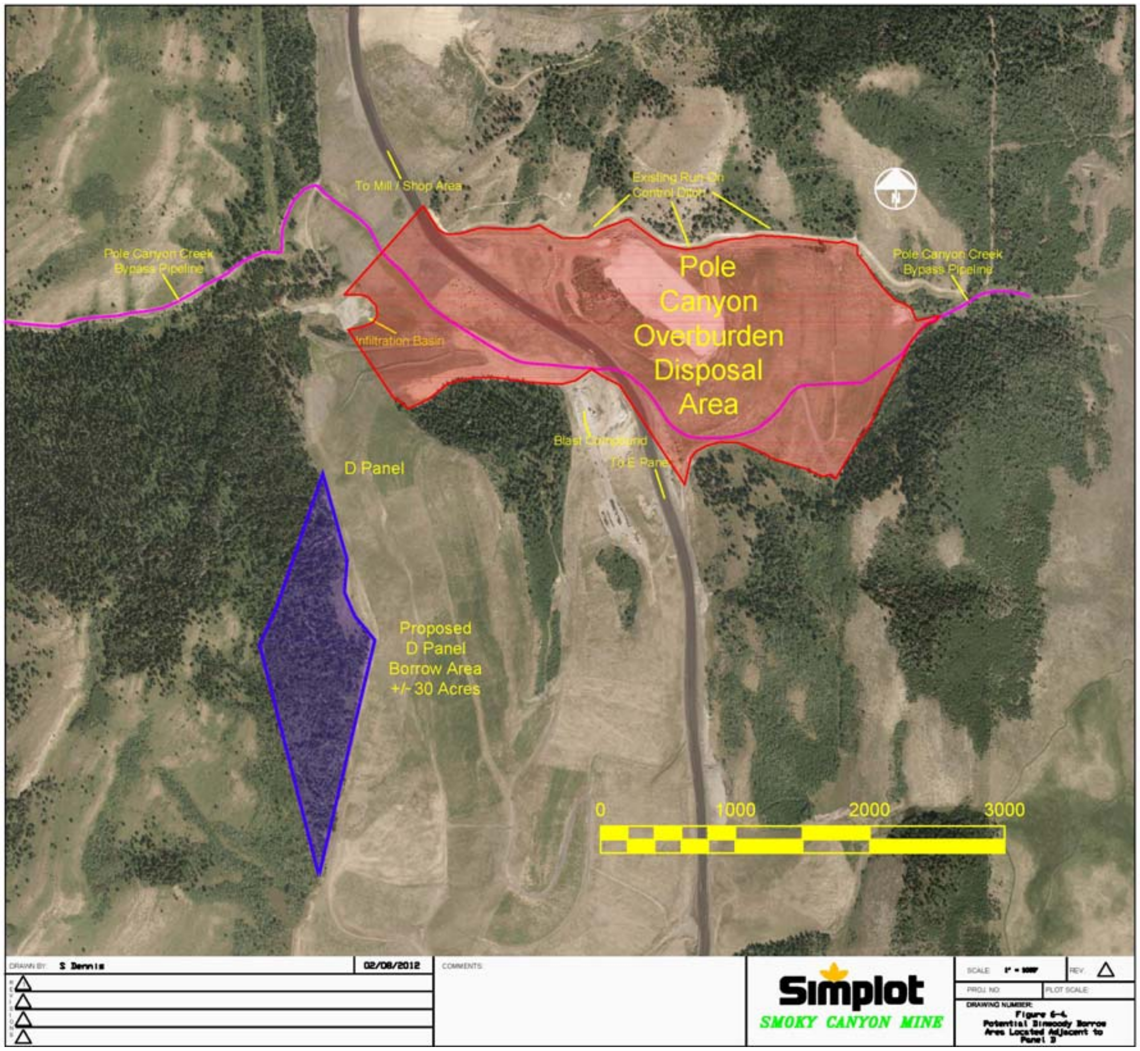

Figure 6-4: Potential Dinwoody Borrow Area Located Adjacent to Panel D

6.5.3.1 On-going Mine Operations

On-going mining operations at Panel F include removal of Dinwoody material to expose the phosphate ore. During the early stages of mining at Panel F, Dinwoody material was stockpiled in that area. As mining progressed, suitable stockpile locations in the Panel F area no longer had capacity to accept newly generated material. Therefore, the Pole Canyon ODA was identified as a potential location for stockpiling Dinwoody in an effort to avoid wasting any Dinwoody. Dinwoody generated from Panel F is stockpiled on the Pole Canyon ODA per a July 18, 2011 application for a Panel F minor Mine Plan modification which was approved by the BLM in October 2011.

The temporary Dinwoody stockpile can accommodate up to approximately 1.25 million cubic yards and is located on the east side of the haul road on the Pole Canyon ODA, as depicted on Figure 6-3. The primary purpose of this temporary Dinwoody stockpile is to assure the full recovery of Dinwoody from Panel F. In the application, Simplot stated an awareness of the on-going activities related to the Smoky Canyon CERCLA work and committed to moving this temporary stockpile if required by any agency decision related to future CERCLA actions on the Pole Canyon ODA. As stated in the application for the Mine Plan modification:

> "If the EE/CA determines that Dinwoody is appropriate for use as a cover material at Pole Canyon, the temporary stockpile may be a potential borrow source for consideration within the EE/CA. If a different cover material is selected, and timing is such that the CERCLA work must commence while this temporary stockpile of Dinwoody is still present on the Pole Canyon ODA, the proper handling of the Dinwoody would be coordinated with the agencies, (i.e., the stockpiled material could be removed from the area for use in reclamation elsewhere at the mine or it could be dozed and help with re-shaping of the ODA prior to the placement of the selected cover). In any case, Simplot commits to the timely resolution regarding the appropriate actions that would be necessary to address the Dinwoody in the temporary stockpile to assure it would not prevent or impede an agency approved action related to the Pole Canyon ODA."

As noted previously, the first priority for Dinwoody mined from Panel F is for use in the Deep Dinwoody cover system required for reclamation by the BLM Record of Decision for the Smoky Canyon Mine Panels F&G EIS. Depending upon suitability, this may be from the Dinwoody currently stockpiled or from direct placement during mining. For the Pole Canyon ODA cover, available materials are expected to be primarily Type B or a mixture of Type A and Type B Dinwoody from Panel F, to a limited extent, and as needed from a Dinwoody borrow source. The Dinwoody available for the Pole Canyon ODA cover will be determined during the design process based upon the volume of Dinwoody available from Panel F or stockpiled at that time. The available volume would exclude Dinwoody required for the planned reclamation for the Deep Dinwoody cover system on Pit E-0 or Panel F. At this time the volume of material that will be available from Panel F, for use in the Pole Canyon ODA cover, cannot be quantified. This is due to uncertainty associated with the suitability of the Dinwoody mined from Panel F as well as the timing necessary for the placement of Dinwoody for both the Pole Canyon ODA cover as well as the reclamation on Pit E-0. Therefore, for purposes of this EE/CA, Dinwoody volume requirements greater than 193,500 cubic yards (1 foot of thickness over the Pole Canyon ODA) are assumed to be met by a Dinwoody borrow source.

6.5.3.2 Additional Borrow Sources

During the design process, the volume of Dinwoody material needed from the proposed Panel D borrow source for the Pole Canyon ODA cover will be quantified and characterized. Based on experience mining in other locations at the Site, it is expected that the Dinwoody from the Panel D borrow area would be appropriate for use in a cover, with comparable infiltration reduction properties to Dinwoody material available from on-going mining at Panel F. A significant portion of the Panel D borrow source Dinwoody is expected to be Type A material, which is typically more highly weathered and better suited for use as a growth medium than Type B Dinwoody. However, Type B material may be usable as a cover material for the Pole Canyon ODA. For evaluation of infiltration in this EE/CA, a mixture of Type A and Type B Dinwoody material is assumed to be available from the Panel D borrow source. This mixture of Dinwoody material is assumed to have a lower hydraulic conductivity than for Type B material alone (see Table A-3 of Appendix A). The potential Panel D Dinwoody borrow source may provide more than 1 million cubic yards of Dinwoody, assuming excavation to an average depth of 25 feet or more over a 25-acre area.

One of the primary benefits of the Panel D borrow area is its proximity to the Pole Canyon ODA. It is much closer to the Pole Canyon ODA than Panel F and, thus, the haul distance is shorter. The cost to generate and place Dinwoody from the Panel D borrow area onto the Pole Canyon ODA is significantly less than Dinwoody from on-going mining at Panel F ($2.54 versus $6.45 per cubic yard). Therefore, the Panel D borrow source is a more cost-effective source of Dinwoody material. Because specific characterization has not been performed, it would be necessary to perform an investigation during design to verify its quantity and characteristics.

Development of the Panel D borrow source would result in additional disturbance, but the potential impact would be reduced due to its location adjacent to a previously mined area (Panel D). Existing vegetation in the potential Panel D Dinwoody borrow area is typical of mid-elevation areas at the mine which are represented by Douglas-fir (*Pseudotsuga menziesii*) and aspen (*Populus tremuloides*) with an understory component. Forest openings in these mid-elevation areas are dominated by a mixed shrub component that includes species such as mountain snowberry (*Symphoricarpos oreophilus*) and antelope bitterbrush (*Purshia tridentata*) with an understory component.

6.6 Institutional/Access Controls

Interim institutional controls (ICs)[3] and access controls can be effective methods of preventing contact with materials that pose a potential risk while NTCRA selection is on-going, or a means of preserving the physical integrity of constructed actions. Several successfully implemented ICs and access controls are described below.

Range Management – The Pole Canyon ODA is located within a grazing allotment which the USFS administrates. Land managers use grazing management plans as tools to protect water quality, forage, and beneficial use. Traditionally, grazing control is the practice of managing forage harvest levels by cows, horses, and sheep, so that the plant cover and community composition are maintained and erosion and sedimentation are not accelerated. Grazing controls are often included as a BMP at reclaimed mine facilities. The practice can also be implemented to limit the location, timing, and duration of livestock grazing at reclaimed mine

[3] Permanent ICs such as administrative and legal controls that limit land or resource use at the Site may be implemented as part of the Remedial Action to address any risks of exposures that may remain following cleanup.

facilities. Controlling domestic livestock grazing would help to reduce the potential for unacceptable exposure and, therefore, is retained for further consideration during development of NTCRA alternatives. The long-term plan for the land is to return the entire Site to the historically established grazing allotment.

Fencing – Fencing can be used to prevent access to reclaimed areas and allow adequate establishment of a vegetative cover without disturbance. Portions of the Pole Canyon ODA are already fenced. Additional fencing may be considered as part of NTCRA implementation.

Habitat Management – Like soil, water, and vegetation, wildlife is a resource that must be protected. While wildlife control can be difficult, there are certain practices that can be applied to reduce the potential for exposure. In particular, modifying vegetation can change the species that will forage on reclaimed areas (Section 6.4). This option is not being retained for the Early Action; however, habitat management may be considered during development and evaluation of alternatives during the FS.

Deed Restrictions, Covenants, Environmental Easements, Land Use Ordinances, or Administrative Rule-Making – The Area Wide Risk Management Plan recommends precautionary measures to prohibit residential development of any phosphate mining waste units or impacted areas that may present potential public health risks in the future (IDEQ, 2004). The consideration of measures to preclude future residential use of the Pole Canyon ODA will be made during the FS; therefore, this option is not retained for further consideration as part of the Early Action.

6.7 Water Treatment

Water treatment is a potentially viable option. However, it is a less desirable alternative to source control, surface water management, and other measures to reduce the volume and concentration of impacted waters. The Early Action at the Pole Canyon ODA is intended as a source control measure. Source control provides a more practical and long-term effective approach to eliminate seeps from ODAs. Therefore, this option is not considered further for the Pole Canyon ODA Early Action. Consideration of water treatment as a long-term measure to address water quality conditions will be deferred to the FS.

7.0 IDENTIFICATION AND ANALYSIS OF NTCRA ALTERNATIVES

This section identifies the NTCRA alternatives based on the technologies retained after the screening described in Section 6.0. Consistent with EE/CA guidance, a limited number of relevant and viable alternatives, appropriate for addressing the RAOs, are selected for evaluation and comparison. A large base of information on technologies is available regarding the control of releases from historical mining and milling sites under CERCLA. Considerable information on specific options to control selenium releases to the environment has also been developed for the southeast Idaho phosphate mines. The NTCRA alternatives are evaluated individually with respect to the specific evaluation criteria set forth in USEPA's 1993 NTCRA guidance.

Four NTCRA alternatives were developed for the Pole Canyon ODA:

- Alternative 1: No Further Action
- Alternative 2: A cover of 1 foot of Dinwoody over a minimum of 4 feet of chert/limestone cover
- Alternative 3: A cover of 3 feet of Dinwoody over a minimum of 2 feet of chert/limestone cover
- Alternative 4: Geosynthetic Cover System

Alternatives 2 and 3 are intended to represent a range of Dinwoody thicknesses and corresponding benefits, from a minimal 1-foot thickness to a potentially more adequate 3-foot thickness. The 1-foot thickness represents a minimum depth for vegetation establishment and long-term survival which, in combination with the underlying 4-foot thickness of chert/limestone, would provide acceptable separation of established vegetation from the overburden. The total thicknesses of the Alternative 2 and Alternative 3 covers are 5 feet, which is intended to satisfy the USFS cover thickness recommendation of 5 feet for overburden disposal areas at phosphate mines in southeast Idaho.

The alternatives are evaluated against the EE/CA criteria of effectiveness, implementability, and cost as described in more detail below.

Effectiveness

The effectiveness of an alternative refers to its ability to meet the objective within the scope of the NTCRA.

Overall Protection of Public Health and the Environment

Each alternative was evaluated on the degree to which it would protect public health and the environment. This included assessments of other evaluation criteria, including long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The discussion focuses on how each alternative achieves adequate protection and describes how the alternative reduces, controls, or eliminates risks at the Site. This evaluation also identifies any unacceptable short-term impacts.

Compliance with ARARs and Other Criteria, Advisories, and Guidance

This criterion summarizes which requirements are applicable or relevant and appropriate to an alternative and describes how the alternative addresses those requirements.

Long-Term Effectiveness and Permanence

This criterion assesses the extent and effectiveness of the controls that are required to manage risk posed by treatment residuals and/or untreated wastes at the Site. The following factors are considered for each alternative:

- Magnitude of Risk - Because this NTCRA is a provisional step to be followed by remedial action, this factor was not evaluated.

- Adequacy and Reliability of Controls - The completed NTCRA may require PRSCs. This criterion assesses the degree of PRSC activities that may be required to monitor the Site after the removal alternative has been implemented and to sustain the integrity of the NTCRA.

Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion assesses the ability of treatment to reduce toxicity, mobility or volume of hazardous substances. As noted earlier, no treatment technologies are retained for the NTCRA alternatives.

Short-Term Effectiveness

The short-term effectiveness criterion addresses effects of the alternative during implementation before the RAOs have been met. Alternatives were also evaluated with respect to their effects on human health and the environment following implementation. The following factors were addressed as appropriate for each alternative:

- Protection of the Community - This factor addresses any risk to the affected community that results from implementation of the proposed action, whether from air quality impacts, fugitive dusts, transportation of hazardous materials, or other sources.

- Protection of the Workers - This factor addresses any threats to site workers and the effectiveness and reliability of protective measures that would be taken.

- Environmental Impacts - This factor evaluates the potential adverse environmental impacts from the implementation of each alternative. It also addresses the reliability of mitigation measures in preventing or reducing the potential impacts.

- Time Until Response Objectives Are Achieved - This factor estimates the time needed to achieve protection for the ODA itself or for individual elements or threats associated with the ODA.

Implementability

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The following factors were considered under this criterion:

- Technical Feasibility - Each alternative was evaluated for factors such as assembling, staffing, and operating the alternative within the time frames in the removal schedule. Additionally, each alternative was evaluated for technology maturity including: prior use under similar conditions for similar wastes and difficulty in operation after construction. The evaluation considered environmental conditions with respect to the operation, set-up, and construction phases of the alternative. Operational difficulties could include the frequency or complexity of equipment maintenance or controls, the need for raw materials, or the need for a large technical staff. Certain technologies are difficult to construct or operate in remote locations. Climate or terrain may severely impact or eliminate specific alternatives from consideration. Potential future remedial actions are also discussed.

- Availability of Services and Materials - This factor considers if equipment, personnel, services and materials, and other resources necessary to implement an alternative are available in time to maintain the removal schedule. This factor also involves considering such services as laboratory testing capacity and turnaround for chemical analyses, adequate supplies and equipment for onsite activities, or installation of extra utilities (e.g., power lines, sewer connections).

- Administrative Feasibility - The administrative feasibility factor evaluates activities needed to coordinate with other offices and agencies. Administrative feasibility includes assessing the need for off-site permits, adherence to applicable non-environmental laws, and concerns of other regulatory agencies.

- State and other Agency Acceptance - The USFS will consult with the State and other agencies during the public comment period.

- Community Acceptance – The USFS will consider community acceptance of an alternative in the final selection of the alternative in the Action Memorandum.

Cost

Each NTCRA alternative was evaluated to determine its projected cost. The evaluation compared each alternative's capital, operating, and monitoring costs as well as PRSC.

7.1 Alternative 1 – No Further Action

This alternative represents the current condition, which includes continuing operation of the 2008 NTCRA.

7.1.1 Effectiveness

The effectiveness of an alternative refers to its ability to meet the objective within the scope of the NTCRA. Evaluation of effectiveness includes overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness.

7.1.1.1 Overall Protection of Human Health and the Environment

The No Further Action Alternative would not meet the RAOs, because it does not include any action to reduce infiltration through the surface of the ODA and because it would not reduce the potential for risk to ecological and human receptors due to ingestion of ODA materials and vegetation or direct contact.

As discussed in Section 3, the 2008 NTCRA has resulted in significant reduction in the volume of water that enters the ODA and consequently, the transport of selenium and other COPCs from the ODA. Groundwater and surface water conditions are expected to improve due to the 2008 NTCRA as its effect continues to be assessed through on-going monitoring.

In order to support this EE/CA analysis, the USACE HELP Model was used to evaluate the water balance, including infiltration of precipitation, for each of the NTCRA alternatives. USACE developed the HELP model to conduct water balance analyses for landfills, cover systems, and other solid waste containment facilities (Schroeder et al., 1994). The HELP model requires weather and soil data and calculates the water balance while taking into account effects of conditions including soil moisture storage, ET, vegetative cover area, vegetation root depth, and runoff potential. It can synthetically generate weather for up to 100 years based on monthly mean precipitation, temperature, and solar radiation. Details of the model set up and simulations are provided in Appendix A. Using the model, the long-term average conditions for the No Further Action alternative were estimated as shown in Table 7-1.

Table 7-1. Pole Canyon ODA Water-Balance and Selenium Mass-Balance Model Summary – Long Term Average Conditions for the No Further Action Alternative

	"No Further Action" (Current Conditions)
Inflow to ODA (ac-ft per year)	
Surface water from upper Pole Canyon	0
Alluvial groundwater	0
Direct infiltration via ODA surface (precipitation input)	49
Run-on from hill slope north of Pole Canyon ODA	0
Total (ac-ft per year)	**49**
Annual Selenium Mass Transport	
Annual average selenium in outflow water (mg/L)	6.3
Total (lbs per year)	**840**

Key assumptions made in the evaluation were:

- The 2008 NTCRA is operating as designed.
- The selenium concentration in the outflow water (i.e., to groundwater and surface water) is the same as measured in the seep in 2010 (6.3 mg/L).

The use of the selenium concentrations measured at the ODA seep, station LP-1, to represent the level of selenium in all water exiting the ODA represents a conservative approach that likely overestimates the average annual selenium concentration in water that flows from the ODA to underlying groundwater. Selenium concentrations can be readily monitored at LP-1 but not at other locations where water migrates from the base of the ODA into subsurface materials. The lack of seepage data from any other location within the ODA results in a reliance on the data collected at LP-1. Samples collected at this location since implementation of the 2008 NTCRA provide a reliable basis for estimating selenium concentrations in the water that flows seasonally from the ODA into lower Pole Canyon. However, the selenium concentrations observed at LP-1 are not necessarily representative of selenium concentrations in all water that flows from the ODA for the following reasons. First, historical surface water data collected immediately downstream of the ODA indicate an annual pattern of the highest selenium concentrations occurring during the spring with decreasing concentrations thereafter. As a result, reliance on selenium concentration data collected during spring conditions, the time of year that LP-1 still flows, most likely overestimates the average annual selenium concentration for water exiting the ODA. Second, water flowing at LP-1 is the water that has the longest pathway through overburden materials and is likely to represent seepage with the highest concentrations. Water flowing from the base of the ODA at locations upgradient of LP-1, where the overburden thickness is less and infiltration/migration pathways are shorter, would have a lower expected selenium concentration than the water flowing at the toe of the ODA. However, the LP-1 data are used in this evaluation to provide consistency. This approach will be reassessed as part of the RI evaluations.

7.1.1.2 Compliance with ARARs and Other Criteria, Advisories, and Guidance

A summary of how the No Further Action alternative meets the key applicable and the key relevant and appropriate requirements is discussed in the following text. Table 7-5 (at end of this section) summarizes how the alternative performs against the remaining ARARs.

Applicable ARARs – The applicable ARARs include the promulgated Federal and State surface water and groundwater quality standards (Table 5-1). These ARARs are not met under current conditions.

Relevant and Appropriate ARARs – The key relevant and appropriate ARARs are summarized in Table 7-5. There are no emissions from the ODA under current conditions, such that the requirements of the substantive requirements of the National Emission Standards for Hazardous Air Pollutants rules are met.

7.1.1.3 Long-Term Effectiveness and Permanence

Because no additional actions would be implemented under this alternative, no PRSCs to maintain the NTCRA would be required.

7.1.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The No Further Action alternative does not include a treatment component. It therefore has a low level of performance against this sub-criterion.

7.1.1.5 Short-Term Effectiveness

No actions would be implemented, therefore, there would be no risks to the community and no environmental impact associated with implementation activities. Response Objectives would not be met.

7.1.2 Implementability

This alternative is implementable.

7.1.3 Cost

No costs are associated with the No Further Action alternative.

7.2 Alternative 2 – A Cover of One Foot of Dinwoody Overlying Four Feet of Chert/Limestone Cover

Alternative 2 would entail the following actions:

- Grade the ODA as shown in Figure 7-1.
- Cover the ODA with a minimum of four feet of chert/limestone and one foot of Dinwoody. The Dinwoody will be supplied only from on-going mining at Panel F (see discussion in Section 6.4).
- Install stormwater run-on/runoff controls to convey water off the ODA.
- Revegetate the Dinwoody cover surface using native non-selenium-accumulator species to control erosion. Application of fertilizer and an organic material amendment would be included in all revegetation areas.
- Implement range management to limit livestock grazing until revegetation success is achieved.

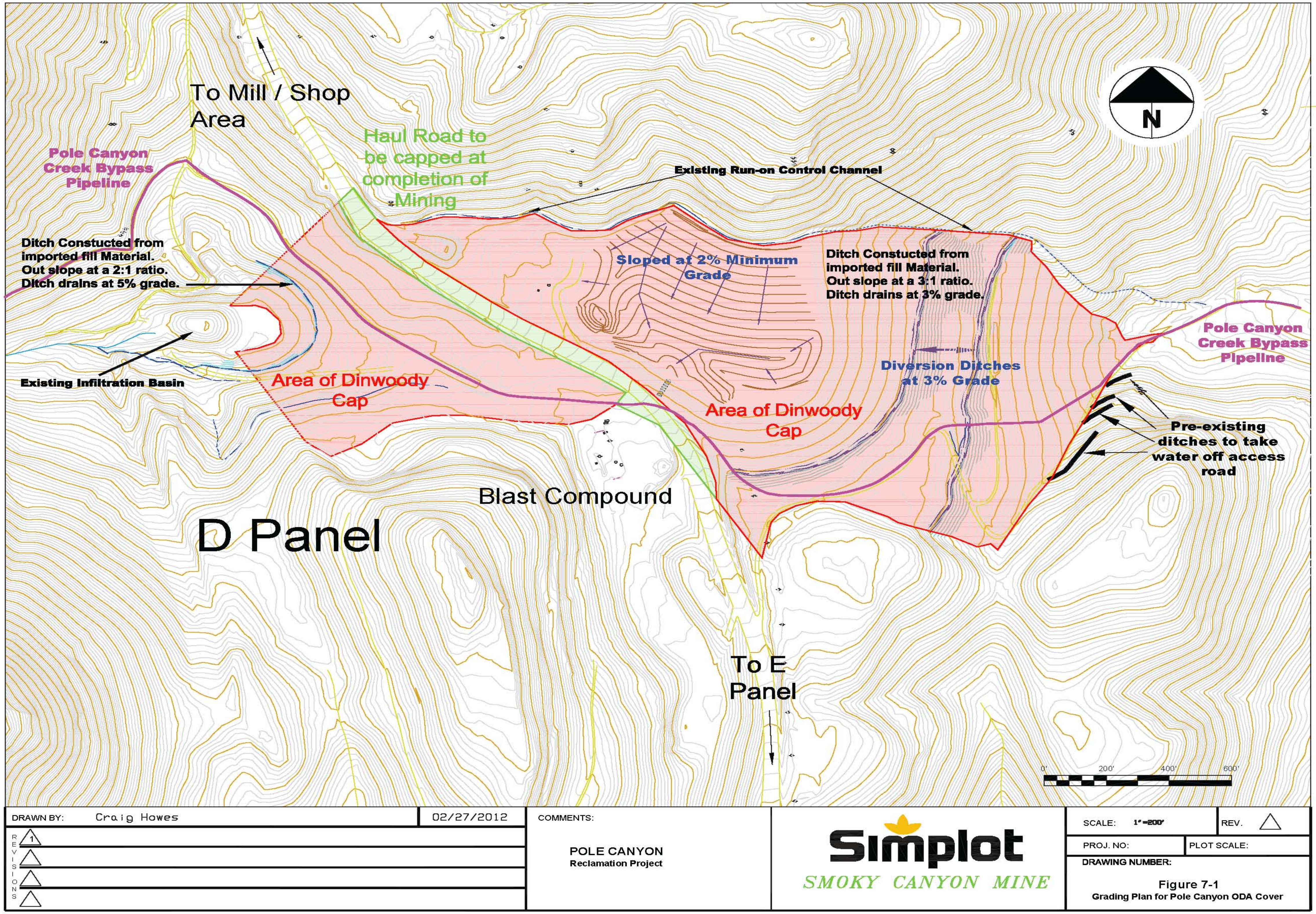

Figure 7-1: Grading Plan for Pole Canyon ODA Cover

7.2.1 Effectiveness

The effectiveness of an alternative refers to its ability to meet the objective within the scope of the NTCRA. Evaluation of effectiveness includes overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness.

7.2.1.1 Overall Protection of Human Health and the Environment

Alternative 2 would meet the requirements of the RAOs. The Dinwoody portion of the cover would reduce the amount of water that infiltrates into the ODA from direct precipitation. The 5-foot thick cover would also be effective in eliminating the ingestion of ODA materials by wildlife and domestic livestock and reducing the potential ecological risk due to ingestion of vegetation on the ODA. The potential risk to human receptors due to ingestion of vegetation, and ingestion of and direct contact with ODA materials would also be reduced.

Alternative 2 is predicted to reduce infiltration of precipitation into the surface of the ODA to 41 acre-feet per year (see details in Appendix A). Compared to current conditions this represents an estimated 16% decrease in both infiltration and transport of selenium from the ODA compared to the No Further Action alternative (Table 7-2).

Table 7-2. Pole Canyon ODA Water-Balance and Selenium Mass-Balance Model Summary – Long Term Average Conditions for Alternative 2

	Current Condition	With 2011 EE/CA NTCRA Alternative 2	Estimated Reduction from 2011 EE/CA NTCRA Alternative 2
Inflow to ODA (ac-ft per year)			
Surface water from upper Pole Canyon	0	0	**0%**
Alluvial groundwater	0	0	**0%**
Direct infiltration via ODA surface (precipitation input)	49	41	**16%**
Run-on from hill slope north of Pole Canyon ODA	0	0	**0%**
Total (ac-ft per year)	**49**	**41**	**16%**
Annual Selenium Mass Transport			
Annual average selenium in outflow water (mg/L)	6.3	6.3	**---**
Total (lbs per year)	**840**	**702**	**16%**

7.2.1.2 Compliance with ARARs and Other Criteria, Advisories, and Guidance

A summary of how Alternative 2 meets the key applicable and relevant and appropriate requirements is discussed in the following text. Table 7-5 summarizes how the alternative meets the remaining ARARs.

Applicable ARARs – The applicable ARARs include the promulgated Federal and State surface water and groundwater quality standards (Table 5-1). The Dinwoody and chert/limestone cover and surface vegetation are predicted to reduce infiltration of rainfall and snowmelt into the ODA, as described above. This reduction of infiltration into the ODA would reduce the transport of COPCs to groundwater and surface water and would contribute toward meeting the requirements of these ARARs. Post-construction monitoring would be implemented to assess progress toward compliance with these requirements and any additional actions necessary to meet these ARARs will be addressed as part of the RI/FS.

Relevant and Appropriate ARARs – The key relevant and appropriate ARARs are summarized in Table 5-1. Standard dust control methods during implementation would minimize the potential for transport of overburden and cover materials to the air and provide for compliance with the substantive requirements of the National Emission Standards for Hazardous Air Pollutants rules. The regrading, revegetating, and stormwater management controls would minimize erosion and would contribute toward meeting the requirements of the National Oceanic and Atmospheric Administration (NOAA) Freshwater Sediment Benchmarks (a TBC). Substantive requirements of the National Pollutant Discharge Elimination System (NPDES) regulations would be met by meeting surface water quality standards and by continued compliance with the existing stormwater permit. Dust and stormwater controls can be implemented during construction to minimize COPC transport and provide for compliance with pertinent regulations. This would be addressed in detail in the NTCRA design.

7.2.1.3 Long-Term Effectiveness and Permanence

PRSCs to maintain the NTCRA would be relatively straight-forward. These would include inspection of the cover and maintenance of any poor vegetation areas, elimination of undesirable plant species or cover erosion. Inspections are already performed on the ODA as part of the 2008 NTCRA and adding these additional elements would be simple. Monitoring of groundwater and surface water already in place for the 2008 NTCRA would be appropriate to assess the effectiveness of this action. Any additional monitoring could be easily added if required.

7.2.1.4 Reduction of Toxicity, Mobility or Volume Through Treatment

Alternative 2 does not include a treatment component. It therefore has a low level of performance against this sub-criterion.

7.2.1.5 Short-Term Effectiveness

Alternative 2 would provide short-term effectiveness. There would be no risks to the community during implementation. Construction would be implemented using standard equipment and procedures that would be protective of workers. Minor grading of the overburden has low potential for transport of selenium and other COPCs in the short-term due to weathering. Under Alternative 2 approximately 967,500 cubic yards of material would be used in the cover. Approximately 193,500 cubic yards of Dinwoody would be needed for a 1-foot of Dinwoody cover over the Pole Canyon ODA. On-going mining at Panel F would generate this material. The approximately 774,000 cubic yards of chert/limestone would also be generated from Panel F as part of on-going mining operations. This alternative would meet RAOs within two years of completion of the cover (the time for vegetation to become established).

7.2.2 Implementability

Alternative 2 is implementable because it would be both technically and administratively feasible, and all goods and services required to implement the alternative are expected to be readily available.

7.2.2.1 Technical Feasibility

Alternative 2 is technically feasible to implement. It would not require unconventional construction techniques or special access logistics. Simplot has installed similar covers at the Smoky Canyon Mine. Engineering controls are easily implementable during construction activities to prevent impacts to adjoining areas. Based on the surface area of the ODA, it is estimated that approximately 193,500 cubic yards of Dinwoody would be required for a one-foot thick layer. As discussed previously, this material would be generated from on-going mining at Panel F. Chert/limestone would also be generated from on-going mining. The rate of material generation depends on the location of mining within the active pit. Experience with recent reclamation activities at the Smoky Canyon Mine demonstrates that both chert/limestone and Dinwoody placement can be implemented year-round. Based on current estimates, if the action were to begin in the fall of 2012, the cover would be expected to be completed by fall 2013.

Similar RI/FS projects are on-going throughout the Southeast Idaho Phosphate Mining Resource Area. Based on these and other EE/CAs that have been completed, a basic range of appropriate response action technologies has been developed for phosphate mines. This range is consistent with the NTCRA technologies identified and evaluated for the Pole Canyon ODA in Section 6 and focuses on: (1) small scale excavation and disposal (i.e. pond sediments); (2) surface water management; (3) grading and reshaping; (4) covering or capping; (5) institutional/access controls; and (6) water treatment. As such, the actions in this alternative are consistent with potential future remedial actions. Depending on the final Smoky Canyon site remedial action objectives, the results of the Pole Canyon NTCRA performance monitoring, inspections of the surface water controls, and maintenance of ODA slopes and covers, it may be necessary to augment the NTCRA alternative with additional remedial actions. Examples of potential additional remedial actions include supplemental surface water controls to protect the cover and treatment of the seep (if it continues to flow after the NTCRA is completed).

7.2.2.2 Availability of Services and Materials

The excavation of overburden material would be accomplished using heavy equipment (e.g., scrapers, excavators, dozers, and trucks) provided by Simplot and already present at the mine. Dinwoody and chert/limestone cover materials are available from on-going mining operations. Construction water is also readily available from the mine. Additionally, trained and experienced labor is available for site work activities.

7.2.2.3 Administrative Feasibility

Alternative 2 would be administratively feasible because the USFS is coordinating with the other regulatory agencies during the EE/CA and Action Memorandum process. It would require relatively simple administrative and construction management controls. No off-site permits would be required. Range management would be implementable because the Pole Canyon ODA is situated on USFS-managed land.

7.2.2.4 State and Community Acceptance

The USFS will consult with the State and other Federal agencies during development and public comment on this EE/CA. Community acceptance of this action will be determined after receiving public comments on the EE/CA.

7.2.3 Cost

The net present value of Alternative 2, including Operations and Maintenance (O&M), is estimated to be $8.2 million (Appendix B; Table B-1). Capital costs for Alternative 2 are estimated at $7.6 million. Details on the cost estimate for Alternative 2 are provided in Table B-2.

7.3 Alternative 3 – A Cover of Three Feet of Dinwoody Overlying Two Feet of Chert/Limestone Cover

Alternative 3 would entail the following actions:

- Same grading as for Alternative 2.

- Place a cover of chert/limestone averaging 2-feet in thickness.

- Place three feet of Dinwoody cover over the chert/limestone cover. This alternative assumes that Dinwoody would be provided from on-going mining at Panel F and from an area on-lease immediately upslope from Panel D (see discussion in Section 6.4). Based on experience at other locations it is expected that the Dinwoody from these sources would be appropriate for use in a cover. However, sampling conducted during the design phase would determine the suitability of this material. The Dinwoody material would be placed in two lifts. The first (lower) lift would be 1-foot thick, and placed and nominally compacted only by equipment travel, whereas, the upper 2 feet would be placed loose and equipment travel would be limited. The nominal compaction of the lower lift would not limit the potential for root development of vegetation. If constructed in this manner, the full 3-foot thickness of Dinwoody would provide a zone for root growth and moisture storage for use by the vegetation. Simplot intends to obtain the Dinwoody material required for the lower lift from on-going mining at Panel F, and material for the upper lift would be obtained from a new on-lease borrow source such as may be available adjacent to the western side of Panel D. For EE/CA purposes, this borrow source of Dinwoody is assumed. Any topsoil generated from borrow areas would be stockpiled. The primary use of the stockpiled topsoil would be reclamation of the borrow areas. If any additional topsoil is available (i.e., not needed elsewhere), it would be placed on the surface of the Pole Canyon ODA cover. Overall, this approach provides for reduction of infiltration and establishment of a suitable condition for revegetation at the surface.

- Install stormwater run-on/runoff controls to convey water off the ODA.

- Revegetate the Dinwoody surface using native non-selenium-accumulator species to control erosion. Application of fertilizer and an organic material amendment would be included in all revegetation areas.

- Implement range management to limit livestock grazing until revegetation success is achieved.

7.3.1 Effectiveness

The effectiveness of an alternative refers to its ability to meet the objective within the scope of the NTCRA. Evaluation of effectiveness includes overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness.

7.3.1.1 Overall Protection of Human Health and the Environment

Alternative 3 would meet the requirements of the RAOs. The Dinwoody portion of the cover would significantly reduce the amount of water that infiltrates into the ODA from direct precipitation. The 5-foot thick cover would also be highly effective in eliminating the ingestion of ODA materials by wildlife and domestic livestock and reducing the potential ecological risk due to ingestion of vegetation on the ODA. It would also reduce the potential risk to human receptors due to ingestion of vegetation, and ingestion of and direct contact with ODA materials.

Alternative 3 is predicted to significantly reduce infiltration of precipitation into the surface of the ODA to 10.6 acre-feet per year (see details in Appendix A). Compared to current conditions this represents an estimated 78% decrease in both infiltration and transport of selenium from the ODA compared to the No Further Action alternative (Table 7-3).

Table 7-3. Pole Canyon ODA Water-Balance and Selenium Mass-Balance Model Summary – Long Term Average Conditions for Alternative 3

	Current Condition	With 2011 EE/CA NTCRA Alternative 3	Estimated Reduction from 2011 EE/CA NTCRA Alternative 3
Inflow to ODA (ac-ft per year)			
Surface water from upper Pole Canyon	0	0	**0%**
Alluvial groundwater	0	0	**0%**
Direct infiltration via ODA surface (precipitation input)	49	10.6	**78%**
Run-on from hill slope north of Pole Canyon ODA	0	0	**0%**
Total (ac-ft per year)	**49**	**10.6**	**78%**
Annual Selenium Mass Transport			
Annual average selenium in outflow water (mg/L)	6.3	6.3	**---**
Total (lbs per year)	**840**	**182**	**78%**

7.3.1.2 Compliance with ARARs and Other Criteria, Advisories and Guidance

A summary of how Alternative 3 meets the key applicable and relevant and appropriate requirements is discussed in the following text. Table 7-5 summarizes how the alternative meets the remaining ARARs.

Applicable ARARs – The applicable ARARs include the promulgated Federal and State surface water and groundwater quality standards (Table 5-1). The Dinwoody and chert/limestone cover and surface vegetation are predicted to reduce infiltration of rainfall and snowmelt into the ODA, as described above. This reduction of infiltration into the ODA would reduce the transport of COPCs to groundwater and surface water and would contribute toward meeting the requirements of these ARARs. Post-construction monitoring would be implemented to assess progress toward compliance with these requirements and any additional actions necessary to meet these ARARs will be addressed as part of the RI/FS.

Relevant and Appropriate ARARs – The key relevant and appropriate ARARs are summarized in Table 5-1. Standard dust control methods during implementation would minimize the potential for transport of overburden and cover materials to the air and provide for compliance with the substantive requirements of the National Emission Standards for Hazardous Air Pollutants rules. The regrading, revegetating, and stormwater management controls would minimize erosion and would contribute toward meeting the requirements of the NOAA

Freshwater Sediment Benchmarks (a TBC). Substantive requirements of the NPDES regulations would be met by meeting surface water quality standards and by continued compliance with the existing stormwater permit. Dust and stormwater controls can be implemented during construction to minimize transport of COPCs and provide for compliance with pertinent regulations. This would be addressed in detail in the NTCRA design.

7.3.1.3 Long-Term Effectiveness and Permanence

PRSCs to maintain the NTCRA would be relatively straight-forward. These would include inspection of the cover and maintenance of any poor vegetation areas, elimination of undesirable plant species or cover erosion. Inspections are already performed on the ODA as part of the 2008 NTCRA and adding these additional elements would be simple. Monitoring of groundwater and surface water already in place for the 2008 NTCRA would be appropriate to assess the effectiveness of this action. Any additional monitoring could be easily added if required.

7.3.1.4 Reduction of Toxicity, Mobility or Volume Through Treatment

Alternative 3 does not include a treatment component. It therefore has a low level of performance against this sub-criterion.

7.3.1.5 Short-Term Effectiveness

Alternative 3 would provide for short-term effectiveness. There would be no risks to the community during implementation. Construction would be implemented using standard equipment and procedures that would be protective of workers. Minor grading of the overburden has low potential for transport of selenium and other COPCs in the short-term due to weathering. Under Alternative 3 approximately 967,500 cubic yards of material would be transported for use in the cover. The Dinwoody material needed (approximately 580,500 cubic yards) would be obtained from on-going mining at Panel F and the rest developed from a borrow area on-lease immediately upslope from Panel D. This would have a short-term impact on the on-site borrow area, but reclamation of the area once the required volume of Dinwoody was obtained would mitigate these impacts. The approximately 387,000 cubic yards of chert/limestone would be transported from Panel F. This alternative would meet RAOs within two years of completion of the cover (the time for vegetation to become established).

7.3.2 Implementability

Alternative 3 is implementable because it would be both technically and administratively feasible, and all goods and services required to implement this alternative are expected to be readily available.

7.3.2.1 Technical Feasibility

Alternative 3 is technically feasible to implement. It would not require unconventional construction techniques or special access logistics. Simplot has installed similar covers at the Smoky Canyon Mine. Engineering controls are easily implementable during construction activities to prevent impacts to adjoining areas. Based on the surface area of the ODA, it is estimated that approximately 580,500 cubic yards of Dinwoody would be required for a three-foot thick cover layer. Availability of Dinwoody from Panel F will be evaluated during the design process and will depend on the location of mining in the Panel F pits. The first priority for the mined Dinwoody material is to determine its suitability to meet the needs for Pit E-0 and Panel F cover systems. If the Dinwoody material from Panel F is not available to meet all of the needs for the Pole Canyon ODA cover, then a Dinwoody borrow source within the on-lease area would be characterized and developed. Chert/limestone would be generated from on-going mining. The rate of chert/limestone generation also depends on the location of mining within the active pit. Experience with recent reclamation activities at the Smoky Canyon Mine demonstrates that both chert/limestone and Dinwoody placement can be implemented year-round. Based on current estimates, if the action were to begin in the fall of 2012, the cover would be expected to be completed by fall 2013.

Similar RI/FS projects are on-going throughout the Southeast Idaho Phosphate Mining Resource Area. Based on these and other EE/CAs that have been completed, a basic range of appropriate response action technologies has been developed for phosphate mines. This range is consistent with the NTCRA technologies identified and evaluated for the Pole Canyon ODA in Section 6 and focuses on: (1) small scale excavation and disposal (i.e. for pond sediments); (2) surface water management; (3) grading and reshaping; (4) covering or capping; (5) institutional/access controls; and (6) water treatment. As such, the actions in this alternative are consistent with potential future remedial actions. Depending on the final Smoky Canyon site remedial action objectives, the results of Pole Canyon NTCRA performance monitoring, inspections of the surface water controls, and maintenance of ODA slopes and covers, it may be necessary to augment the NTCRA alternative with additional actions. Examples of potential additional remedial actions include supplemental surface water controls to protect the cover and treatment of the seep (if it continues to flow after the NTCRA is completed).

7.3.2.2 Availability of Services and Materials

The excavation of overburden material would be accomplished using heavy equipment (e.g., scrapers, excavators, dozers, and trucks) provided by Simplot and already present at the mine. Cover materials are available on-Site (from on-going mining and on-lease borrow areas). Construction water is also readily available from the mine. Additionally, trained and experienced labor is available for site work activities.

7.3.2.3 Administrative Feasibility

Alternative 3 would be administratively feasible because the USFS is coordinating with the other regulatory agencies during the EE/CA and Action Memorandum process. It would require relatively simple administrative and construction management controls. No off-site permits would be required. Range management would be implementable because the Pole Canyon ODA is situated on USFS-managed land.

7.3.2.4 State and Community Acceptance

The USFS will consult with the State and other Federal agencies during development and public comment on this EE/CA. Community acceptance of this action will be determined after receiving public comments on the EE/CA.

7.3.3 Cost

The net present value of Alternative 3, including O&M, is estimated to be $7.0 million (Appendix B; Table B-1). Capital costs for Alternative 3 are estimated at $6.5 million. Details on the cost estimate for Alternative 3 are provided in Table B-3.

7.4 Alternative 4 – Geosynthetic Cover System

Alternative 4 would entail the following actions:

- The same grading as included in Alternatives 2 and 3.

- Place an average of 6 inches of chert/limestone cushioning layer on the overburden. This cushioning layer would provide a protective layer beneath the GCLL liner and would be composed of sorted and crushed chert/limestone that would minimize risks of puncturing or damaging the geosynthetic material. A six-inch layer of cushioning material is consistent with industry standards for geosynthetic cover systems.

- Install a geosynthetic liner consisting of a 40-mil linear low density polyethylene GCLL, or similar material.

- Install a drainage layer over the liner consisting of a 6- to 8-inch thick sand-gravel or well-sorted chert/limestone drainage layer. The drainage layer is necessary to provide drainage and stability on the steep slopes during all hydraulic conditions. Chert/limestone is preferred as an abundant supply of this material would be available from on-going mining operations. Use of this material would require crushing of larger rock and separation of fine material to allow rapid gravitational drainage of infiltrated water that reaches this layer. An additional 1.5 feet of chert/limestone would be placed above this 6-inch drainage layer.

- Install a 1-foot Dinwoody cover over the chert/limestone layer. For cost estimation purposes, a total of 193,500 cubic yards of Dinwoody are assumed to be available from mining at Panel F.

- Install stormwater run-on/runoff controls to convey water off the ODA.

- Revegetation would be accomplished using native species to control erosion and establish a diverse community of native species. Vegetation with a low potential for selenium uptake would not be required because the potential for plant roots to enter the overburden materials through the cover system is limited. Fertilizer and an organic material amendment would be used, as needed, to provide appropriate vegetation growth.

- Implement range management to limit livestock grazing until as revegetation success is achieved.

7.4.1 Effectiveness

The effectiveness of an alternative refers to its ability to meet the objective within the scope of the NTCRA. Evaluation of effectiveness includes overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness.

7.4.1.1 Overall Protection of Human Health and the Environment

Alternative 4 would meet the requirements of the RAOs. The geosynthetic cover system would significantly reduce the amount of water that infiltrates into the ODA from direct precipitation. Additionally, the geosynthetic cover system and 4-foot thick cover would also be highly effective in eliminating the ingestion of ODA materials by wildlife and domestic livestock and reducing the potential ecological risk due to ingestion of vegetation on the ODA. It would also reduce the potential risk to human receptors due to ingestion of vegetation, and ingestion of and direct contact with ODA materials.

Alternative 4 is predicted to significantly reduce infiltration of precipitation into the surface of the ODA to 1.3 acre-feet per year (see details in Appendix A). Compared to current conditions this represents an estimated 97% decrease in both infiltration and transport of selenium from the ODA compared to the No Further Action alternative (Table 7-4).

Table 7-4. Pole Canyon ODA Water-Balance and Selenium Mass-Balance Model Summary – Long Term Average Conditions for Alternative 4

	Current Condition	With 2011 EE/CA NTCRA Alternative 4	Estimated Reduction from 2011 EE/CA NTCRA Alternative 4
Inflow to ODA (ac-ft per year)			
Surface water from upper Pole Canyon	0	0	**0%**
Alluvial groundwater	0	0	**0%**
Direct infiltration via ODA surface (precipitation input)	49	1.3	**97%**
Run-on from hill slope north of Pole Canyon ODA	0	0	**0%**
Total (ac-ft per year)	**49**	**1.3**	**97%**
Annual Selenium Mass Transport			
Annual average selenium in outflow water (mg/L)	6.3	6.3	**---**
Total (lbs per year)	**840**	**22**	**97%**

7.4.1.2 Compliance with ARARs and Other Criteria, Advisories and Guidance

The following text summarizes how Alternative 4 meets the key applicable and relevant and appropriate requirements. Table 7-5 summarizes how the alternative meets the remaining ARARs.

Applicable ARARs – The applicable ARARs include the promulgated Federal and State surface water and groundwater quality standards (Table 5-1). The geosynthetic cover system is predicted to reduce infiltration of rainfall and snowmelt into the ODA, as described above. This reduction of infiltration into the ODA would reduce the transport of COPCs to groundwater and surface water and would contribute toward meeting the requirements of these ARARs. Post-construction monitoring would be implemented to assess progress toward compliance with these requirements and any additional actions necessary to meet these ARARs will be addressed as part of the RI/FS.

Relevant and Appropriate ARARs – The key relevant and appropriate ARARs are summarized in Table 5-1. Standard dust control methods during implementation would minimize the potential for transport of overburden and cover materials to the air and provide for compliance with the substantive requirements of the National Emission Standards for Hazardous Air Pollutants rules. The regrading, revegetating and stormwater management controls would minimize erosion and would contribute toward meeting the requirements of the NOAA Freshwater Sediment Benchmarks (a TBC). Substantive requirements of the NPDES regulations would be met by meeting surface water quality standards and by continued compliance with the existing stormwater permit. Dust and stormwater controls can be implemented during construction to minimize transport of COPCs and provide for compliance with pertinent regulations. This would be addressed in detail in the NTCRA design.

7.4.1.3 Long-Term Effectiveness and Permanence

PRSCs to maintain the NTCRA would be relatively straight-forward. These would include inspection of the cover and maintenance of any poor vegetation areas or cover erosion. Inspections are already performed on the ODA as part of the 2008 NTCRA and adding these additional elements would be simple. Monitoring of groundwater and surface water already in place for the 2008 NTCRA would be appropriate to assess the effectiveness of this action. Any additional monitoring could be easily added if required.

7.4.1.4 Reduction of Toxicity, Mobility or Volume Through Treatment

Alternative 4 does not include a treatment component. It therefore has a low level of performance against this sub-criterion.

7.4.1.5 Short-Term Effectiveness

Alternative 4 would provide short-term effectiveness. There would be no risks to the community during implementation. Construction would be implemented using standard equipment and procedures that would be protective of workers. Relatively minor grading of the overburden would have low potential for transport of selenium and other COPCs in the short-term due to weathering. Under Alternative 4, approximately 677,250 cubic yards of material would be transported for use in the cover. For purposes of this EE/CA, all of this material is assumed to be available from on-going mining at Panel F. Liner installation can be implemented only in dry, warm conditions.This alternative would meet RAOs within three years of completion of the cover (the time for vegetation to become established).

7.4.2 Implementability

Alternative 4 is implementable because it would be both technically and administratively feasible, and all goods and services required to implement this alternative are expected to be readily available.

7.4.2.1 Technical Feasibility

Alternative 4 is technically feasible to implement. Installation of geosynthetics such as GMs, GCLLs, and geotextiles can be installed on the slopes shown on the grading plan (Figure 7-1). Alternative 4 does not require unconventional construction techniques or special access logistics, although installation of a geosynthetic liner would require a specialized subcontractor and specialized construction expertise (at least in terms of construction supervision). Engineering controls are easily implementable during construction activities to prevent impacts to adjoining property. In addition, relevant BMPs are easily implemented such as not to impose unacceptable risks to workers or other receptors.

Alternative 4 would likely require up to three years to implement. The rate of chert/limestone and Dinwoody generation depends on the location of mining within the active pit. This alternative would require a large quantity of crushed/sorted rock to be placed under the liner. This material is available at the mine, but will take several months to a year to generate and place due to limitations on the capacity of available mining equipment in addition to other needs for this material within the active mine. Also, work would be limited in the winter months; while chert/limestone and Dinwoody placement can occur year-round, GCLL installation is problematic during freezing conditions. Finally, the availability of geosynthetics may require longer lead-times due to other large-scale projects that are planned in the Idaho phosphate patch. If the action were to begin in the fall of 2012, the cover installation would be expected to be completed by fall 2015.

Similar RI/FS projects are on-going throughout the Southeast Idaho Phosphate Mining Resource Area. Based on these and other EE/CAs that have been completed, a basic range of appropriate response action technologies has been developed for phosphate mines. This range is consistent with the NTCRA technologies identified and evaluated for the Pole Canyon ODA in Section 6 and focuses on: (1) excavation and disposal (i.e. small scale for pond sediments); (2) surface water management; (3) grading and reshaping; (4) covering or capping; (5) institutional/access controls; and (6) water treatment. As such, the actions in this alternative are consistent with potential future remedial actions. Depending on the final Smoky Canyon site remedial action objectives, results of the Pole Canyon NTCRA performance monitoring, inspections of the surface water controls, and maintenance of ODA slopes and covers, it may be necessary to augment the NTCRA alternative with additional actions. Examples of potential additional remedial actions include supplemental surface water controls to protect the cover and treatment of the seep (if it continues to flow after the NTCRA is completed).

7.4.2.2 Availability of Services and Materials

The excavation of overburden material would be accomplished using heavy equipment (e.g., scrapers, excavators, dozers, and trucks) provided by Simplot. Natural cover materials are available on-Site (either from on-going mining or on-lease borrow areas). Geosynthetic materials for the GM or GCLL cover system are available regionally, but the timing of availability may be limited if other large-scale projects requiring use of GM or GCLL are implemented concurrently in the Southeast Idaho Phosphate Mining Resource Area. Also, as previously mentioned, the time required for crushing and sorting of chert/limestone for use in a drainage layer and for subgrade materials would be significant and would potentially extend the implementation of this alternative by several months to a year. Construction water is readily available from the mine. All goods and services required to implement Alternative 4 are expected to be readily available regionally, if not locally. Trained and experienced labor is available for site work activities.

7.4.2.3 Administrative Feasibility

Alternative 4 would be administratively feasible because the USFS is coordinating with the other regulatory agencies during the EE/CA and Action Memorandum process. It would require relatively simple administrative and construction management controls. No off-site permits would be required. Range management would be implementable because the Pole Canyon ODA is situated on USFS-managed land.

7.4.2.4 State and Community Acceptance

The USFS will consult with the State and other Federal agencies during development and public comment on this EE/CA. Community acceptance of this action will be determined after receiving public comments on the EE/CA.

7.4.3 Cost

The net present value of Alternative 4, including O&M, is estimated to be $16.4 million (Appendix B; Table B-1). Capital costs for Alternative 4 are estimated at $15.9 million. Details on the cost estimate for Alternative 4 are provided in Table B-4.

Table 7-5. Summary of Alternative Performance Against Potential ARARs and Other Criteria, Advisories, and Guidance

Standard, Limitation, or Requirement Criteria		Alternatives			
		1 - No Further Action	**2 – A Cover of One Foot of Dinwoody Overlying Four Feet of Chert/Limestone Cover**	**3 – A Cover of Three Feet of Dinwoody Overlying Two Feet of Chert/Limestone Cover**	**4 - Geosynthetic Cover System**
Federal					
Chemical-Specific	Clean Water Act, Water Quality Standards, National Recommended Water Quality Criteria November 2002. (**Applicable**), National Primary Drinking Water Regulations, Safe Drinking Water Act (**Relevant and Appropriate**)	Does not meet requirements under current conditions due to release of COPCs to groundwater and surface water.	The reduction in infiltration (16%) and increase of runoff with reduced direct contact with overburden contribute to the reduction of subsequent release of COPCs (16% reduction of selenium release compared to no action). This action meets requirements.	The reduction in infiltration (78%) and increase of runoff with reduced direct contact with overburden contribute to the reduction of subsequent release of COPCs (78% reduction of selenium release compared to no action). This action meets requirements.	The reduction in infiltration (97%) and increase of runoff with reduced direct contact with overburden contribute to the reduction of subsequent release of COPCs (97% reduction of selenium release compared to no action). This action meets requirements.
	National Emission Standards for Hazardous Air Pollutants (NESHAP) (**Relevant and Appropriate**)	The no action alternative meets the requirements of NESHAP.	Standard dust control methods during implementation would minimize the potential for release of overburden material to the air and provide for compliance with the substantive requirements of the rule.	See Alternative 2.	See Alternative 2.
	NOAA Freshwater Sediment Benchmarks (**TBC**)	Does not meet requirements under current conditions as continued erosion and transport of COPCs into sediments may occur.	The cover would limit the erosion of overburden material, would reduce COPC concentrations in down-gradient sediments, and may reduce concentrations below the benchmarks.	See Alternative 2.	See Alternative 2.

Table 7-5. Summary of Alternative Performance Against Potential ARARs and Other Criteria, Advisories, and Guidance (Con't.)

Standard, Limitation, or Requirement Criteria		**Alternatives**			
		1 - No Further Action	**2 – A Cover of One Foot of Dinwoody Overlying Four Feet of Chert/Limestone Cover**	**3 – A Cover of Three Feet of Dinwoody Overlying Two Feet of Chert/Limestone Cover**	**4 - Geosynthetic Cover System**
Chemical-Specific	National Pollutant Discharge Elimination System (NPDES) Permit Regulations (**Relevant and Appropriate**)	Simplot holds a NPDES stormwater permit for the Site and operates under a stormwater management plan. The Plan guides inspection and maintenance of stormwater control structures to ensure compliance with the permit.	Zero discharge to surface water is intended through the implementation of stormwater controls. Compliance with the substantive requirements of these regulations would be achieved by meeting surface water quality standards and through continued compliance with the existing stormwater permit.	See Alternative 2.	See Alternative 2.
Action-Specific	Surface Mining Control and Reclamation Act (**Relevant and Appropriate**)	Does not meet requirements under current conditions and unreclaimed areas will remain in place.	Requirements for reclamation would be met by the cover, revegetation, and the run-on/runoff controls.	See Alternative 2.	See Alternative 2.
	Resource Conservation and Recovery Act (**Applicable**)	No hazardous wastes were identified in the Early Action area, and none are expected to be encountered based on site data and history.	See Alternative 1.	See Alternative 1.	See Alternative 1.
	Archaeological and Historic Preservation Act (**Applicable**)	No actions would be implemented.	No historic items are known or expected in the Early Action area because it consists of mining overburden.	See Alternative 2.	See Alternative 2.

Table 7-5. Summary of Alternative Performance Against Potential ARARs and Other Criteria, Advisories, and Guidance (Con't.)

Standard, Limitation, or Requirement Criteria		Alternatives			
		1 - No Further Action	**2 – A Cover of One Foot of Dinwoody Overlying Four Feet of Chert/Limestone Cover**	**3 – A Cover of Three Feet of Dinwoody Overlying Two Feet of Chert/Limestone Cover**	**4 - Geosynthetic Cover System**
Action-Specific	National Historic Preservation Act, Archaeological Resources Protection Act, and National Historic Landmark Regulations (**Applicable**)	No actions would be implemented.	No historic items are known or expected in the Early Action area because it consists of mining overburden.	See Alternative 2.	See Alternative 2.
	Historic Sites, Buildings, Objects, and Antiquities Act (**Applicable**)	No actions would be implemented.	No historic items are known or expected in the Early Action area because it consists of mining overburden.	See Alternative 2.	See Alternative 2.
	Migratory Bird Treaty Act (**Applicable**)	No actions would be implemented.	The taking of game is not anticipated for this action.	See Alternative 2.	See Alternative 2.
	Fish and Wildlife Coordination Act (**Applicable**)	No actions would be implemented.	Alternative would not result in control or structural modification.	See Alternative 2.	See Alternative 2.
	Endangered Species Act (**Applicable**)	No actions would be implemented.	The taking of endangered or threatened species is not anticipated for this action.	See Alternative 2.	See Alternative 2.
	Bald and Golden Eagle Protection Act (**Applicable**)	No action would be implemented	Cover and revegetation would improve habitat for birds.	See Alternative 2.	See Alternative 2.

Table 7-5. Summary of Alternative Performance Against Potential ARARs and Other Criteria, Advisories, and Guidance (Con't.)

Standard, Limitation, or Requirement Criteria		Alternatives			
		1 - No Further Action	**2 – A Cover of One Foot of Dinwoody Overlying Four Feet of Chert/Limestone Cover**	**3 – A Cover of Three Feet of Dinwoody Overlying Two Feet of Chert/Limestone Cover**	**4 - Geosynthetic Cover System**
Action-Specific	Clean Air Act (**Relevant and Appropriate**)	No action would be implemented	Standard dust control methods during implementation would minimize the potential for release of overburden and cover material to the air and provide for compliance with the substantive requirements of the rule.	See Alternative 2.	See Alternative 2.
	American Indian Religious Freedom Act (**TBC**)	No actions would be implemented.	No sacred sites have been identified in the Early Action area because it consists of mining overburden.	See Alternative 2.	See Alternative 2.
Location-Specific	2003 Revised Forest Plan for the Caribou National Forest, 1997 Revised Forest Plan – Targhee National Forest, National Forest Management Act of 1976, Forest and Rangeland Renewable Resources Planning Act of 1971 (**Applicable**)	Does not meet requirements as unreclaimed areas will remain in place.	The cover, revegetation, and run-on/runoff controls would contribute to containment and control of COPCs. This action is consistent with sustainable National Forest resource management and potential future land uses.	See Alternative 2.	See Alternative 2.
	Pocatello Field Office Proposed Resource Management Plan and Final Environmental Impact Statement (**TBC**)	Does not meet requirements as unreclaimed areas will remain in place.	The cover, revegetation, and run-on/runoff controls would contribute to containment and control of COPCs. Future land use would be safe and productive.	See Alternative 2.	See Alternative 2.

Table 7-5. Summary of Alternative Performance Against Potential ARARs and Other Criteria, Advisories, and Guidance (Con't.)

Standard, Limitation, or Requirement Criteria		Alternatives			
		1 - No Further Action	**2 – A Cover of One Foot of Dinwoody Overlying Four Feet of Chert/Limestone Cover**	**3 – A Cover of Three Feet of Dinwoody Overlying Two Feet of Chert/Limestone Cover**	**4 - Geosynthetic Cover System**
Location-Specific	Native American Graves Protection and Repatriation Act (**TBC**)	No actions would be implemented.	No human remains or cultural items have been identified in the Early Action area because it consists of mining overburden.	See Alternative 2.	See Alternative 2.
State of Idaho					
Chemical-Specific	Idaho Water Quality Standards, Idaho Ground Water Quality Rule. (**Applicable**)	Does not meet requirements under current conditions.	The reduction in infiltration (16%) and increase of runoff with reduced direct contact with overburden contribute to the reduction of subsequent release of COPCs (16% reduction of selenium release compared to no action). This action meets requirements.	The reduction in infiltration (78%) and increase of runoff with reduced direct contact with overburden contribute to the reduction of subsequent release of COPCs (78% reduction of selenium release compared to no action). This action meets requirements.	The reduction in infiltration (97%) and increase of runoff with reduced direct contact with overburden contribute to the reduction of subsequent release of COPCs (97% reduction of selenium release compared to no action). This action meets requirements.
	Public Drinking Water System Rules (**Applicable**)	Meets requirements. No public drinking water systems present.	See Alternative 1.	See Alternative 1.	See Alternative 1.

Table 7-5. Summary of Alternative Performance Against Potential Applicable or Relevant and Appropriate Requirements (Con't.)

Standard, Limitation, or Requirement Criteria		Alternatives			
		1 - No Further Action	**2 – A Cover of One Foot of Dinwoody Overlying Four Feet of Chert/Limestone Cover**	**3 – A Cover of Three Feet of Dinwoody Overlying Two Feet of Chert/Limestone Cover**	**4 - Geosynthetic Cover System**
Chemical-Specific	Rules and Standards for Hazardous Waste (**Applicable**), Idaho Hazardous Substance Emergency Response Act (**Relevant and Appropriate**)	No hazardous wastes were identified in the Early Action area, and none are expected based on site data and history.	See Alternative 1.	See Alternative 1.	See Alternative 1.
	Secondary Drinking Water Regulations (**TBC**)	Meets requirements. No public drinking water systems present.	See Alternative 1.	See Alternative 1.	See Alternative 1.
Action-Specific	Solid Waste Management Rules (**Applicable**)	Would be applicable if solid wastes were contained in the area. Does not meet requirements under current conditions.	Consolidating, regrading, covering, and installation of controls would meet requirements.	See Alternative 2.	See Alternative 2.
	Idaho Surface Mining Act (**Relevant and Appropriate**)	Does not meet requirements as unreclaimed areas will remain in place.	Cover, revegetation, and run-on/runoff controls would meet requirements for reclamation.	See Alternative 2.	See Alternative 2.
	Exploration and Surface Mining Rules (**Relevant and Appropriate**)	Does not meet requirements as unreclaimed areas will remain in place.	Cover, revegetation, and run-on/runoff controls would meet requirements for reclamation.	See Alternative 2.	See Alternative 2.
	Air Pollution Control Rules (**Relevant and Appropriate**)	Meets the requirements as there are no emissions at the Site.	Dust control would meet requirements.	See Alternative 2.	See Alternative 2.

Table 7-5. Summary of Alternative Performance Against Potential Applicable or Relevant and Appropriate Requirements (Con't.)

Standard, Limitation, or Requirement Criteria		Alternatives			
		1 - No Further Action	**2 – A Cover of One Foot of Dinwoody Overlying Four Feet of Chert/Limestone Cover**	**3 – A Cover of Three Feet of Dinwoody Overlying Two Feet of Chert/Limestone Cover**	**4 - Geosynthetic Cover System**
Action-specific	Idaho Classification and Protection of Wildlife Rule (**Applicable**)	Does not meet requirements as unreclaimed areas will remain.	Regrading and revegetation would improve habitat for birds and wildlife.	See Alternative 2.	See Alternative 2.
	Protection of Animals and Birds (**Applicable**)	No actions would be implemented.	The taking of animals or birds is not anticipated for this action.	See Alternative 2.	See Alternative 2.
	Idaho Non-Point Source Management Plan (**TBC**)	Does not meet requirements as runoff will continue to contact overburden materials and potentially impact surface waters.	The cover would reduce contact of surface water with overburden.	See Alternative 2.	See Alternative 2.
	Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (**TBC**)	Simplot holds a NPDES stormwater permit for the Site and operates under a stormwater management plan. The Plan guides inspection and maintenance of stormwater control structures to ensure compliance with the permit.	Zero discharge to surface water is intended through the implementation of stormwater controls. Stormwater best management practices for site discharge during construction will be incorporated as applicable.	See Alternative 2.	See Alternative 2.

Table 7-5. Summary of Alternative Performance Against Potential Applicable or Relevant and Appropriate Requirements (Con't.)

Standard, Limitation, or Requirement Criteria		Alternatives			
		1 - No Further Action	**2 – A Cover of One Foot of Dinwoody Overlying Four Feet of Chert/Limestone Cover**	**3 – A Cover of Three Feet of Dinwoody Overlying Two Feet of Chert/Limestone Cover**	**4 - Geosynthetic Cover System**
Location-Specific	Preservation of Historical Sites (**Applicable**)	No actions would be implemented.	No historic items have been identified in the Early Action area.	See Alternative 2.	See Alternative 2.
	Idaho Water Quality Act (**Applicable**)	Does not meet requirements under current conditions. .	The regrading, installation of run-on/runoff controls, clean cover, and revegetation would result in an estimated 16% reduction in infiltration. The reduction in infiltration and increase of runoff with reduced direct contact with overburden contribute to the reduction of subsequent release of COPCs.	The regrading, installation of run-on/runoff controls, clean cover, and revegetation would result in an estimated 78% reduction in infiltration. The reduction in infiltration and increase of runoff with no direct contact with overburden contribute to the reduction of subsequent release of COPCs.	The regrading, installation of run-on/runoff controls, clean cover, and revegetation would result in an estimated 97% reduction in infiltration. The reduction in infiltration and increase of runoff with no direct contact with overburden contribute to the reduction of subsequent release of COPCs.
	Selenium Area Wide Investigation Area Wide Risk Management Plan (**TBC**)	Does not meet requirements under current conditions.	The cover, revegetation, and run-on/runoff controls would contribute to containment and control of COPCs. Thus, the action would meet the primary goals of the Risk Management Plan including protection of surface water resources, wildlife and habitat, beneficial uses of resource area, and regional groundwater sources.	See Alternative 2.	See Alternative 2.

8.0 COMPARATIVE ANALYSIS OF NTCRA ALTERNATIVES

The NTCRA alternatives are compared in the following discussion based on the criteria of effectiveness, implementability, and cost. The comparative analysis identifies the advantages and disadvantages of each NTCRA alternative relative to one another so that key trade-offs that affect remedy selection can be identified. The comparison focuses on the significant differences to identify an alternative that is clearly superior in meeting a specific criterion.

The NTCRA alternatives are:

- Alternative 1: No Further Action
- Alternative 2: A cover of 1 foot of Dinwoody over a minimum of 4 feet of chert/limestone cover
- Alternative 3: A cover of 3 feet of Dinwoody over a minimum of 2 feet of chert/limestone cover
- Alternative 4: Geosynthetic Cover System

8.1 Effectiveness

The following comparative analysis for effectiveness evaluates overall protection of human health and the environment (including short- and long-term effectiveness) and compliance with ARARs and other criteria, advisories, and guidance.

8.1.1 Protection of Human Health and the Environment

Under the No Further Action alternative, water would continue to infiltrate into the ODA material from direct precipitation at its current rate. This infiltrated water moves through the overburden, leaching selenium and other COPCs, and is released to groundwater and surface water. Reducing the release and migration of selenium and other COPCs is a key goal of the NTCRA. The NTCRA alternatives, by implementation of vegetated covers, are predicted to provide reductions of surface water infiltration into the ODA when compared to the No Further Action alternative, as shown in Table 8-1.

Table 8-1. Relative Reduction of Water Inflow and Transport of Selenium from the Pole Canyon ODA

Alternative	Estimated Reduction in Water Inflow Relative to Current Conditions	Estimated Reduction in Selenium Transport from the ODA Relative to Current Conditions
2 – A cover of 1 foot of Dinwoody over a minimum of 4 feet of chert/limestone cover	16%	16%
3 – A cover of 3 feet of Dinwoody over a minimum of 2 feet of chert/limestone cover	78%	78%
4 – Geosynthetic Cover System	97%	97%

Alternatives 3 and 4 provide significantly greater reduction in water flow into, and selenium transport from the ODA compared to Alternatives 1 and 2. To put these reductions into context, the 2008 NTCRA eliminated inflow of 94% of water into the Pole Canyon ODA. Therefore, these reductions are applicable to the remaining 6% of water inflow (i.e., Alternative 3 reduces the remaining 6% water inflow by a further 78% or to approximately 1.3% of the pre-2008 NTCRA inflow).

The reductions in infiltration would be expected to result in a corresponding decrease in releases of selenium and other COPCs from the ODA by this transport pathway. Reduction of this release will contribute to meeting MCLs for groundwater and surface water quality standards in the vicinity of the ODA. Each of Alternatives 2, 3, and 4 meets the RAO requirement to reduce the amount of water that infiltrates into the ODA from direct precipitation. No alternative eliminates all infiltration into the ODA.

Dinwoody material is available from on-going mining at Panel F and from an on-lease borrow source immediately upslope from Panel D. Based on experience mining in other locations at the Site, it is expected that the Panel D borrow area Dinwoody would be appropriate for use in a cover, with better properties for reducing infiltration than the Dinwoody available from on-going mining at Panel F. The cost to generate and place Dinwoody from the Panel D borrow area is significantly less than from on-going mining at Panel F ($2.54 versus $6.45 per cubic yard). This is primarily due to shorter haul distances. Therefore, the Panel D borrow source is expected to be a more cost-effective option for Dinwoody material. Because specific characterization has not been performed, it would be necessary to perform an investigation during design to verify its quantity and characteristics.

The SRE identified that concentrations of selenium and other COPCs in soils and vegetation on the ODA exceed their respective conservative risk-based benchmarks. The covers and revegetation with non-selenium accumulator species specified in Alternatives 2, 3, and 4 meet the RAOs identified in Section 5.1.

There would be no risks to the community during implementation of the NTCRA alternatives. Construction would be implemented using standard equipment and procedures that would be protective of workers. Minor grading of the overburden conducted for Alternatives 2, 3, and 4 has low potential for transport of selenium and other COPCs in the short-term due to weathering.

Each action alternative would have similar short-term risks. On-going mining at Panel F would generate the chert/limestone and Dinwoody materials for Alternatives 2, 3 and 4. Alternative 3 would also require development of an on-lease Dinwoody borrow area immediately upslope from Panel D. This would have a short-term impact on the borrow area, which would be mitigated by reclamation of the area once the required volume of Dinwoody had been obtained. All NTCRA alternatives would meet RAOs within two years of completion of the cover (the time for vegetation to become established).

8.1.2 Compliance with ARARs and Other Criteria, Advisories, and Guidance

The following paragraphs summarize the relative performance of each alternative with respect to the key ARARs. The greater the reduction of infiltration of precipitation into the ODA, the greater the contribution of the action to meeting ARARs (see Section 8.1 for the relative performance of each alternative with respect to reduction in water inflow and transport of selenium). Post-construction monitoring would be implemented to assess progress toward compliance with chemical- and location-specific ARARs and any additional actions required to meet these ARARs will be addressed as part of the RI/FS.

Applicable ARARs – As previously discussed in Section 5, the applicable ARARs include the promulgated Federal and State surface water and groundwater quality standards. All alternatives will further contribute to meeting these key ARARs, except for the No Further Action alternative. The relative contribution towards meeting the requirements of these key ARARs increases as the alternatives increase in number.

Relevant and Appropriate ARARs – As previously mentioned in Section 5, the key relevant and appropriate ARARs include National Emission Standards for Hazardous Air Pollutants Rules and NOAA Freshwater Sediment Benchmarks. All alternatives (except the no action alternative) are predicted to meet these key ARARs. Standard dust control methods during implementation would minimize the potential for release of overburden material to the air and provide for compliance with the substantive requirements of the National Emission Standards for Hazardous Air Pollutants Rules. The covers, revegetation, and stormwater management controls would minimize erosion and would contribute toward meeting the requirements of the NOAA Freshwater Sediment Benchmarks (a TBC). There are no significant differences in the performance of the action alternatives in meeting the requirements of the relevant and appropriate ARARs.

8.2 Implementability

Compared to the differences in cost and effectiveness of the alternatives, there are no significant differences in terms of their implementability. While the scope of activities increases from Alternatives 2 to 4, none of the alternatives require unconventional construction techniques or special access logistics. However, installation of a geosynthetic liner in Alternative 4 would require a specialized subcontractor and specialized construction expertise (at least in terms of construction supervision). All goods and services required for implementation are expected to be readily available regionally, if not locally. Engineering controls are easily implementable during construction activities to prevent impacts to adjoining property. In addition, relevant BMPs are easily implemented and would not impose unacceptable risks to workers or other receptors. Also, none of the alternatives require permits or easements. Actions would be conducted on USFS-managed land and, therefore, interim range management would be implementable. Assuming work begins in fall 2012, the covers under Alternatives 2 and 3 could be completed by fall 2013. Alternative 4 could be completed by fall 2015.

Depending on the final Site remedial action objectives, results of NTCRA performance monitoring, and inspections of the surface water controls and covers, it may be necessary to augment the NTCRA alternative with additional actions. In general, the NTCRA alternatives increase in scope (amount of grading, complexity of cover) from Alternatives 2 to 4. The reduction in infiltration also increases from Alternatives 2 to 4. Therefore the potential for the need for additional actions would be lowest for Alternative 4, followed in order by Alternatives 3 and 2.

8.3 Cost

The estimated net present value of the action alternatives are as follows:

- Alternative 2: $8.2 million;
- Alternative 3: $7.0 million; and
- Alternative 4: $16.4 million.

Table 8-2 and Figure 8-1 provide a comparison of the alternatives in terms of estimated infiltration reduction against the present worth costs. As shown in Table 8-2 and Figure 8-1, Alternative 3 would be the most cost-effective at reducing infiltration into the ODA. Alternative 4 would entail significantly higher costs than Alternative 3 with relatively small incremental benefits (noting that the alternatives address the 6% water inflow remaining after implementation of the 2008 NTCRA; i.e., Alternative 3 would result in an overall reduction of water inflow of 98.7% compared to pre-2008 NTCRA conditions).

Table 8-2. Cost Effectiveness of Pole Canyon ODA Alternatives at Reducing Infiltration

Alternative	Estimated Present Worth Cost	Estimated Reduction in Infiltration (percent)[a]	Cost Effectiveness ($/acre-ft reduced)
1	$0	0%	$0
2	$8,152,000	16%	$510,000
3	$7,009,000	78%	$90,000
4	$16,426,000	97%	$169,000

[a] From Appendix A, Table A-6

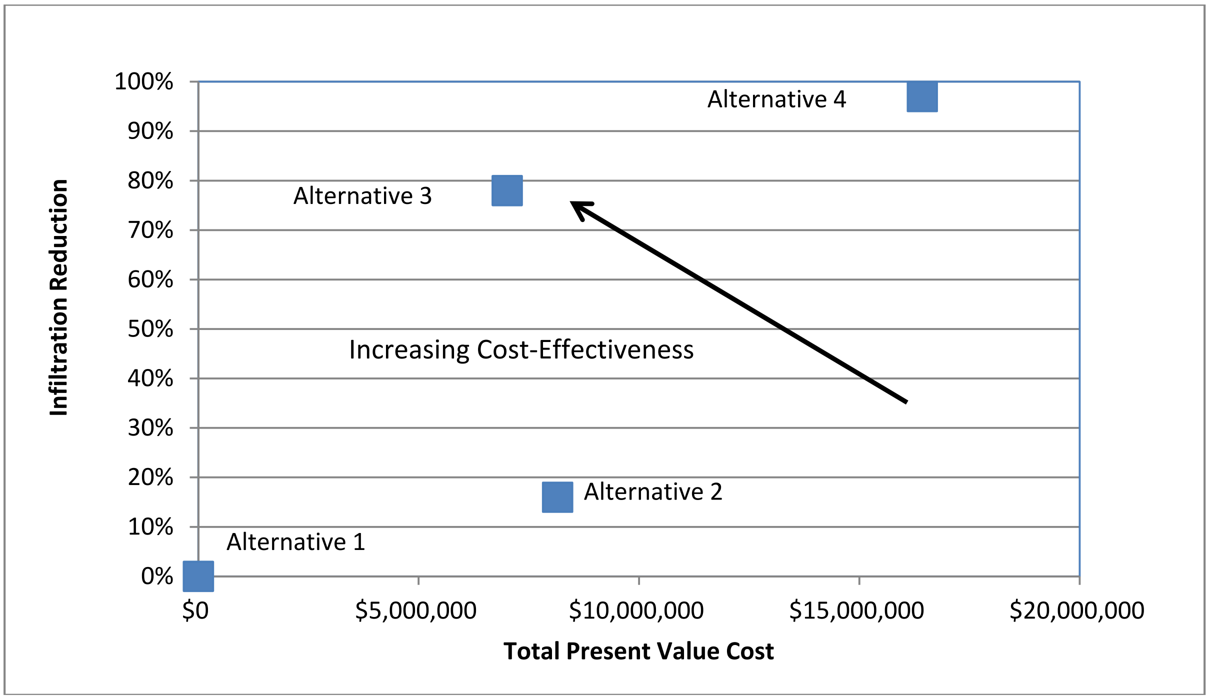

Figure 8-1: Summary of Infiltration Reduction Relative to Cost

9.0 RECOMMENDED NTCRA ALTERNATIVE

The recommended NTCRA alternative is identified based on results of the comparative analysis which highlights the effectiveness, implementability, and cost considerations relevant to identifying the preferred NTCRA for the Pole Canyon ODA.

Alternative 3 is the recommended NTCRA alternative for the Pole Canyon ODA for the following reasons:

- It provides protection of human health and the environment and meets the requirements of all the RAOs. It is predicted to reduce annual infiltration into the surface of the ODA to 10.6 acre-feet. Compared to current conditions this represents an estimated 78% decrease in both infiltration to and transport of selenium from the ODA. To put this in context, the 2008 NTCRA reduced the water inflow to the ODA by 94%. Alternative 3 would reduce the remaining 6% of inflow by 78%, i.e., to approximately 1.3% of the original water inflow. This is expected to result in significant reductions in selenium concentrations in the environment downgradient of the ODA. Alternative 3 also provides the most cost-effective reduction compared to the other alternatives.

- The cover thickness and revegetation with non-selenium-accumulating species would also prevent the potential for selenium exposure via direct contact and ingestion of ODA materials or vegetation containing COPCs. This alternative provides a level of performance similar to the other action alternatives.

- Alternative 3 would meet the action and location-specific ARARs and contribute toward meeting the chemical-specific ARARs. This alternative would likely be consistent with the future remedial actions at the Site.

- If the action were to begin in the fall of 2012, the cover would be expected to be completed by the fall of 2013. Response Objectives would be met about two years after the cover was complete (once vegetation was established). This would be a shorter time frame than would be needed to implement Alternative 4, which includes a geosynthetic liner.

- The Dinwoody material needed (approximately 580,500 cubic yards) would be obtained from Panel F mining and from an on-lease borrow area immediately to the west of Panel D. The quality and quantity of Dinwoody available from this potential borrow source would be determined from sampling conducted to support design. The actual proportion of Panel F/Panel D Dinwoody to be used in the cover would also be identified at that time. This implementation schedule, in combination with low potential for risk to workers and the community during implementation, would provide a high level of short-term effectiveness.

- Alternative 3 is implementable from both a technical and administrative standpoint. The construction of this alternative would utilize standard construction equipment and techniques. Experienced contractors and skilled workers are available locally. Additionally, there would be no significant administrative implementability issues associated with this alternative.

The estimated present worth cost for Alternative 3 is $7.0 million. Alternative 3 is the lowest cost alternative. It provides a significant and the most cost-effective approach to reducing infiltration to the Pole Canyon ODA (a reduction of 78% compared to current conditions and 98.7% compared to pre-2008 NTCRA conditions).

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Appendix A

Pole Canyon ODA Water Balance Calculations

Appendix A

Pole Canyon ODA Water-Balance Calculations

A.1 Background

The existing Pole Canyon Overburden Disposal Area (ODA) is located at Simplot's Smoky Canyon Mine and covers approximately 120 acres. The Pole Canyon ODA is a cross-valley fill comprised of seleniferous waste rock that covers an approximately 4,000-foot-long reach of Pole Canyon Creek.

Simplot implemented a Removal Action (RA) in 2007 and 2008 which included measures to convey upper Pole Canyon Creek flow around the ODA in a bypass pipeline, infiltrate creek flows not captured by the pipeline, and direct run-on from an adjacent hillslope (to the north) away from the ODA. The 2008 RA did not include actions to reduce the infiltration of water into the ODA from direct precipitation or to reduce the potential for risk to ecological receptors due to ingestion of ODA surface materials or ingestion of vegetation, and to human receptors due to ingestion of vegetation, and ingestion of and direct contact with ODA materials. This Pole Canyon ODA Engineering Evaluation/Cost Analysis (EE/CA) identifies and evaluates a range of cover options to reduce infiltration into the ODA and the potential for ecological risk.

The seep flow at the toe of the ODA is believed to originate in part from percolation of water which enters the ODA from surface infiltration, specifically in response to direct rainfall and melting of snow accumulations on the surface. Therefore, a water-balance model is used to estimate reductions in the movement of infiltrated water into and through the overburden resulting from possible removal action alternatives considered as part of the EE/CA.

This appendix summarizes the water-balance model calculations for the Pole Canyon ODA that were prepared prior to this EE/CA, followed by a discussion of the inputs and results for estimating net infiltration into the ODA under current conditions addressed by this EE/CA. Prior to this EE/CA, water-balance model calculations were prepared to assess the components and magnitudes of water inflows and outflows for the Pole Canyon ODA under conditions prior to and since implementation of the 2008 RA. The results of the water balance were presented on an average annual basis, along with selenium concentration data, to estimate the release and transport of selenium from the overburden materials placed in the ODA. The first water-balance model for the major water inflows to and outflows from the ODA was prepared during the SI to represent conditions in the early to mid-2000s (NewFields, 2005), followed by minor updates and application to estimate the potential effectiveness of three removal action alternatives presented in the 2006 EE/CA (NewFields, 2006). Since implementation of the Pole Canyon RA in 2007 and 2008, updated water-balance calculations have been prepared annually to assess the overall effectiveness of the RA in terms of decreasing selenium transport from the Pole Canyon ODA to groundwater and surface water for each individual year. These recent evaluations have relied on collected water quality and flow data and modeling of infiltration rates using measured site temperature and precipitation data for each year. Effectiveness monitoring activities and results are presented by year in an annual effectiveness monitoring report (Formation, 2012) which includes an evaluation of the overall effectiveness of the RA.

A.2 2006 EE/CA Water-Balance Model

Prior to implementation of the RA in 2007 and 2008, Pole Canyon Creek water entered the upstream side of the ODA and then was lost to the Wells Formation aquifer and alluvial deposits beneath the ODA while flowing in the underlying stream channel. Any remaining flow discharged at the downstream end, or toe, of the ODA and continued downstream with a significant portion or all of the flow infiltrating into the alluvium and, potentially, the underlying Wells Formation aquifer. Infiltration and runoff from adjacent areas entered the ODA through its surface, and some of the water entering the ODA migrated downward to the alluvium and the Wells Formation aquifer. A hydrologic schematic of the Pole Canyon ODA prior to implementation of the RA is shown on Figure 2-3(a) of this current EE/CA.

The water-balance model prepared during the SI (NewFields, 2005) and used for evaluation of alternatives in the 2006 EE/CA (NewFields, 2006) represented conditions in the early to mid-2000s prior to construction of the bypass pipeline, infiltration basin, and run-on control channel. The water balance was set up for an average annual time frame, assuming the amount of water flowing into the ODA each year is equivalent to the amount of water flowing out of the ODA each year. Site-specific, instantaneous streamflow measurements taken from 1979 to 2004 were used to estimate the annual average inflow and outflow of Pole Canyon Creek water. Annual average infiltration into the ODA surface was estimated based on precipitation measured at the mine and modeling of evapotranspiration (ET), surface runoff, and surface run-on based on the characteristics of Pole Canyon ODA and adjacent slopes, including vegetation type and abundance, and the local climatic conditions. The amount of water flowing in alluvial deposits immediately upgradient and downgradient of the ODA was estimated based on site conditions. The amount of recharge to the Wells Formation aquifer (underlying the ODA footprint) was calculated as the difference between the sum of inflows and sum of outflows.

The water balance in the 2006 EE/CA evaluations focused on three major inputs of water into the Pole Canyon ODA. The largest input of water was from Pole Canyon Creek flowing directly into the upstream toe of the ODA. Pole Canyon Creek was estimated to contribute, on average, approximately 44.2 million cubic feet of water per year to the ODA. The next largest input of water to the Pole Canyon ODA was surface water run-on from hillslope area north of the ODA. This area was estimated to contribute approximately 2.2 million cubic feet per year of water to the Pole Canyon ODA. A third major input of water to the Pole Canyon ODA was direct infiltration, which was estimated to contribute approximately 1.2 million cubic feet per year of water. The sum total of estimated water input, on average, to the Pole Canyon ODA was 47.6 million cubic feet per year (1.51 cfs) under conditions prior to implementation of the RA in 2007 and 2008. Approximately 93 percent of this input consisted of Pole Canyon Creek streamflow. Estimation of the remaining 7 percent of the input (i.e., surface water run-on and direct infiltration) is summarized in the following discussion.

The U.S. Army Corps of Engineers (USACE) Hydrologic Evaluation of Landfill Performance (HELP) model was used to estimate net infiltration from incident precipitation (Schroeder et al., 1994). The HELP model was developed by the U.S. Army Corps of Engineers to assess infiltration of precipitation through waste disposal sites. The model inputs include local weather, soil and waste conditions, cover materials, and interior drainage systems. A number of internal solution techniques are used to account for the effects of surface runoff, snowmelt, infiltration, evapotranspiration (ET), vegetative growth, soil moisture storage, lateral drainage, and vertical drainage through the base of the ODA and provide an estimate for the net infiltration from incident precipitation.

The HELP model requires several inputs to describe the local climate conditions, including precipitation, temperature, solar radiation, wind speed, and humidity. These inputs were developed from the best available information, including temperature for Afton, Wyoming (adjusted for the elevation difference) and solar radiation, wind speed, and humidity for Pocatello, Idaho. The annual precipitation estimate used for the Pole Canyon area, 32.2 inches per year, was the annual average precipitation recorded at a NRCS precipitation monitoring station at Slug Creek Divide from 1982 through 2002. Due to drought conditions in the several years prior to the SI, the long-term average value was higher than the annual precipitation measured at Pole Canyon. Incident precipitation recorded monthly from 2000 through 2003 at a rain gage located at Smoky Canyon Mine indicated an annual average precipitation of 20.1 inches, and the precipitation total recorded at Pole Canyon in 2003 was 22.6 inches. Use of the higher precipitation depths in the HELP model may result in overestimation of infiltration.

The HELP model also considered the material properties and surface conditions for the ODA. Parameters for these inputs were based on the observed material types and thicknesses, slope gradients, and vegetation growth. Material properties were obtained from previous site-specific studies. Based these and other inputs, an infiltration estimate of 3.7 inches per year (volume of 1.2 million cubic feet per year) was obtained for the Pole Canyon ODA.

Another water input to the top surface of the ODA and a component of net infiltration into the ODA is surface water run-on from the south-facing hillslope that was estimated to cover 50 acres to the north of the ODA. Surface run-on to the Pole Canyon ODA was also estimated using the HELP model, with input parameters assigned to reflect the soil characteristics, vegetation density and type, and slope characteristics for that area. The HELP model output indicates that annual runoff from the slope north of Pole Canyon ranges from an estimated 11.5 to 13.5 inches per year with an average of 12 inches equivalent to a volume of 2.2 million cubic feet per year.

The 2006 EE/CA estimated that, by implementation of the bypass pipeline and infiltration basin, all of the Pole Canyon Creek inflow (44.2 million cubic feet per year) would be isolated from the ODA and have no contact with the overburden. Also, the EE/CA assumed the surface water run-on control channel (on the north side of the ODA) would result in an 80 percent reduction in run-on, which would be a decrease from 2.2 to 0.44 million cubic feet per year. The remaining 1.2 million cubic feet per year (i.e., direct infiltration) was not addressed by the RA.

A.3 Annual Effectiveness Evaluations

Since implementation of the RA in 2007 and 2008, an assessment of the effectiveness of the RA has been completed for each individual year of record – on an annual basis and not as long-term averages. Groundwater and surface water monitoring within Pole Canyon and Sage Valley has provided data for the annual assessment of the overall effectiveness of the RA in terms of decreasing selenium transport from the Pole Canyon ODA to groundwater and surface water. The water-balance and mass-balance approach was introduced in the 2009 Annual Effectiveness Monitoring Report (Formation, 2011c), and is based on previous water-balance calculations presented in the SI Report (NewFields, 2005) and 2006 EE/CA (NewFields, 2006). The water-balance model used for effectiveness evaluations includes updates, from these earlier efforts, for improved accuracy based on the more recent site-wide water-balance model created for the Smoky Canyon Mine (NewFields, 2009a).

Each year's annual water-balance model is based on measured and, as necessary, modeled water inflows to and outflows from the Pole Canyon ODA. The current year's meteorological and flow measurement data are used to estimate the amount of water flowing into and out of the ODA with the RA implemented ("with RA" model scenario) and the corresponding amount of water under a hypothetical scenario where the RA is not implemented (i.e., "without RA" scenario). The hypothetical scenario, or "without RA" model, is based on the current year's meteorological data but with input assumptions corresponding to the pre-RA conditions (i.e., no creek diversion, no runoff diversion, etc.).

The annual water-balance model used for effectiveness evaluations represents the following improvements over the model presented in the SI and 2006 EE/CA:

- Accurate, continuous flow data are available for upper Pole Canyon Creek upstream of the ODA. This allows for improved estimation of the effectiveness of the "with RA" compared to "without RA" conditions. The previous water-balance model presented in the SI and 2006 EE/CA relied on instantaneous, manually-measured flow data collected only occasionally, from 1979 to 2004, to estimate creek inflow into the ODA.
- Estimation of direct infiltration into the ODA surface, using the HELP model, now utilizes temperature and precipitation measured at the mine. This allows more accurate estimation of the actual infiltration. Also, the Curve Number used for HELP modeling is now increased to 86, from 75, thus decreasing infiltration as a result of the increased runoff potential for the highly armored surface containing significant proportions of small rock.
- Estimation of runoff from the hillslope area to the north of the ODA, using the HELP model, now utilizes temperature and precipitation measured at the mine. Also, the drainage area for this hillslope was re-calculated at 95 acres as an update to the 50 acres presented in the SI and 2006 EE/CA model. In addition, the effectiveness evaluations assume all run-on generated from the hillslope area is captured and conveyed to lower Pole Canyon Creek without contact with the ODA, whereas, the 2006 EE/CA assumed the capture/conveyance would be 80 percent effective. Also, the Curve Number used for HELP modeling is now increased to 86 (see Table 2-2c [SCS, 1986] which is attached to this appendix), from 75, thus decreasing infiltration as a result of the increased runoff potential.

Also, the effectiveness evaluations present results for water input from alluvial groundwater under “with RA” and “without RA” conditions. However, in the SI Report (NewFields, 2005) and 2006 EE/CA (NewFields, 2006), alluvial groundwater inflows were evaluated but were not included in the computation of water input percentages. Water input totals were computed in the SI and 2006 EE/CA water-balance model based on the three major inputs of surface water which include upper Pole Canyon Creek streamflow, direct infiltration of precipitation into the ODA surface, and run-on from the hillslope to the north of the ODA. As discussed for the SI and 2006 EE/CA water-balance model, from the total of these three inputs, approximately 93 percent of the input volume (44.2 million cubic feet per year) consisted of Pole Canyon Creek streamflow and the remaining 7 percent consisted of surface water run-on (2.2 million cubic feet per year) and direct infiltration (1.2 million cubic feet per year).

The 2010 effectiveness evaluation (Formation, 2012) presents total inflows, with RA and without the RA, for upper Pole Canyon Creek, alluvial groundwater, direct infiltration, and run-on from the hillslope to the north for the years 2008, 2009, and 2010 (Table A-1). While the magnitudes of water input were lower for these three years, compared with the 2006 EE/CA average annual estimates, the percentages for each component, with RA, were similar (when excluding water input from alluvial groundwater). Specifically, the water input from direct infiltration ranged from 0.8 to 2.0 million cubic feet for these three years (for conditions without the RA). Corresponding percentages of direct infiltration to the total input ranged from 3 to 5 percent for these three years compared with 2.5 percent of the total presented in the 2006 EE/CA (excluding alluvial groundwater). This indicates good agreement between the water-balance calculations presented in the 2006 EE/CA and effectiveness evaluations, with approximately 3 to 5 percent of the total water input remaining to be addressed based on the calculations for these three years.

A.4 Model Inputs for Current EE/CA

The analysis of water inputs in the current EE/CA focuses only on direct infiltration and the potential effectiveness of several cover system removal action alternatives for reducing infiltration into the ODA. The magnitudes of direct infiltration for current conditions and for each of the removal action alternatives were simulated using the HELP model to develop a long-term average infiltration estimate for a 100-year period. The inputs for this modeling effort were similar to those used for estimation of direct infiltration in the effectiveness evaluations. With the substantially longer modeling period for this EE/CA compared with effectiveness evaluations (100 years compared with one year), the temperature and precipitation data collected at the mine were used internally within the HELP model to synthetically generate long-term temperature and precipitation data sets for the 100-year simulation. For the ODA surface material (i.e., overburden), the material properties were identical for HELP model simulations under the current EE/CA and for annual effectiveness evaluations. Material properties for other materials included in the cover system removal action alternatives, including Dinwoody, chert, and geosynthetic materials, were developed from other site-specific studies at the Smoky Canyon Mine, as discussed below.

The model inputs for comparison of net percolation differences for the Pole Canyon ODA removal action alternatives included climate, soil/material properties (i.e., hydraulic conductivity, porosity, etc), and cover characteristics as shown in Tables A-2, A-3, and A-4, respectively.

Input parameters for temperature and precipitation are presented in Table A-2. Precipitation data have been collected at the Smoky Canyon Mine since 2000, and temperature data have been collected since 2005. These data were used to develop mean monthly precipitation and termperature values for use in the HELP model for its internal synthetic generation of daily data for use during model simulations. Other parameters were based on Pocatello but adjusted by the HELP Model to better represent the site.

Material property input data (Table A-3) included porosity, field capacity, wilting point, and saturated hydraulic conductivity (Ksat). For all material types the initial moisture content was assumed to be in steady state and was calculated by the HELP Model. The material properties for the existing overburden, Alternative 1, were generally based on data utilized by Knight Piésold (2005) for HELP modeling performed in the early 2000s for the Smoky Canyon Mine. For the local Dinwoody and chert/limestone materials used in the alternatives, the material properties were also based on data utilized for previous HELP modeling performed by Knight Piésold (2005) with adjustments to Ksat values for Dinwoody based on the quality of material expected from the active mining operations in Panel F or from a new potential on-lease borrow area located adjacent to the west side of D Panel.

The Dinwoody Formation varies in composition and material properties, but generally is comprised of interbedded siltstone, shale, and limestone that grades into a calcareous shale and siltstone with depth. Material testing and database reviews of Dinwoody (Type A, as discussed below) indicate a typical particle size distribution of 19% gravels, 23% sands, and 58% fines, and saturated hydraulic conductivity, Ksat, typically ranging from 1.0x10-6 to 1.6x10-4 cm/sec (O'Kane Consultants, 2006). Depending on the extent of weathering, Dinwoody soil textures range from clay to loam, including sandy clay loam. Typical soil-water characteristic curve data show Dinwoody with a field capacity (-33 kPa) at 34% moisture content and wilting point (-1,500 kPa) at 23% moisture content (O'Kane Consultants, 2006). Additional information on Dinwoody characteristics is provided in the report entitled "*Smoky Canyon Mine Proposed "F" and "G" Panels Expansion – Material Characterizations used for the Modeling of Soil Cover System Alternatives*" (O'Kane Consultants, 2006).

Two potential sources of Dinwoody material were identified for evaluation of the Pole Canyon ODA removal action alternatives – ongoing mining on Panel F and a new borrow source adjacent to Panel D. Two types of Dinwoody material have been identified in Panel F using the Visual Delineation Method – Type A and Type B. These two types of Dinwoody material were distinguished because the generally higher quality (Type A) material is preferred for reclamation on Panel F, as it is a more highly weathered Dinwoody material in comparison withType B Dinwoody material which is acceptable as a cover material on the Pole Canyon ODA. The proportions/volumes of these two types of Dinwoody material in the Panel D borrow source are not currently known, although a significant portion is expected to be Type A material.

Characterization of the Panel D borrow source for potential use in the removal action, if needed, will be performed as part of preliminary/pre-design work.

Panel F Dinwoody (Type B) was assumed to be the first source of Dinwoody that will be used for Alternatives 2, 3, and 4, and for this EE/CA any additional Dinwoody volume needed will be obtained from a borrow source such as the potential location adjacent to Panel D. A maximum of approximately 193,500 cubic yards (equivalent to a 1-foot thickness over the 120-acre ODA area) of Panel F Dinwoody is assumed to be available for the Pole Canyon ODA cover. Alternative 2 utilizes Panel F Dinwoody as the only Dinwoody material source, requiring a total Dinwoody volume of 193,500 cubic yards. Alternative 3 includes one lift (1 foot) of Dinwoody from Panel F (193,500 cubic yards) nominally compacted only by equipment travel, and a second lift (2 feet) of Dinwoody is assumed from the Panel D borrow source (387,000 cubic yards) placed loose with minimal equipment travel. Alternative 4 utilizes 193,500 cubic yards (1 foot) of Panel F Dinwoody as the only Dinwoody material source.

Two Ksat values were used for Dinwoody material – a lower value was used for Dinwoody in Alternative 3 compared with the conservatively higher Ksat used for Alternatives 2 and 4. The lower Ksat for Dinwoody in Alternative 3 results from using Dinwoody from both Panel F (Type B only) and, possibly, the Panel D borrow source (a combination of Type A and Type B materials) along with effects of lift placement and nominal compaction from equipment travel. The higher Ksat of 10^{-3} cm/sec was used for both Alternatives 2 and Alternative 4 because the Dinwoody for these alternatives would be Panel F Type B material.

Geosynthetic materials, as infiltration barriers, include materials such as linear low-density polyethylene (LLDPE-T), high-density polyethylene (HDPE-T), or geosynthetic clay laminate liner (GCLL). Ksat is estimated at a maximum of 5.0×10^{-9} cm/sec for this material. The Ksat for geoynthetic materials such as GCLL, used in Alternative 4, was set at this value to account for potentially reduced effectiveness, relative to the default HELP Model values, due to installation factors that could result in increased Ksat.

Cover characteristics for the HELP Model simulations (Table A-4) were assigned based on the cover concepts for each alternative. The HELP Model utilized input data for the surface material, vegetation quality, and evaporative zone depth, along with data including the Leaf Area Index (LAI), the start and end of the growing season, average annual wind speed, average quarterly relative humidity, to calculate ET. Runoff was estimated based on the Soil Conservation Service (SCS), now Natural Resources Conservation Service, runoff curve numbers (CNs) that were assigned based on the surface material and vegetation cover, consistent with calculations for the annual effectiveness monitoring reporting for the Pole Canyon ODA. Information on curve numbers for calculation of runoff volume is presented by Haan et al. (1994), which provides copies of tables presented by the SCS in Technical Release No. 55 (TR55) (SCS, 1986). Table 2-2c (SCS, 1986), from which a CN of 86 was selected, is attached at the end of this appendix.

An SCS CN of 86 for current conditions (i.e., overburden on the surface) was assigned to the HELP model analyses based on its current usage in Pole Canyon Removal Action effectiveness calculations (updated annually). The surface of the existing overburden is highly armored, containing significant proportions of small rock, thus yielding a high runoff potential. While Dinwoody material varies in composition, observations of surface runoff in areas of its use for Panel E reclamation indicate a generally high runoff potential as well because it typically has significant fine-grained material. Therefore, both overburden and Dinwoody material have high runoff potential, but for different reasons. However, Ksat values for Dinwoody and overburden were not similar due to differences in gradation. Generally, a finer-grained material such as Dinwoody is expected to have a lower Ksat than a coarser-grained material such as overburden. Therefore, the differences in Ksat for Dinwoody and overburden are expected and consistent with available information and/or current usage.

The maximum LAI is used by the HELP model to account for the level of vegetation growth which impacts infiltration, due to root channels, and evapotranspiration. The maximum LAI is assigned by the HELP model user based on the quality of vegetation growth, with a higher LAI representing more vigorous, healthy vegetation. LAI values range from 0 (bare soil) to 5.0 (excellent stand of grass). The maximum LAI for No Action (Alternative 1) was set at 1.5 to represent the current poor to fair stand of grass on the ODA. The stand of grass for Alternatives 2 and 4 is assumed to be fair to good (better than current conditions), with maximum LAI of 2.5, and the stand of grass for Alternative 3 is assumed to be good (better than Alternative 2 and current conditions), with maximum LAI of 3.5.

A.5 Model Output for Current EE/CA

Simulations of the water balance for the removal action alternatives provide output for runoff, ET, and percolation into the overburden, as briefly summarized in Table A-5 and listed on the attached output file printouts for the cover conditions simulated for No Action and Alternatives 2 through 4. These results are based on simulation over a 100-year period using model-generated daily weather conditions. The water balance for a given cover is calculated on a daily basis, accounting for rainfall, runoff, evapotranspiration, stored water in the ET zone, and percolation through the ET zone. The model also utilizes daily air temperature and soil temperature to simulate conditions below freezing. Results are also presented in Table A-6 for average annual volume (acre-feet) and for the percentage reduction in net percolation through the overburden, for comparison of the effects of each alternative relative to existing condtions.

Results of the current EE/CA evaluation for existing conditions (i.e., Alternative 1) show an average annual direct infiltration volume of 49 acre-feet (2.1 million cubic feet per year), which is larger than the direct infiltration estimate of 1.2 million cubic feet per year presented in the 2006 EE/CA. This difference is probably largely due to the updated temperature and precipitation data set used for the current EE/CA along with an increase in the ODA area (from 112 to 120 acres) combined with extending the simulation over a 100-year period instead of the several-year period used for the 2006 EE/CA (and the annual estimates prepared for the effectiveness evaluations).

The analysis prepared in the current EE/CA, based on long-term conditions and an updated areal extent of the ODA, estimates that the 2008 RA has removed a long-term average of 94% of the inflow. Therefore, the remaining 6% (49 acre-feet) of the total input would be addressed by implementation of a cover system on the ODA.

A.6 References

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Table A-1. Modeled Inflows, by Pathway and Year, for the Pole Canyon ODA

Without RA Inflow Pathways: Annual Inflows (ac-ft)					
Year	Surface Water	Alluvial Groundwater	Direct Infiltration	Run-on	Total Annual Inflow (sum of inflow pathways)
2008	600	36	21	22	679
2009	833	36	46	24	939
2010	583	36	19	5	643
With RA Inflow Pathways: Annual Inflows (ac-ft)					
2008	0	0	21	22	43
2009	0	0	46	0	46
2010	0	0	19	0	19

Without RA Inflow Pathways: Annual Inflows (million cubic feet)					
Year	Surface Water	Alluvial Groundwater	Direct Infiltration	Run-on	Total Annual Inflow (sum of inflow pathways)
2008	26.1	1.6	0.9	1.0	29.6
2009	36.3	1.6	2.0	1.0	40.9
2010	25.4	1.6	0.8	0.2	28.0
With RA Inflow Pathways: Annual Inflows (million cubic feet)					
2008	0.0	0.0	0.9	1.0	1.9
2009	0.0	0.0	2.0	0.0	2.0
2010	0.0	0.0	0.8	0.0	0.8

Without RA Inflow Pathways: Annual Inflows (% of total)					
Year	Surface Water	Alluvial Groundwater	Direct Infiltration	Run-on	Total Annual Inflow (sum of inflow pathways)
2008	88%	5%	3%	3%	100%
2009	89%	4%	5%	3%	100%
2010	91%	6%	3%	1%	100%
With RA Inflow Pathways: Annual Inflows (% of total)					
2008	0%	0%	49%	51%	100%
2009	0%	0%	100%	0%	100%
2010	0%	0%	100%	0%	100%

From *2010 Annual Report–Pole Canyon Removal Action Effectiveness Monitoring* (Formation, 2012)

Table A-2.
Climate Input Parameters

Month	Mean Monthly Data for Smoky Canyon Mine	
	2000-2010 Precipitation (inches)	2005-2010 Temperature (deg. F)
January	2.18	20.2
February	1.48	21.9
March	1.89	27.5
April	1.87	34.2
May	2.13	43.6
June	2.40	53.4
July	0.80	64.7
August	1.29	60.6
September	1.52	52.0
October	1.96	39.2
November	2.05	28.9
December	2.35	19.6

Other Parameters (Assigned by Model Based on Site Location):

Parameter	Value
Solar Radiation	Varies with time
Start of Growing Season (Julian Date)	150
End of Growing Season (Julian Date)	240
Average Annual Wind Speed (miles/hour)	2.7
Average 1st Quarter Relative Humidity (%)	72
Average 2nd Quarter Relative Humidity (%)	53
Average 3rd Quarter Relative Humidity (%)	44
Average 4th Quarter Relative Humidity (%)	62

Table A-3.
Material Properties

Material Type	Soil/Material Properties [1]				Initial Soil Water Content
	Hydraulic Conductivity, K (cm/sec)	Porosity (vol/vol)	Field Capacity (vol/vol)	Wilting Point (vol/vol)	
Dinwoody from Panel F active mining operations [2]	1.0E-03	0.491	0.354	0.238	Model Calculated
Dinwoody from Panel D on-lease borrow source [3]	1.0E-04	0.491	0.354	0.238	Model Calculated
Chert/Limestone	2.0E-02	0.238	0.162	0.056	Model Calculated
Geosynthetic material [4]	5.0E-09	Not applicable for geosynthetic materials			
Overburden	2.6E-02	0.365	0.239	0.102	Model Calculated

[1] Material properties are generally based on data utilized by Knight Piésold (2005) for HELP modeling performed in the early 2000s for the Smoky Canyon Mine with adjustments as necessary to reflect material quality in the Smoky Canyon Mine area.

[2] Dinwoody Type B material is assumed to be the only material available from Panel F for a Pole Canyon ODA cover. This material type is lower quality, but usable, for reclamation (compared with Type A material). This type of Dinwoody is conservatively assumed to have a K value of 10^{-3} cm/sec when placed loose; if nominally compacted by equipment travel only (Alternative 3), this material is assumed to have a K value of 10^{-4} cm/sec.

[3] For purposes of this EE/CA, potential Panel D borrow source Dinwoody is assumed to be a mixture of Type A and Type B material, and is conservatively assumed to have a K value of 10^{-4} cm/sec when placed loose (not compacted).

[4] Geoynthetic materials, used as infiltration barriers, include LLDPE-T, HDPE-T, GCLL, etc. Hydraulic conductivity (K) is estimated at a maximum of 5.0E-09 cm/sec, though K may be lower for some materials.

Table A-4.
Cover Characteristic Input Parameters

ODA Setting	Simulated Cover	Evaporative Zone Depth (inches)	Vegetation Quality/ Maximum LAI [a]	SCS Curve Number [b]
Alternative 1 Current Conditions	Existing conditions (no action)	24	poor to fair/1.5	86
Alternative 2	1 foot Dinwoody over 4 feet of chert/limestone	24	fair to good/2.5	86
Alternative 3	3 feet Dinwoody over 2 feet of chert/limestone	36	good/3.5	86
Alternative 4	Geosynthetic cover system (layers include, from the top): 1 foot of Dinwoody 1.5 feet of chert/limestone (uncrushed) 6 inches of chert/limestone (crushed, sorted) Geosynthetic Clay Laminate Liner (GCLL) or similar 6 inches of chert/limestone (for bedding)	24	fair to good/2.5	86

[a] LAI = Leaf Area Index. This parameter accounts for the level of vegetation growth which impacts infiltration, due to root channels, and evapotranspiration.

[b] Curve Numbers (CNs) are utilized from the annual effectiveness monitoring reporting for the Pole Canyon ODA (current conditions), and also reflect information presented in Appendix 3C (tables from the USDA-Soil Conservation Service) of Haan et al. (1994) which presents tables originally provided by the USDA Soil Conservation Service (SCS) (1986). Table 2-2c, from SCS (1986), is attached to this appendix. This information, along with engineering judgment, was used to assign the CN for ODA surface conditions. Note that the CN values represent surface conditions and are all set at 86, indicating a high runoff potential for current conditions as well as for Dinwoody material in the surface layer. The surface of the existing overburden is highly armored, containing significant proportions of small rock, thus yielding a high runoff potential. While Dinwoody material varies in composition, observations of surface runoff in areas of its use for Panel E reclamation indicate a generally high runoff potential as well because it typically has significant fine-grained material. Therefore, both overburden and Dinwoody material have high runoff potential, but for different reasons.

Table A-5.
HELP Model Output for Removal Action Alternatives

ODA Setting	Simulated Cover	Average Annual Depth (inches) [a]		
		Surface Runoff	Evapo-transpiration	Percolation through Overburden
Alternative 1 Current Conditions	Existing conditions (no action)	6.48	10.45	4.86
Alternative 2	1 foot Dinwoody over 4 feet of chert/limestone	6.88	10.81	4.08
Alternative 3	3 feet Dinwoody over 2 feet of chert/limestone	6.82	13.90	1.06
Alternative 4	Geosynthetic cover system (layers include, from the top): 1 foot of Dinwoody 1.5 feet of chert/limestone (uncrushed) 6 inches of chert/limestone (crushed, sorted) Geosynthetic Clay Laminate Liner (GCLL) or similar 6 inches of chert/limestone (for bedding)	6.88	10.98	0.134

[a] For Alternatives 1-3, precipitation is the input to the water balance simulated by the HELP model, and surface runoff, evapotranspiration, and percolation are outputs. For Alternative 4, lateral drainage is an additional output (at approximately 3.78 inches per year) due to the use of a chert drainage layer overlying the geomembrane liner. The set of output values for each alternative (for a given location in the ODA) are additive and equal to the precipitation depth (i.e., input value).

Table A-6.
Infiltration Volume Summary

ODA Setting	Simulated Cover	Area (acres)	Average Annual Percolation Volume (acre-feet)	Percent Reduction (relative to No Action)
Alternative 1 Current Conditions	Existing conditions (no action)	120	49	--
Alternative 2	1 foot Dinwoody over 4 feet of chert/limestone	120	41	16%
Alternative 3	3 feet Dinwoody over 2 feet of chert/limestone	120	10.6	78%
Alternative 4	Geosynthetic cover system (layers include, from the top): 1 foot of Dinwoody 1.5 feet of chert/limestone (uncrushed) 6 inches of chert/limestone (crushed, sorted) Geosynthetic Clay Laminate Liner (GCLL) or similar 6 inches of chert/limestone (for bedding)	120	1.3	97%

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**                                                                        **
**                                                                        **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**              HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**              DEVELOPED BY ENVIRONMENTAL LABORATORY                     **
**              USAE WATERWAYS EXPERIMENT STATION                         **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY               **
**                                                                        **
**                                                                        **
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PRECIPITATION DATA FILE:    C:\HELP3\pole\PRCP100.D4
TEMPERATURE DATA FILE:      C:\HELP3\pole\TEMP100.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\pole\SOLR100.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\pole\EVAP2415.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\pole\1EXSTG.D10
OUTPUT DATA FILE:           C:\HELP3\pole\1EXSTG.OUT


TIME:   9: 7     DATE:   9/ 9/2011


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     TITLE:  Pole Canyon ODA Covers - Option 1, No Action

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
            COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =    240.00   INCHES
           POROSITY                   =      0.3650 VOL/VOL
           FIELD CAPACITY             =      0.2390 VOL/VOL
           WILTING POINT              =      0.1020 VOL/VOL
           INITIAL SOIL WATER CONTENT =      0.2313 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.260000005000E-01 CM/SEC



                   GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                   ----------------------------------------
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NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER	=	86.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.935	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	8.760	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.448	INCHES
INITIAL SNOW WATER	=	2.253	INCHES
INITIAL WATER IN LAYER MATERIALS	=	55.514	INCHES
TOTAL INITIAL WATER	=	57.768	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
POCATELLO IDAHO

STATION LATITUDE	=	42.55	DEGREES
MAXIMUM LEAF AREA INDEX	=	1.50	
START OF GROWING SEASON (JULIAN DATE)	=	150	
END OF GROWING SEASON (JULIAN DATE)	=	240	
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	2.70	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	72.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	53.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	44.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	62.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.18	1.48	1.89	1.87	2.13	2.40
0.80	1.29	1.52	1.96	2.05	2.35

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
20.20	21.90	27.50	34.20	43.60	53.40
64.70	60.60	52.00	39.20	28.90	19.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO
AND STATION LATITUDE = 42.55 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.34	1.63	1.87	1.81	2.03	2.41
	0.87	1.31	1.32	1.71	2.03	2.43
STD. DEVIATIONS	0.99	0.75	0.84	0.77	1.17	1.53
	0.64	1.04	1.16	1.24	0.99	1.05
RUNOFF						
TOTALS	0.036	0.240	2.518	3.116	0.349	0.039
	0.001	0.014	0.021	0.025	0.071	0.050
STD. DEVIATIONS	0.135	0.469	1.983	2.395	0.927	0.153
	0.006	0.062	0.070	0.078	0.166	0.159
EVAPOTRANSPIRATION						
TOTALS	0.270	0.242	0.316	0.887	1.723	2.082
	1.008	1.107	1.028	0.899	0.524	0.368
STD. DEVIATIONS	0.042	0.037	0.093	0.433	0.778	0.943
	0.634	0.721	0.759	0.489	0.172	0.059
PERCOLATION/LEAKAGE THROUGH LAYER 1						
TOTALS	0.0000	0.0000	0.1051	2.0956	1.3540	0.2339
	0.0328	0.0351	0.0676	0.3355	0.5359	0.0656
STD. DEVIATIONS	0.0000	0.0000	0.6014	1.8959	1.9186	0.8571
	0.3279	0.3509	0.4756	1.1228	1.2348	0.4614

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	21.76	(3.902)	78973.9	100.00
RUNOFF	6.480	(1.9831)	23521.31	29.784
EVAPOTRANSPIRATION	10.452	(1.9622)	37941.09	48.043
PERCOLATION/LEAKAGE THROUGH LAYER 1	4.86109	(1.76036)	17645.750	22.34377

CHANGE IN WATER STORAGE -0.037 (2.2296) -134.22 -0.170

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	3.81	13830.300
RUNOFF	2.378	8632.3193
PERCOLATION/LEAKAGE THROUGH LAYER 1	4.737925	17198.66600
SNOW WATER	10.83	39324.6992
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.2953
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1020

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FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	53.5123	0.2230
SNOW WATER	0.558	

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****

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****************************************************************************
****************************************************************************
**                                                                        **
**                                                                        **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE             **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)              **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                 **
**                    USAE WATERWAYS EXPERIMENT STATION                   **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY            **
**                                                                        **
**                                                                        **
****************************************************************************
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PRECIPITATION DATA FILE:     C:\HELP3\POLE\PRCP100.D4
TEMPERATURE DATA FILE:       C:\HELP3\POLE\TEMP100.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\POLE\SOLR100.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\POLE\EVAP2425.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\POLE\2REV.D10
OUTPUT DATA FILE:            C:\HELP3\POLE\2rev.OUT


TIME:   9:40     DATE:   2/29/2012


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     TITLE:  Pole Canyon ODA EECA - Alternative 2, 1ft Dinwoody/4ft chert

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER   0
           THICKNESS                   =     12.00   INCHES
           POROSITY                    =      0.4910 VOL/VOL
           FIELD CAPACITY              =      0.3540 VOL/VOL
           WILTING POINT               =      0.2380 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.3476 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC


                                  LAYER  2
                                  --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
```

```
               MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     48.00   INCHES
POROSITY                     =      0.2380 VOL/VOL
FIELD CAPACITY               =      0.1620 VOL/VOL
WILTING POINT                =      0.0560 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1304 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-01 CM/SEC
```

LAYER 3

```
          TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER   0
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.3650 VOL/VOL
FIELD CAPACITY               =      0.2390 VOL/VOL
WILTING POINT                =      0.1020 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2315 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.260000005000E-01 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

```
 NOTE:  SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER              =     86.00
FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
EVAPORATIVE ZONE DEPTH               =     24.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =      5.063  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =      8.748  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =      3.528  INCHES
INITIAL SNOW WATER                   =      2.253  INCHES
INITIAL WATER IN LAYER MATERIALS     =     65.996  INCHES
TOTAL INITIAL WATER                  =     68.250  INCHES
TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

```
 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
          POCATELLO             IDAHO

     STATION LATITUDE                        =  42.55 DEGREES
     MAXIMUM LEAF AREA INDEX                 =   2.50
     START OF GROWING SEASON (JULIAN DATE)   =    150
     END OF GROWING SEASON (JULIAN DATE)     =    240
     EVAPORATIVE ZONE DEPTH                  =  24.0  INCHES
     AVERAGE ANNUAL WIND SPEED               =   2.70 MPH
     AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  72.00 %
     AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  53.00 %
     AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  44.00 %
     AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  62.00 %
```

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.18	1.48	1.89	1.87	2.13	2.40
0.80	1.29	1.52	1.96	2.05	2.35

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
20.20	21.90	27.50	34.20	43.60	53.40
64.70	60.60	52.00	39.20	28.90	19.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO
AND STATION LATITUDE = 42.55 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.34	1.63	1.87	1.81	2.03	2.41
	0.87	1.31	1.32	1.71	2.03	2.43
STD. DEVIATIONS	0.99	0.75	0.84	0.77	1.17	1.53
	0.64	1.04	1.16	1.24	0.99	1.05
RUNOFF						
TOTALS	0.043	0.274	2.691	3.249	0.365	0.046
	0.001	0.017	0.023	0.029	0.084	0.058
STD. DEVIATIONS	0.155	0.511	2.057	2.483	0.956	0.175
	0.006	0.067	0.074	0.091	0.195	0.170
EVAPOTRANSPIRATION						
TOTALS	0.270	0.242	0.319	0.908	1.787	2.213
	1.047	1.130	1.081	0.921	0.527	0.368

STD. DEVIATIONS	0.042	0.037	0.109	0.431	0.814	1.016
	0.680	0.790	0.823	0.496	0.165	0.059

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.0000	0.0000	0.0777	1.8053	1.3701	0.2425
	0.0000	0.0343	0.0680	0.2798	0.1365	0.0670
STD. DEVIATIONS	0.0000	0.0000	0.5502	1.9179	1.8558	0.8893
	0.0000	0.3429	0.4792	0.9544	0.6724	0.4714

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	21.76 (3.902)	78973.9	100.00
RUNOFF	6.879 (2.0630)	24972.29	31.621
EVAPOTRANSPIRATION	10.811 (2.0793)	39245.38	49.694
PERCOLATION/LEAKAGE THROUGH LAYER 3	4.08119 (1.60606)	14814.717	18.75900
CHANGE IN WATER STORAGE	-0.016 (2.1250)	-58.46	-0.074

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	3.81	13830.300
RUNOFF	2.404	8726.9395
PERCOLATION/LEAKAGE THROUGH LAYER 3	4.740970	17209.72070
SNOW WATER	10.83	39324.6992
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3307	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1470	

****

****

FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	3.0365	0.2530
2	6.3347	0.1320
3	56.7101	0.2363
SNOW WATER	0.558	

****
****

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP3\POLE\PRCP100.D4
TEMPERATURE DATA FILE:       C:\HELP3\POLE\TEMP100.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\POLE\SOLR100.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\POLE\EVAP3635.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\POLE\3.D10
OUTPUT DATA FILE:            C:\HELP3\POLE\3.OUT


TIME:  10:43     DATE:   9/20/2011


******************************************************************************

     TITLE:  Pole Canyon ODA EECA - Alternative 3, 3ft Dinwoody/2ft chert

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   0
          THICKNESS                   =     36.00   INCHES
          POROSITY                    =      0.4910 VOL/VOL
          FIELD CAPACITY              =      0.3540 VOL/VOL
          WILTING POINT               =      0.2380 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.3474 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.999999975000E-04 CM/SEC


                                   LAYER  2
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
```

MATERIAL TEXTURE NUMBER 0

```
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.2380 VOL/VOL
FIELD CAPACITY               =      0.1620 VOL/VOL
WILTING POINT                =      0.0560 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1481 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-01 CM/SEC
```

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

```
THICKNESS                    =    240.00   INCHES
POROSITY                     =      0.3650 VOL/VOL
FIELD CAPACITY               =      0.2390 VOL/VOL
WILTING POINT                =      0.1020 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2304 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.260000005000E-01 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

```
SCS RUNOFF CURVE NUMBER              =     86.00
FRACTION OF AREA ALLOWING RUNOFF     =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
EVAPORATIVE ZONE DEPTH               =     36.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =     12.507  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =     17.676  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =      8.568  INCHES
INITIAL SNOW WATER                   =      2.253  INCHES
INITIAL WATER IN LAYER MATERIALS     =     71.353  INCHES
TOTAL INITIAL WATER                  =     73.606  INCHES
TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
POCATELLO IDAHO

```
STATION LATITUDE                          =  42.55 DEGREES
MAXIMUM LEAF AREA INDEX                   =   3.50
START OF GROWING SEASON (JULIAN DATE)     =    150
END OF GROWING SEASON (JULIAN DATE)       =    240
EVAPORATIVE ZONE DEPTH                    =  36.0  INCHES
AVERAGE ANNUAL WIND SPEED                 =   2.70 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY     =  72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY     =  53.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY     =  44.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY     =  62.00 %
```

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.18	1.48	1.89	1.87	2.13	2.40
0.80	1.29	1.52	1.96	2.05	2.35

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
20.20	21.90	27.50	34.20	43.60	53.40
64.70	60.60	52.00	39.20	28.90	19.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO
AND STATION LATITUDE = 42.55 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.34	1.63	1.87	1.81	2.03	2.41
	0.87	1.31	1.32	1.71	2.03	2.43
STD. DEVIATIONS	0.99	0.75	0.84	0.77	1.17	1.53
	0.64	1.04	1.16	1.24	0.99	1.05
RUNOFF						
TOTALS	0.047	0.287	2.659	3.158	0.361	0.067
	0.001	0.018	0.027	0.039	0.098	0.063
STD. DEVIATIONS	0.168	0.519	2.004	2.453	0.927	0.221
	0.006	0.070	0.082	0.124	0.212	0.173
EVAPOTRANSPIRATION						
TOTALS	0.270	0.242	0.322	0.993	2.508	2.716
	3.359	1.042	0.955	0.716	0.408	0.364

```
  STD. DEVIATIONS         0.042     0.037     0.095     0.500     0.606     0.954
                          0.861     0.762     0.651     0.319     0.078     0.057

PERCOLATION/LEAKAGE THROUGH LAYER  3
------------------------------------
  TOTALS                  0.0000    0.0000    0.0000    0.3821    0.5713    0.1017
                          0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

  STD. DEVIATIONS         0.0000    0.0000    0.0000    1.1623    1.3205    0.5815
                          0.0000    0.0000    0.0000    0.0000    0.0000    0.0000

********************************************************************************


********************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS    1 THROUGH  100
--------------------------------------------------------------------------------
                                      INCHES            CU. FEET       PERCENT
                               -------------------   -------------   ---------
 PRECIPITATION                  21.76    (   3.902)     78973.9       100.00

 RUNOFF                          6.824   (  2.0559)     24771.22      31.366

 EVAPOTRANSPIRATION             13.896   (  2.0780)     50440.73      63.870

 PERCOLATION/LEAKAGE THROUGH     1.05513 (  1.67201)     3830.118      4.84985
   LAYER  3

 CHANGE IN WATER STORAGE        -0.019   (  2.8536)       -68.15      -0.086
********************************************************************************


********************************************************************************

             PEAK DAILY VALUES FOR YEARS    1 THROUGH  100
   ------------------------------------------------------------------------
                                                    (INCHES)      (CU. FT.)
                                                   ----------   -------------
     PRECIPITATION                                   3.81         13830.300

     RUNOFF                                          2.378         8632.3193

     PERCOLATION/LEAKAGE THROUGH LAYER  3            4.805813     17445.10160

     SNOW WATER                                     10.83         39324.6992

     MAXIMUM VEG. SOIL WATER (VOL/VOL)                        0.4485

     MINIMUM VEG. SOIL WATER (VOL/VOL)                        0.2380
********************************************************************************
```

****

FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	11.4378	0.3177
2	3.6245	0.1510
3	56.1084	0.2338
SNOW WATER	0.558	

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******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP3\POLE\PRCP100.D4
TEMPERATURE DATA FILE:       C:\HELP3\POLE\TEMP100.D7
SOLAR RADIATION DATA FILE:   C:\HELP3\POLE\SOLR100.D13
EVAPOTRANSPIRATION DATA:     C:\HELP3\POLE\EVAP2425.D11
SOIL AND DESIGN DATA FILE:   C:\HELP3\POLE\4REV2.D10
OUTPUT DATA FILE:            C:\HELP3\POLE\4rev2.OUT


TIME:  15:19     DATE:   4/17/2012


******************************************************************************

     TITLE:  Pole Canyon ODA Covers - Option 4, Geosynthetic System

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                        TYPE 1 - VERTICAL PERCOLATION LAYER
                            MATERIAL TEXTURE NUMBER   0
           THICKNESS                    =     12.00   INCHES
           POROSITY                     =      0.4910 VOL/VOL
           FIELD CAPACITY               =      0.3540 VOL/VOL
           WILTING POINT                =      0.2380 VOL/VOL
           INITIAL SOIL WATER CONTENT   =      0.3476 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                                   LAYER  2
                                   --------

                        TYPE 1 - VERTICAL PERCOLATION LAYER
```

```
               MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     18.00   INCHES
POROSITY                     =      0.2380 VOL/VOL
FIELD CAPACITY               =      0.1620 VOL/VOL
WILTING POINT                =      0.0560 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1036 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-01 CM/SEC


                        LAYER  3
                        --------

             TYPE 2 - LATERAL DRAINAGE LAYER
               MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      6.00   INCHES
POROSITY                     =      0.2380 VOL/VOL
FIELD CAPACITY               =      0.1620 VOL/VOL
WILTING POINT                =      0.0560 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1620 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-01 CM/SEC
SLOPE                        =     10.00   PERCENT
DRAINAGE LENGTH              =    100.0    FEET


                        LAYER  4
                        --------

             TYPE 4 - FLEXIBLE MEMBRANE LINER
               MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      0.04   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.499999997000E-08 CM/SEC
FML PINHOLE DENSITY          =      0.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      0.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  4 - POOR


                        LAYER  5
                        --------

           TYPE 1 - VERTICAL PERCOLATION LAYER
               MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      6.00   INCHES
POROSITY                     =      0.2380 VOL/VOL
FIELD CAPACITY               =      0.1620 VOL/VOL
WILTING POINT                =      0.0560 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.1443 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-01 CM/SEC


                        LAYER  6
                        --------
```

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	240.00	INCHES
POROSITY	=	0.3650	VOL/VOL
FIELD CAPACITY	=	0.2390	VOL/VOL
WILTING POINT	=	0.1020	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2261	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.260000005000E-01	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER	=	86.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	5.063	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	8.748	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	3.528	INCHES
INITIAL SNOW WATER	=	2.253	INCHES
INITIAL WATER IN LAYER MATERIALS	=	62.143	INCHES
TOTAL INITIAL WATER	=	64.397	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
POCATELLO IDAHO

STATION LATITUDE	=	42.55	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.50	
START OF GROWING SEASON (JULIAN DATE)	=	150	
END OF GROWING SEASON (JULIAN DATE)	=	240	
EVAPORATIVE ZONE DEPTH	=	24.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	2.70	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	72.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	53.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	44.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	62.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
2.18	1.48	1.89	1.87	2.13	2.40
0.80	1.29	1.52	1.96	2.05	2.35

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
20.20	21.90	27.50	34.20	43.60	53.40
64.70	60.60	52.00	39.20	28.90	19.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR POCATELLO IDAHO
AND STATION LATITUDE = 42.55 DEGREES

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.34	1.63	1.87	1.81	2.03	2.41
	0.87	1.31	1.32	1.71	2.03	2.43
STD. DEVIATIONS	0.99	0.75	0.84	0.77	1.17	1.53
	0.64	1.04	1.16	1.24	0.99	1.05
RUNOFF						
TOTALS	0.043	0.274	2.691	3.249	0.365	0.046
	0.001	0.017	0.023	0.029	0.084	0.058
STD. DEVIATIONS	0.155	0.511	2.057	2.483	0.957	0.175
	0.006	0.067	0.074	0.091	0.195	0.170
EVAPOTRANSPIRATION						
TOTALS	0.270	0.242	0.318	0.960	1.871	2.223
	1.065	1.130	1.082	0.922	0.527	0.368
STD. DEVIATIONS	0.042	0.037	0.105	0.459	0.820	1.023
	0.684	0.788	0.824	0.496	0.165	0.059
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0000	0.0000	0.0677	1.5779	1.1629	0.1944
	0.0146	0.0483	0.1026	0.2853	0.3098	0.0201
STD. DEVIATIONS	0.0000	0.0000	0.3897	1.2951	1.3470	0.4495
	0.0829	0.2009	0.3176	0.5902	0.4815	0.0830

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0000	0.0000	0.0026	0.0602	0.0447	0.0078
	0.0007	0.0019	0.0040	0.0110	0.0120	0.0008
STD. DEVIATIONS	0.0000	0.0000	0.0148	0.0495	0.0514	0.0171
	0.0032	0.0077	0.0121	0.0224	0.0183	0.0032

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.1005	0.0335
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.5745	0.3350
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0000	0.0000	0.0195	0.4708	0.3361	0.0577
	0.0042	0.0139	0.0305	0.0820	0.0920	0.0058
STD. DEVIATIONS	0.0000	0.0000	0.1120	0.3873	0.3901	0.1335
	0.0238	0.0577	0.0943	0.1696	0.1430	0.0239

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	21.76	(3.902)	78973.9	100.00
RUNOFF	6.879	(2.0637)	24970.76	31.619
EVAPOTRANSPIRATION	10.977	(2.0810)	39845.50	50.454
LATERAL DRAINAGE COLLECTED FROM LAYER 3	3.78368	(1.21039)	13734.743	17.39149
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.14556	(0.04637)	528.381	0.66906
AVERAGE HEAD ON TOP OF LAYER 4	0.093	(0.030)		
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.13403	(0.65990)	486.519	0.61605
CHANGE IN WATER STORAGE	-0.018	(1.9611)	-63.61	-0.081

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	3.81	13830.300
RUNOFF	2.404	8726.9014
DRAINAGE COLLECTED FROM LAYER 3	1.74180	6322.74658
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.069930	253.84531
AVERAGE HEAD ON TOP OF LAYER 4	16.446	
MAXIMUM HEAD ON TOP OF LAYER 4	22.734	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	26.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	3.353457	12173.04980
SNOW WATER	10.83	39324.6992

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3307
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1470

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	3.0365	0.2530
2	1.7882	0.0993
3	0.9720	0.1620
4	0.0000	0.0000
5	0.8909	0.1485
6	55.3987	0.2308

SNOW WATER 0.558

****
****

(SCS, 1986)

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

current conditions (Alt. 1)

Alternatives 2, 3, and 4

1 Average runoff condition, and $I_a = 0.2S$.

2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Appendix B

Detailed Cost Estimates

APPENDIX B
DETAILED COST ESTIMATES

This appendix provides discussion and supporting cost estimate tables for the removal action alternatives developed for the Pole Canyon ODA. As detailed in the Engineering Evaluation/Cost Analysis (EECA) text, the removal action alternatives are:

- Alternative 1: No Further Action (as required for consideration by the NCP)
- Alternative 2: 1 foot of Dinwoody, 4 feet of Chert/Limestone Cover
- Alternative 3: 3 feet of Dinwoody, 2 feet of Chert/Limestone Cover
- Alternative 4: Geosynthetic Cover System

These cost estimates were developed consistent with procedures in the G*uide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA, 2000) and are expected to result in estimates that are within a range of -30 percent to +50 percent of what actual costs may be. The estimates include capital costs, operations and maintenance (O&M) costs, and periodic costs. These cost categories are described below.

B.1 Capital Costs

Capital costs are those expenditures that are required to design and construct a removal action. They exclude costs required to operate or maintain the action throughout its lifetime. Capital costs consist primarily of expenditures initially incurred to build or install the removal action (e.g., construction of a soil cover system and related site work). Capital costs include all labor, equipment, and material costs, including contractor markups such as overhead and profit, associated with activities such as mobilization/demobilization; monitoring; site work; and installation of cover systems. Capital costs also include expenditures for professional/technical services necessary to support construction of the removal action.

Construction-related indirect costs and contingencies are estimated as a percentage of capital costs. For this EE/CA, adjustments were made to reflect Site-specific costs because much of the design and construction work will be performed by Simplot using equipment and materials present at the Mine and will not require outside contractors. Adjustments to these indirect costs and contingencies are discussed below:

- Mobilization/demobilization – typical costs may be on the order of 5% of the direct construction subtotal; this is adjusted to 1% for Alternatives 2 and 3 because equipment and operators are already present at the mine. This was increased to 2% for Alternative 4, because outside contractors would need to be used for the geosynthetic liner system.
- Water/sediment control – costs are typically on the order of 2-3% (2.5%) of total construction costs.
- Scope – the scope of the action is well defined: the area to be covered is defined and the cover thicknesses are defined. Therefore this contingency has been adjusted to 10%.
- Bid – typical costs may be on the order of 10% to develop bid materials, solicit bids, select contractor(s), and negotiate contract(s); this is adjusted to 0% for Alternatives 2 and 3 (all work performed by Simplot; for no outside contracts) or 5% for Alternative 4 (outside contract(s) for installation of geomembrane, etc).
- Project management – typical costs may be on the order of 5% (from G*uide to Developing and Documenting Cost Estimates During the Feasibility Study* [EPA, 2000]); this is adjusted to 2% due to increased efficiencies of the internal process.
- Remedial design – typical costs may be on the order of 6-8% (from G*uide to Developing and Documenting Cost Estimates During the Feasibility Study* [EPA, 2000]); this is adjusted to 4% due to increased efficiencies of the internal process and because the actions are straightforward.
- Construction management – typical costs may be on the order of 6% (from G*uide to Developing and Documenting Cost Estimates During the Feasibility Study* [EPA, 2000]); this is adjusted to 2% for Alternatives 2 and 3 (Simplot performed all work with equipment and personnel already managed at the Site) to 4% for Alternative 4 (third party oversight of liner installation and increased project complexity).

B.2 Annual O&M Costs

Operation and maintenance (O&M) costs are those post-construction costs necessary to ensure or verify the continued effectiveness of a removal action. These costs are typically estimated on an annual basis. Some EPA guidance documents refer to O&M as post-removal site control (PRSC). Annual O&M costs include all labor, equipment, and material costs, including contractor markups such as overhead and profit, associated with activities such as monitoring and maintaining revegetated cover systems. Costs for periodic inspection and repair of ditches, swales, and appurtenant structures are also included. Annual O&M costs also include expenditures for professional/technical services necessary to support O&M activities.

For cost estimation, O&M activities are assumed to occur each year for a 30-year period. For the first five years, it is assumed that maintenance/additional revegetation will be performed each year as required in previously seeded areas. The annual maintenance revegetation cost, for the first five years, was estimated by assuming this would be required on 10-15% (average of 12.5%) of the total area at a revegetation unit cost of $2,200 to $2,600 ($2,400 average) per acre, yielding a post-construction O&M revegetation unit rate for the entire area of $300 per acre. In addition, the cost for inspections in all areas was estimated by assuming an average inspection frequency of twice per year (annually and after severe storm events) with limited repair required. These inspection activities are assumed to occur on two days each year, at an estimated cost of $150 per day, for a total annual inspection cost of $300 per acre. Therefore, the total annual O&M cost for the first five years is estimated at $600 per acre. Environmental monitoring (groundwater/surface water) is already performed to monitor the effectiveness of the 2008 Removal Action. No addition environmental monitoring is assumed for the cover alternatives. Also, spot spraying of herbicides to control selenium accumulators and noxious weeds is covered by the mine plan and, therefore, is not included in these O&M costs.

For the remaining years of O&M, it is assumed that the additional revegetation activities of the first five years will no longer be required, but inspections of all areas will occur at an average frequency of twice per year (annually and after severe storm events) with limited repair required. The annual O&M cost for the remaining years of the 30-year O&M period is assumed at $300/acre.

B.3 Periodic Costs

Periodic costs are those costs that occur only once every few years (e.g., five-year reviews, equipment replacement) or expenditures that occur only once during the entire O&M period or removal timeframe (e.g., site closeout, remedy failure/replacement). These costs may be either capital or O&M costs, but because of their periodic nature, it is more practical to consider them separately from other capital or O&M costs in the estimating process. For the Pole Canyon ODA area, none of the removal action alternatives entail periodic costs though routine review would be required as part of the O&M process.

B.4 Present Value Analysis

For each alternative, a -30 to +50 percent cost estimate is developed in accordance with procedures in the G*uide to Developing and Documenting Cost Estimates During the Feasibility*

Study (EPA, 2000). Cost estimates for each alternative are based on conceptual engineering and design and are expressed in terms of 2012 dollars. This analysis is used to evaluate the capital, O&M, and periodic costs of a removal action alternative based on its present value. A present value analysis compares expenditures for various alternatives where those expenditures occur over different time periods. By discounting all costs to a common base year, the costs for different removal action alternatives can be compared based on a single cost figure for each alternative.

The total present value for a single alternative is equal to the full amount of all costs incurred through the end of the first year of operation, plus the series of expenditures in following years reduced by the appropriate future value/present value discount factor. This analysis allows the comparison of removal action alternatives on the basis of a single cost representing an amount that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the removal action over its planned life. The present value calculations are based on the following fundamental equation:

$$P = F / (1+i)^n$$

Where: P = present worth ($)
F = future worth ($)
i = discount rate (%)
n = time period (years)

A discount rate of 7 percent is used for the present worth calculations, consistent with EPA guidance and directives (EPA, 1988 and 2000). The discount rate represents the anticipated difference between the rate of inflation and investment return.

B.5 Cost Estimates

Present value cost estimates for removal action alternatives are presented in Table B-1. Detailed cost estimate information for Alternatives 2 through 4 is presented in Tables B-2 through B-4, respectively. Note that the cost estimates presented in Tables B-2 through B-4 do not reflect present worth; the present value calculations are applied to the compilation of estimated costs presented in Table B-1.

Alternative 1 – No Further Action

- No costs are associated with the No Further Action alternative.

Alternative 2 – 1 foot of Dinwoody, 4 feet of Chert/Limestone Cover

- The area requiring clearing and grubbing is estimated at 2.6 acres.
- Approximately 20.5 acres on the top of the ODA will require regrading to promote drainage (currently flat) or eliminate current ponding.
- The east face of the ODA will be regraded, as needed, to a maximum 3:1 slope to eliminate areas currently with large bench widths. Diversion ditches will be constructed on the regraded 3:1 slope to route runoff off of the regraded slope. The estimated volume of regrading is 82,000 cubic yards.
- A 4-foot layer of chert/limestone will be placed directly over the run-of-mine overburden. All chert/limestone will be obtained from mining at Panel F; no other sources for chert/limestone are required. A total volume of approximately 774,000 cubic yards will be needed to cover the total area of 120 acres.
- A 1-foot layer of Dinwoody will be placed over the chert/limestone layer. The Dinwoody will be obtained from mining at Panel F. A total volume of approximately 193,500 cubic yards will be needed.
- Unlined, vegetated runon-runoff control ditches will be constructed in selected ODA perimeter locations. A total length of approximately 2,711 feet will be needed.
- Two hydraulic structures will be constructed to tie in the runon/runoff ditches with the runon control channel on the northern edge of the ODA.
- Within the ODA 3:1 sloped area, lined runoff chutes will be constructed with rock over geotextile. Gullies in the area will also be stablized. A total length of approximately 1,500 feet is estimated for this type of measure.
- Revegetation will include application of a seed mixture in all work areas, along with fertilizer and inoculants. Species with low potential for selenium uptake will be used. Waddles will be placed as needed to reduce erosion potential.
- Range management controls are assumed to require $5,000 in costs to limit cattle grazing in revegetation areas.

Alternative 3 – 3 feet of Dinwoody, 2 feet of Chert/Limestone Cover

- The following actions included under Alternative 2 will also be completed in the same manner/scope for Alternative 3:
  - Clearing and grubbing.
  - Regrading to promote drainage or eliminate current ponding.
  - Regrading the east face of the ODA to a maximum 3:1 slope, along with diversion ditch construction.

    - Construction of unlined, vegetated runon-runoff control ditches in selected ODA perimeter locations.
    - Construction of two hydraulic structures to tie in the runon/runoff ditches with the runon control channel.
    - Construction of lined runoff chutes within the ODA 3:1 sloped area.
    - Revegetation in all work areas, including placement of waddles.
    - Range management controls to limit cattle grazing in revegetation areas.
- A 2-foot layer of chert/limestone will be placed directly over the run-of-mine overburden.
- A 3-foot layer of Dinwoody will be placed over the chert/limestone layer. The Dinwoody material will be obtained from two sources – 1 foot of Panel F (Type B) material (193,500 cubic yards) placed and nominally compacted by equipment travel, with another 2 feet of Dinwoody (Type A and/or Type B) material (387,000 cubic yards) loosely placed over the 1 foot of Panel F (Type B) material. The Dinwoody material for the upper lift would be from Panel F, if available, or a new on-lease borrow source such as may be available adjacent to the western side of Panel D. For EE/CA cost estimation purposes, the source of Dinwoody for this upper lift is assumed to be a new borrow source adjacent to Panel D, although the need for such a source (or other sources) will be determined during the design process. Costs for reclaiming a borrow area are also included in Alternative 3.
- All chert/limestone will be obtained from mining in Panel F. No other sources for chert/limestone are required.

<u>Alternative 4 – Geosynthetic Cover System</u>

- The following actions included under both Alternatives 2 and 3 will also be completed in the same manner/scope for Alternative 4:
    - Clearing and grubbing.
    - Regrading to promote drainage or eliminate current ponding.
    - Regrading the east face of the ODA to a maximum 3:1 slope, along with diversion ditch construction.
    - Construction of unlined, vegetated runon-runoff control ditches in selected ODA perimeter locations.
    - Construction of two hydraulic structures to tie in the runon/runoff ditches with the runon control channel.
    - Construction of lined runoff chutes within the ODA 3:1 sloped area.
    - Revegetation in all work areas, including placement of waddles.
    - Range management controls to limit cattle grazing in revegetation areas.
- The geosynthetic cover system includes the following layers (top to bottom):
    - 1 foot of Dinwoody
    - 1.5 feet of chert/limestone (uncrushed) directly under the Dinwoody layer
    - 6 inches of well-sorted (crushed) chert/limestone as a drainage layer
    - Geosynthetic liner – assume a geosythetic clay laminate liner (GCLL) is used

    - 6 inches of sorted and crushed chert/limestone to provide a protective subgrade material (i.e., bedding)
- The Dinwoody volume required (193,500 cubic yards) would be obtained from mining at Panel F.
- All chert/limestone will be obtained from mining at Panel F. No other sources for chert/limestone are required.

TABLE B-1
PRESENT VALUE OF REMOVAL ACTION ALTERNATIVES
POLE CANYON ODA EE/CA

Item	Notes	Start Year (1)	End Year (2)	Estimated Cost (3)	Present Value (4)
Alternative 2: 1 foot of Dinwoody, 4 feet of Chert/Limestone Cover					
Capital Costs	Table B-2	0	1	$7,857,976	$7,600,939
O&M Costs - Years 1-5 (post-construction)	Table B-2	2	6	$72,000	$275,901
O&M Costs - Years 6-30	Table B-2	7	30	$36,000	$275,130
Periodic Costs	Table B-2	0	0	$0	$0
Total Present Value					**$8,151,970**
Alternative 3: 3 feet of Dinwoody, 2 feet of Chert/Limestone Cover					
Capital Costs	Table B-3	0	1	$6,676,725	$6,458,327
O&M Costs - Years 1-5 (post-construction)	Table B-3	2	6	$72,000	$275,901
O&M Costs - Years 6-30	Table B-3	7	30	$36,000	$275,130
Periodic Costs	Table B-3	0	0	$0	$0
Total Present Value					**$7,009,358**
Alternative 4: Geosynthetic Cover System					
Capital Costs	Table B-4	0	2	$17,004,494	$15,916,309
O&M Costs - Years 1-5 (post-construction)	Table B-4	3	7	$72,000	$257,852
O&M Costs - Years 6-30	Table B-4	8	30	$36,000	$252,711
Periodic Costs	Table B-4	0	0	$0	$0
Total Present Value					**$16,426,872**

Notes:

For Present Value calculations, the Discount Rate used is…. 7%

Costs and Present Value are based on "constant" or "real" 2012 dollars not adjusted for future inflation.

Unless identified separately, burden and profits are included in unit costs.

(1) Start Year is the year during which the capital construction or the O&M activities begin. Costs are assumed to be incurred on the first day of the year indicated.

(2) End Year is the year during which the capital construction or the O&M activities are completed. Costs are assumed to be incurred on the first day of the year indicated.

(3) Capital Costs are totals for the activity, not annualized; Annual O&M Costs are annualized to represent one year only; Periodic Costs are one-time or repeating (not annual) costs.

(4) Present Value represents the total cost over the project life based on a discount rate applied to the estimated cost for each year after Year 0 (2012).

TABLE B-2
ALTERNATIVE 2
1 foot of Dinwoody, 4 feet of Chert/Limestone Cover

Item	Notes	Quantity	Unit	Unit Cost	Total Cost
Capital Costs					
Direct Construction					
Clear and grub	a, b	2.6	acre	$5,675	$14,755
Regrade areas currently flat or prone to ponding	a, c	20.5	acre	$2,385	$48,893
Regrade to 3:1 max, construct diversion ditches on slopes	a	82,000	cy	$1.68	$137,760
Place 4-ft layer of chert/limestone over run of mine overburden	a, d	744,000	cy	$6.15	$4,575,600
Place 1-ft of Dinwoody over chert/limestone	a, e	193,500	cy	$6.45	$1,248,075
Construct unlined, vegetated runon/runoff ditches	a, f	2,711	ft	$0.18	$488
Construct hydraulic structures to tie in ditches with run-on channel	a, g	2	each	$15,000	$30,000
Construct lined runoff chutes and stabilize gullies; rock, geotextile	a	1,500	ft	$7.50	$11,250
Seed ODA area - includes fertilizer, waddles, inoculants, etc	a	120	acre	$2,658	$318,960
Range management	h	1	each	$5,000	$5,000
Direct Construction Subtotal					**$6,390,780**
Indirect Construction					
Mobilization/Demobilization	h	1%			$63,908
Water/Sediment Control	h	2.5%			$159,770
Indirect Construction Subtotal					**$223,677**
Construction Subtotal					**$6,614,458**
Contingencies					
Scope	i	10%			$661,446
Bid	i	0%			$0
Subtotal					**$7,275,904**
Project Management	i	2%			$145,518
Remedial Design	i	4%			$291,036
Construction Management	i	2%			$145,518
TOTAL CAPITAL COSTS					**$7,857,976**
Annual O&M Costs					
Maintenance of seeded areas + inspections (Yr 1-5)	j	120	acre	$600	$72,000
Inspections only (Years 6-30)	k	120	acre	$300	$36,000
TOTAL ANNUAL O&M COSTS - Years 1-5					**$72,000**
TOTAL ANNUAL O&M COSTS - Years 6-30					**$36,000**
TOTAL PERIODIC COSTS					**$0**

Notes

a Based on typical productivity and costs for Smoky Canyon Mine operations.
b Use 988 loader/end dump for clearing and grubbing; replant medium pines.
c Dozer productivity at 5 hrs/acre.
d Chert/limestone from Panel F mining; sort sizes, haul, handle, place.
e Dinwoody from Panel F mining; sort, haul, handle, place.
f Grade and install erosion control materials (TRMs, etc).
g Requires substantial concrete structure to minimize erosion and velocities.
h Assumed values/professional judgment, adjusted as needed to reflect work performed by Smoky Canyon Mine.
i Based on EPA FS Cost Guidance, adjusted as needed to reflect work performed by Smoky Canyon Mine.
j For first five years, annual O&M is assumed to involve maintenance/additional revegetation as required in 10-15% of previously seeded areas, along with inspections of all areas an average of twice per year (annually and after severe storm events), at a cost of $150/acre per inspection, with limited repair required.
k For the remaining O&M years, annual O&M is assumed to involve inspections of all areas at an average frequency of twice per year (annually and after severe storm events), at a cost of $150/acre per inspection, with limited repair required.

TABLE B-3
ALTERNATIVE 3
3 feet of Dinwoody, 2 feet of Chert/Limestone Cover

Item	Notes	Quantity	Unit	Unit Cost	Total Cost
Capital Costs					
Direct Construction					
Clear and grub	a, b	2.6	acre	$5,675	$14,755
Regrade areas currently flat or prone to ponding	a, c	20.5	acre	$2,385	$48,893
Regrade to 3:1 max, construct diversion ditches on slopes	a	82,000	cy	$1.68	$137,760
Place 2-ft layer of chert/limestone over run of mine overburden	a, d	387,000	cy	$6.15	$2,380,050
Place 3 ft of Dinwoody over chert/limestone	a, e1	193,500	cy	$7.70	$1,489,950
(1 ft thick lower lift, 2 ft thick upper lift)	a, e2	387,000	cy	$2.54	$982,980
Construct unlined, vegetated runon/runoff ditches	a, f	2,711	ft	$0.18	$488
Construct hydraulic structures to tie in ditches with run-on channel	a, g	2	each	$15,000	$30,000
Construct lined runoff chutes and stabilize gullies; rock, geotextile	a	1,500	ft	$7.50	$11,250
Seed ODA area - includes fertilizer, waddles, inoculants, etc	a	120	acre	$2,658	$318,960
Reclaim borrow area	h	1	each	$10,000	$10,000
Range management	h	1	each	$5,000	$5,000
Direct Construction Subtotal					**$5,430,085**
Indirect Construction					
Mobilization/Demobilization	h	1%			$54,301
Water/Sediment Control	h	2.5%			$135,752
Indirect Construction Subtotal					**$190,053**
Construction Subtotal					**$5,620,138**
Contingencies					
Scope	i	10%			$562,014
Bid	i	0%			$0
Subtotal					**$6,182,152**
Project Management	i	2%			$123,643
Remedial Design	i	4%			$247,286
Construction Management	i	2%			$123,643
TOTAL CAPITAL COSTS					**$6,676,725**
Annual O&M Costs					
Maintenance of seeded areas + inspections (Yr 1-5)	j	120	acre	$600	$72,000
Inspections only (Years 6-30)	k	120	acre	$300	$36,000
TOTAL ANNUAL O&M COSTS - Years 1-5					**$72,000**
TOTAL ANNUAL O&M COSTS - Years 6-30					**$36,000**

TOTAL PERIODIC COSTS					**$0**

Notes

a Based on typical productivity and costs for Smoky Canyon Mine operations.
b Use 988 loader/end dump for clearing and grubbing; replant medium pines.
c Dozer productivity at 5 hrs/acre.
d Chert/limestone from Panel F mining; sort sizes, haul, handle, place.
e1 Dinwoody from Panel F, with nominal compaction by equipment travel only, bottom 1 ft of total 3 ft thickness.
e2 Dinwoody from potential new borrow source (adjacent to Panel D), placed loose, top 2 ft of total 3 ft thickness.
f Grade and install erosion control materials (TRMs, etc).
g Requires substantial concrete structure to minimize erosion and velocities.
h Assumed values/professional judgment, adjusted as needed to reflect work performed by Smoky Canyon Mine.
i Based on EPA FS Cost Guidance, adjusted as needed to reflect work performed by Smoky Canyon Mine.
j For first five years, annual O&M is assumed to involve maintenance/additional revegetation as required in 10-15% of previously seeded areas, along with inspections of all areas an average of twice per year (annually and after severe storm events), at a cost of $150/acre per inspection, with limited repair required.
k For the remaining O&M years, annual O&M is assumed to involve inspections of all areas at an average frequency of twice per year (annually and after severe storm events), at a cost of $150/acre per inspection, with limited repair

TABLE B-4
ALTERNATIVE 4
Geosynthetic Cover System

Item	Notes	Quantity	Unit	Unit Cost	Total Cost
Capital Costs					
Direct Construction					
Clear and grub	a, b	2.6	acre	$5,675	$14,755
Regrade areas currently flat or prone to ponding	a, c	20.5	acre	$2,385	$48,893
Regrade to 3:1 max, construct diversion ditches on slopes	a	82,000	cy	$1.68	$137,760
Place 6-inch chert/limestone drainage layer (bedding) under liner	a, e	96,750	cy	$8.65	$836,888
Geosynthetic liner - GCLL or similar	f	120	acre	$63,162	$7,579,440
Place 6-inch chert/limestone drainage layer (crushed, sorted) over liner	a, g	96,750	cy	$8.65	$836,888
Place 1.5-ft layer of chert/limestone (uncrushed) over drainage layer	a, d	290,250	cy	$6.15	$1,785,038
Place 1 ft of Dinwoody over chert/limestone	a, h	193,500	cy	$6.45	$1,248,075
Construct unlined, vegetated runon/runoff ditches	a, i	2,711	ft	$0.18	$488
Construct hydraulic structures to tie in ditches with run-on channel	a, j	2	each	$15,000	$30,000
Construct lined runoff chutes and stabilize gullies; rock, geotextile	a	1,500	ft	$7.50	$11,250
Seed ODA area - includes fertilizer, waddles, inoculants, etc	a	120	acre	$2,658	$318,960
Reclaim borrow area	k	1	each	$10,000	$10,000
Range management	k	1	each	$5,000	$5,000
Direct Construction Subtotal					**$12,863,433**
Indirect Construction					
Mobilization/Demobilization	k	2%			$257,269
Water/Sediment Control	k	2.5%			$321,586
Indirect Construction Subtotal					**$578,854**
Construction Subtotal					**$13,442,287**
Contingencies					
Scope	l	10%			$1,344,229
Bid	l	5%			$672,114
Subtotal					**$15,458,631**
Project Management	l	2%			$309,173
Remedial Design	l	4%			$618,345
Construction Management	l	4%			$618,345
TOTAL CAPITAL COSTS					**$17,004,494**
Annual O&M Costs					
Maintenance of seeded areas + inspections (Yr 1-5)	m	120	acre	$600	$72,000
Inspections only (Years 6-30)	n	120	acre	$300	$36,000
TOTAL ANNUAL O&M COSTS - Years 1-5					**$72,000**
TOTAL ANNUAL O&M COSTS - Years 6-30					**$36,000**
TOTAL PERIODIC COSTS					**$0**

Notes

Cover system (from top): 1 ft Dinwoody, 1.5 ft chert/limestone, 6 inch drainage layer, GCLL or similar, 6 inch bedding

- a Based on typical productivity and costs for Smoky Canyon Mine operations.
- b Use 988 loader/end dump for clearing and grubbing; replant medium pines.
- c Dozer productivity at 5 hrs/acre.
- d Chert/limestone (uncrushed) from Panel F mining; haul, handle, place.
- e Chert/limestone (well-sorted, crushed for bedding) from Panel F mining; sort, crush, haul, handle, place.
- f Developed from Smoky Canyon Mine information; cost delivered to site and installed.
- g Chert/limestone (well-sorted, for use as drainage layer) from Panel F mining; sort, crush as needed, haul, handle, place.
- h Dinwoody from Panel F mining; sort, haul, handle, place.
- i Grade and install erosion control materials (TRMs, etc).
- j Requires substantial concrete structure to minimize erosion and velocities.
- k Assumed values/professional judgment, adjusted as needed to reflect work performed by Smoky Canyon Mine.
- l Based on EPA FS Cost Guidance, adjusted as needed to reflect work performed by Smoky Canyon Mine.
- m For first five years, annual O&M is assumed to involve maintenance/additional revegetation as required in 10-15% of previously seeded areas, along with inspections of all areas an average of twice per year (annually and after severe storm events), at a cost of $150/acre per inspection, with limited repair required.
- n For the remaining O&M years, annual O&M is assumed to involve inspections of all areas at an average frequency of twice per year (annually and after severe storm events), at a cost of $150/acre per inspection, with limited repair required.