FINAL
LANDFILL MONITORING AND MAINTENANCE PLAN
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
ORIGINAL LANDFILL

U.S. Department of Energy
Rocky Flats Environmental Technology Site
Golden, Colorado

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LIST OF ACRONYMS AND ABBREVIATIONS

CCR	Colorado Code of Regulations
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
H	horizontal
IDW	investigation-derived waste
IM/IRA	Interim Measure/Interim Remedial Action
IMP	Integrated Monitoring Plan
LHSU	lower hydrostratigraphic unit
ml	milliliter
mph	miles per hour
OLF	Original Landfill
QA	quality assurance
QC	quality control
Plan	Monitoring and Maintenance Plan
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RL	reporting limit
SOP	Standard Operating Procedure
SVOC	semivolatile organic compound
UHSU	upper hydrostratigraphic unit
V	vertical
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 PURPOSE

This Monitoring and Maintenance Plan (Plan) has been prepared for the Original Landfill (OLF) (Individual Hazardous Substance Site 115 and 196) at the Rocky Flats Environmental Technology Site (RFETS) and is designed to meet the following objectives:

1. Describe the procedures to be used to maintain the integrity and effectiveness of the final cover, including making repairs as necessary (Section 3.0);

2. Describe the features necessary to maintain and monitor the groundwater monitoring system (Section 4.0); and

3. Describe the features necessary to prevent run-on and runoff from eroding or otherwise damaging the final cover (Section 5.0).

Revisions to the plan will be submitted to the Rocky Flats Cleanup Agreement (RFCA) parties for review and endorsement and also documented in the Annual Original Landfill Monitoring Report.

Under the Final Interim Measure/Interim Remedial Action (IM/IRA) for the Original Landfill (U.S. Department of Energy [DOE] 2005a), a 2-foot-thick soil cover was selected to address closure of the Original Landfill. To enhance the slope stability of the landfill, the existing slopes were regraded prior to placement of the soil cover, and a buttress fill was installed at the toe of the landfill. The remedial action also included installation of perimeter drainage channels and cover diversion berms to control surface water run-on and runoff around the landfill cover. Construction was completed in September 2005, with the final regulatory walk-down occurring on September 12, 2005.

1.2 FACILITY LOCATION AND UNITS

RFETS is a government-owned facility formerly used for the fabrication of miscellaneous weapons components for national defense. The 6,550-acre site is located in Jefferson County, Colorado, approximately 16 miles northwest of Denver (Figure 1-1). The Original Landfill is located south of the RFETS Industrial Area on a south-facing hill slope north of Woman Creek (Figure 1-2).

1.3 SITE OPERATIONS

The Original Landfill was used to dispose of solid sanitary and construction debris wastes generated at the Rocky Flats Plant from 1952 to 1968 (DOE 1988). The landfill was not designed or operated as an engineered landfill. Aerial photographs indicate that the landfill was operated as an area fill (DOE 1994). Waste was merely dumped in the area vertically below and just south of the southern edge of the alluvial pediment on which the RFETS Industrial Area is located. The waste disposal area lies north of Woman Creek. The waste was generally spread over the south-facing hillside, serving to fill in the area below the pediment edge. No liner or other collection barrier was installed between the waste and the existing surfaces (DOE 2006).

Waste placed within the Original Landfill is contaminated and commingled with hazardous constituents, including organic compounds and metals at levels greater than action levels and/or applicable standards. Additional information can be found in the IM/IRA for the Original Landfill (DOE 2006).

2.0 SITE PHYSICAL DESCRIPTION

This section describes the physical conditions at the Original Landfill site, such as topography, hydrology, climate and precipitation, hydrogeology, and site features, which include the final cover, the buttress fill, the stormwater management system, the Resource Conservation and Recovery Act (RCRA) groundwater monitoring network, and the surface water monitoring locations.

2.1 TOPOGRAPHY

The final topography of the Original Landfill is as shown on the post-construction survey (Figure 2-1). Slopes are as follows:

- Soil cover slope – 18 percent;
- Top of buttress fill slope – 2-5 percent;
- Buttress fill (south) sideslope – 3 horizontal (H):1 vertical (V);
- Perimeter channel sideslope – generally 3H:1V; and
- Perimeter channel slopes – approximately 12 percent.

2.2 HYDROLOGY

The Original Landfill is located within the Woman Creek drainage. Diversion berms have been constructed on the soil cover to minimize surface water overland flow and divert run-on and run-off to the perimeter channels. The perimeter channels divert the surface water south of the landfill to below the buttress fill. Below the buttress fill, the perimeter channel slopes decrease, and flow encounters rock outfalls that dissipate the flow energy and allow the surface water to return to overland or sheet flow between the buttress fill and Woman Creek.

2.3 CLIMATE AND PRECIPITATION

RFETS is located in the southern Rocky Mountains and has a continental, semiarid climate. The region is noted for large seasonal temperature variations, occasional dramatic short-term temperature changes, and strong, gusty winds that reach 75 miles per hour (mph). Mean annual precipitation is approximately 15.5 inches, with approximately one-half of that amount occurring as snow.

2.4 HYDROGEOLOGY

In the area of the Original Landfill, groundwater flows predominantly within the upper hydrostratigraphic unit (UHSU). The UHSU is composed of materials that include the quaternary Rocky Flats Alluvium, colluvium, Valley Fill Alluvium, and weathered claystone bedrock. Unweathered bedrock claystones are included as part of the lower hydrostratigraphic unit (LHSU). Groundwater elevations typically vary seasonally less than 5 feet, mostly in

response to direct precipitation recharge in wetter periods and evapotranspiration in warmer months. Water levels above the weathered bedrock range from 0 to 5 feet along Woman Creek; below the bedrock in the east-central waste area; 5 to 10 feet in the central waste area; 0 to 5 feet in the western waste area; and from 10 to more than 40 feet above the bedrock north of the Original Landfill (DOE 2006).

Natural groundwater seeps were discovered during construction of the soil cover and perimeter channels. Several seeps were mitigated with a subsurface drain to the buttress sub-drain. The buttress sub-drain was constructed beneath the buttress fill to prevent buttress saturation. This drainage layer directs water to the south of the buttress into the Valley Fill Alluvium.

2.5 SITE FEATURES

Site features included in the monitoring program at the Original Landfill include the final cover, the buttress fill, the stormwater management system, the RCRA groundwater monitoring network, and the surface water sampling locations. Construction included regrading of the site to consistent slopes. This included regrading the waste and placement of clean imported soil gradefill material. A minimum of 2-feet of Rocky Flats Alluvium soil cover was placed within the limit of waste. Monitoring procedures are provided in subsequent sections.

2.5.1 Final Cover

The final cover of the Original Landfill includes a 2-foot-thick Rocky Flats Alluvium soil cover that was constructed over both the regraded surface and the buttress fill. The 2-foot-thick soil cover was constructed within the limit of waste and does not extend to the perimeter channels. Surface soil between the limit of waste and the perimeter channels is also Rocky Flats Alluvium, but was placed as regrade material.

Inspection and monitoring procedures to maintain the integrity and effectiveness of the final cover are included in Section 3.0.

2.5.2 Buttress Fill

The buttress fill is an approximately 20-foot-high, 1,000-foot-long soil mass placed at the toe of the Original Landfill (Figure 2-1). The compacted soil for the buttress fill was continuously tested for compaction and moisture content to meet design specifications. A sub-drain lies beneath the buttress fill and consists of drainage rock covered with a geotextile separation layer. The sub-drain is located below the surface and cannot be visually inspected. The buttress fill was constructed over the sub-drain with engineered fill compacted in 1-foot lifts.

2.5.3 Stormwater Management System

2.5.3.1 Introduction

The stormwater management plan is presented in Appendix D of the Original Landfill Design Submittal (Earth Tech, Inc. 2005). This appendix presents the results of calculations used to

determine the stormwater run-on and runoff volumes to adequately design the diversion berms and perimeter channels. The stormwater management structures are designed to the 100-year, 24-hour storm event and include capacity to handle a 1,000-year, 24-hour storm event.

2.5.3.2 Applications

Effective stormwater management is achieved in the system by applying the following principles:

- Protect the land surface from erosion (Section 2.5.3.3),
- Manage run-on and runoff (Section 2.5.3.4), and
- Inspect and maintain the erosion and stormwater management practices (discussed in Section 3.0).

In the long term, the system is designed as an erosion control system so sediment control will not be necessary since limited sediment will be generated. In the short term, sediment will be controlled with temporary erosion lining and check dams (GeoRidge®).

2.5.3.3 Erosion Control

At the Original Landfill, stormwater management features have been designed with erosion control features to limit both short-term erosion and long-term erosion. Erosion control is any practice that protects soil surfaces and prevents the soil particles from being detached by rainfall or wind. Following construction, the soil cover was covered with both straw mulch and a spray-on erosion control medium called Flexterra™. The diversion berms and upper slope portions of the buttress fill are lined with temporary erosion mat. The diversion berms included temporary check dams (GeoRidge®) to limit sediment transport. These measures will limit short-term erosion until vegetation is established. The check dams may be removed at the end of the 2006 growing season if the vegetation is well established. The perimeter channels and lower sideslope of the buttress are lined with permanent erosion mat. Rock outfalls are present at the diversion berm outfalls to the perimeter channel outfalls to prevent scouring. All areas have been seeded to aid in long-term erosion protection.

2.5.3.4 Run-on and Runoff Control

The stormwater management system is designed to collect, route, and discharge storm water run-on and runoff. Run-on stormwater is conveyed from upper portions of the Original Landfill as overland flow and then enters either the diversion berms or perimeter channels. Runoff enters the perimeter channel from overland flow on the cover and from the diversion berms constructed on the cover.

2.5.4 RCRA Groundwater Monitoring Network

Four RCRA monitoring wells will be used for groundwater monitoring at the Original Landfill as discussed in Section 4.0. These wells will be monitored in accordance with the RFETS

Integrated Monitoring Plan (IMP), FY2005 (DOE 2005a). Of the four wells, one is upgradient and three are downgradient of the Original Landfill.

2.5.5 Surface Water Monitoring

Surface water monitoring will be conducted at two locations, one upgradient and one downgradient of the Original Landfill. Sampling locations and procedures are discussed in Section 4.0.

During construction, intermittent seeps were discovered and remedied if necessary. Seep inspection is required and is discussed in Section 3.3.

3.0 FINAL COVER AND STORMWATER MANAGEMENT SYSTEM INSPECTION AND MONITORING

This section outlines the inspection and monitoring program to be undertaken at the Original Landfill to ensure that the integrity of the cover is not compromised and continues to function as designed. Inspection and monitoring tasks will include monitoring subsidence/consolidation, slope stability, soil cover, vegetation, and stormwater management structures so that any potential maintenance actions can be taken in a timely manner. In the event that actions are needed that go beyond routine maintenance and such actions require engineering design, the RFCA parties will be notified and consulted regarding proposed actions.

3.1 INSPECTION PROCEDURES

In accordance with the IM/IRA (DOE 2006), site inspections of the area will be conducted on a periodic basis following construction of the final cover, with the following exceptions:

- The site shall be inspected within two days after a storm event of one inch or more of rain in a 24-hour period;
- The site shall be inspected within two days after significant melt of a 10-inch or more snow storm assuming 10 inches of snow is equivalent to one inch of water; and
- The vegetation shall be inspected on a monthly basis from April to September and quarterly the rest of the year for the first two growing seasons following initial seeding (2006 and 2007).

Monthly inspections will be conducted for the one year. After one year the frequency of inspections may change based on the data collected and discussions among the Rocky Flats Cleanup Agreement (RFCA) parties. It is anticipated that quarterly inspections will continue for four additional years and the inspection program will be evaluated at the first Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) review.

Inspections will be performed by qualified personnel and reviewed by a competent professional. Site inspections will be performed using a prescribed form containing a checklist of items that documents the evaluation of site conditions. The inspection form is included in Appendix A. The inspection form will be signed and dated by the inspector and the reviewer. The findings and observations of the site inspection will be entered on the form and presented in an Annual Original Landfill Monitoring Report. If deficiencies are discovered that require immediate attention, the RFCA parties will be notified.

3.2 SUBSIDENCE / CONSOLIDATION

Subsidence and consolidation at the Original Landfill largely depend on how well the waste was compacted when placed, thickness of the waste, age, and waste composition. Waste subsidence or continued consolidation may result in differential settlement, which generally occurs when one area of waste settles more readily than another because of differences in waste composition, compaction, thickness, and moisture content. Differential settlement across the landfill may create cracks on the surface, which would allow precipitation to infiltrate more easily.

Differential settlement can also change the topography of the landfill and create areas on the surface where ponding of water can occur – this is particularly important regarding the 2-foot high drainage berms that run across the Original Landfill. Localized waste subsidence can manifest itself in the form of cracks, depressions, and sinkholes. Construction of the final cover system included placement of engineered fills. Therefore, cover subsidence or consolidation is less of a concern than is waste subsidence.

3.2.1 Monitoring Locations and Procedures

Subsidence/consolidation monitoring will be conducted to evaluate actual settlement compared to the expected settlement calculated in the final design and to observe areas of water ponding on the landfill surface or other indicators of differential settlement. Subsidence/consolidation at the Original Landfill will be monitored by visually inspecting the surface of the landfill cover for cracks, depressions, and sinkholes. Visual inspections will involve traversing the landfill to gain perspective on regions of the landfill, i.e., every square foot of the landfill is not inspected. In addition, the seven diversion berm flow lines will be traversed to look for sloughing or differential settling that could change the flow line slope or berm height. Eight settlement monuments will also be installed at locations agreed upon by the RFCA parties as shown on Figure 3-1 (Original Landfill Inspections). For each monument location (A-F on Figure 3-1), the calculated settlement from the final design (Figure 3-1a) will be used to compare with measured settlement. Monuments G and H have no calculated settlement values. The monuments will be monitored quarterly for the first year and annually thereafter, subject to field conditions and monitoring results. Areas of observed differential settlement, including ponding will be staked, photographed, measured, and located on the landfill site map prior to any maintenance action. Control Point 1001 will be maintained as the control for surveying the Original Landfill.

3.2.2 Maintenance Action Activities

The maintenance actions that will normally occur to correct the effect of adverse differential settlement are to place additional soil and regrade the affected area. Replacement soil will be Rocky Flats Alluvium as was used in the construction derived from or near the Site. This action will eliminate the potential for ponding and/or correct the slope of the surface. Maintenance that addresses differential settlement will be photographed, and the area will be measured and located on the Original Landfill site map.

Settlement plate data will be tabulated and the measured settlement will be compared to the anticipated settlement calculated in the final design. After settlement plate locations are finalized, a specific calculation will be done for each location. Should measured settlement exceed 30% of the calculated maximum settlement and be expressed as differential settlement, the area will be photographed, located on the Original Landfill site map, repaired and reported on the inspection forms. Should the measured settlement exceed 90% of the calculated maximum settlement and be expressed as differential settlement, a qualified geotechnical engineer will be consulted to determine a maintenance action and the results of the geotechnical engineer's evaluation will be reported to the RFCA parties. The area(s) where maintenance actions have taken place will be specifically inspected and reported during the inspections of the cover to monitor any continued subsidence. If differential settlement or localized subsidence appears to be substantial and likely to influence the integrity of the existing cover and surface water

drainage over the Original Landfill, the RFCA parties will be consulted and maintenance actions will be taken to mitigate these concerns (e.g. areas of ponding water on the cover).

3.3 SLOPE STABILITY

A landfill site may be susceptible to instability due to lateral movement. Slope failures can be caused by the weight of the wastes and cover material, steeply regraded slopes, and seepage resulting from water infiltration. Seismic forces can also cause slope failures. Steep slopes produce less stable conditions and are more susceptible to failure. Slope failures can also occur within the waste mass, resulting in downslope sliding of the cover components. The cover system with buttress fill has been designed and constructed with applicable safety factors to guard against slope failure. Nevertheless, slope stability will be monitored to verify that slope failure is not in progress. In addition, if areas of slope stability concerns are found outside the boundaries of the Original Landfill footprint but within the general area of the landfill, the area of the inspection will be expanded to include these areas.

3.3.1 Monitoring Locations and Procedures

Slope stability at the Original Landfill will be monitored by visually inspecting the cover, the stormwater diversion berms, the perimeter channel sideslopes, and the buttress fill sideslope for signs of cracks, evidence of block failure, seeps, and evidence of rotational failure. The inspection will categorize the observed cracking. Visual inspection will involve traversing the slope to gain a perspective of the entire slope. Specific attention will be provided to areas where small seeps occurred at the surface of the OLF during construction. These areas are shown on the figure in Appendix A. Any areas where a surface seep is identified will be photographed, marked, located on the Landfill site map and monitored for signs of slope instability. Areas that are identified during the inspections as potential slope stability concerns will be photographed, located on the Landfill site map, and staked for further monitoring. If adverse surface water flow into cracks is likely, actions such as filling the cracks or controlling surface water flow will be taken to prevent surface water from entering the cracked area. If further monitoring indicates a continued stability concern, a qualified geotechnical engineer will be consulted.

3.3.2 Maintenance Action Activities

Based on the site monitoring data and consultation with a qualified geotechnical engineer, maintenance actions will be taken to address any potential slope failure at the OLF that would likely compromise the remedy. The maintenance actions will include, but not be limited to, regrading affected areas, filling areas, maintaining positive drainage of surface water, seep drain construction, and regrading steep sections to achieve side slopes no greater than 4H:1V. Areas where maintenance actions have taken place will be closely monitored for further slope stability concerns. The RFCA parties will be notified and consulted if inspections show continued slope stability concerns in an area of the OLF closure.

3.4 SOIL COVER

The cover system at the Original Landfill is designed to meet the minimum soil erosion requirements from both water and wind erosion. During the post-closure period, it is important

to ensure that both temporary and permanent erosion controls are functioning properly. Regardless, the soil cover thickness may change over time due to wind and water erosion. Subsidence due to waste settlement and lateral movement of wastes or slopes may also contribute to changes in differential soil cover thickness. Monitoring of the soil cover is conducted to verify the soil cover is performing in accordance with the design and the Original Landfill system as a whole continues to meet performance objectives.

3.4.1 Monitoring Locations and Procedures

Monitoring of the soil cover at the Original Landfill will include the following:

- Visually inspecting the soil cover for erosion or deposition areas;
- Visually inspecting the soil cover for signs of burrowing animals;
- Visually inspecting previously identified seep areas and noting any new ones that may have developed; and
- Visually inspecting the diversion berms, diversion berm outfalls, and the perimeter channels for erosion rills or excessive deposition. Particular attention and appropriate measurements will occur regarding the design parameters (Specification 01310-0976) for the diversion berms of 2 feet high minimum and a gradient of at least 2% with the primary focus being the performance objective of the berms.

Visual inspection will involve traversing the slope to gain a perspective of the entire area. Signs of rill and gully erosion will be photographed, marked with stakes, measured and located on the landfill site map and reported on the inspection form. Additionally, areas of observed soil deposition will also be photographed, marked, measured, and located on the landfill site map and reported on the inspection form. If visual inspections of the diversion berms indicate a departure from the design parameters, the height and gradient will be measured. Measurement of the berm height and drainage gradient will occur at least annually until the CERCLA review, at which time the need and frequency will be assessed.

3.4.2 Maintenance Action Activities

If monitoring indicates significant loss of soil over time, maintenance actions will be taken. If any section of gully is greater than 6-inches deep, maintenance actions will be implemented. Maintenance actions will include, but not be limited to soil replacement and regrading the affected areas to maintain the minimum design soil cover thickness and removing and relocating eroded soils (if necessary). The regraded areas will be vegetated per design criteria to prevent further erosion. Erosion control measures will be implemented to prevent further erosion of cover soils, (e.g., erosion control mat, revegetation), if necessary. The amount of soil used to fill areas of erosion will be estimated, recorded, and reported in the quarterly monitoring report. The RCRA parties will be notified and consulted if soil erosion concerns persist. Areas of soil deposition that hinder the flow of surface water in a stormwater channel will be removed to maintain the designed channel configuration of at least 2% grade and flow capacity as well as a

berm height of 2 feet. Maintenance of these areas will also be documented and reported in the quarterly report.

3.5 VEGETATION

Vegetation is important to long-term erosion protection for the cover, the upper portion of the buttress sideslope, and the diversion berms. Permanent erosion mat has been placed in the perimeter channels and the lower portion of the buttress sideslope; nevertheless, vegetation is important to reinforcing the erosion mat and providing long-term protection. For short-term protection, Flexterra™ and crimped straw have been placed on the cover, and temporary erosion mat, which has a 2 to 3 year life span, has been placed on the diversion berms and upper buttress fill sideslope. In addition, check dams have been placed in the diversion berms. Vegetation inspections will ensure that vegetation is established properly and will be consistent with the Rocky Flats, Colorado, Site Revegetation Plan (DOE 2005b) and the Rocky Flats, Colorado, Site Vegetation Management Plan (DOE 2005c).

3.5.1 Monitoring Locations and Procedures

Vegetation at the Original Landfill will be monitored by visual inspection on a monthly basis from April to September and quarterly for the rest of the year for the first two growing seasons following initial seeding (2006 and 2007), and only quarterly after that. Monthly inspections will help identify problematic weeds that can grow quickly and potential drought conditions that can adversely affect young vegetation. The vegetation will be monitored by traversing the cover and visually inspecting for the health of the grasses and for unwanted vegetation such as weeds or deep-rooting trees. Particular attention will be focused on the berms, channels and buttress sideslope. The percentage of weeds versus grass on the cover will be estimated. At least one of the inspections during the spring/summer months must be conducted by a competent person capable of identifying weed species known in the area. If, after the first growing season, the Flexterra and mulch have eroded and vegetation is sparse, maintenance action will be necessary on the cover. If, after two growing seasons, the temporary erosion mat in the diversion berms and upper buttress fill sideslope has degraded and vegetation is sparse (The design documents assumed a vegetation density in these areas of at least 75% after two full growing seasons. This "vegetation density" is equivalent to "a good stand of unmowed grass"), maintenance action will also be necessary.

3.5.2 Maintenance Action Activities

If visual inspections indicate vegetation concerns on the cover, maintenance actions will be taken. Actions will include, but not be limited to the following:

- Localized reseeding of the soil cover;
- Spot herbicide applications;
- Reseeding;
- Reapplication of temporary erosion controls; and

- Removal of deep-rooting trees and repair of the area.

The maintenance of the cover vegetation will be consistent with the Site Revegetation Plan (DOE 2005b). The RFCA parties will be notified and consulted should an area consistently show vegetation concerns.

3.6 STORMWATER MANAGEMENT STRUCTURES

Stormwater management inspections will be required at the Original Landfill to ensure that existing stormwater control structures (man-made drainage features) are functioning adequately to achieve the following objectives:

- Reduce flow onto the landfill (run-on controls);
- Reduce overland flow on the landfill;
- Collection and transport of runoff from the Original Landfill; and
- Limit transport of sediment from the disturbed areas to off-site drainage ways.

Existing stormwater controls at the Original Landfill include the following (Figure 2-1):

- Diversion berms 1 through 7;
- Diversion berm outfalls 1 through 7;
- Diversion berm temporary check dams (GeoRidge®);
- West perimeter channel;
- East perimeter channel;
- West perimeter channel outfall;
- East perimeter channel outfall;
- Permanent erosion mat-lined lower buttress fill sideslope;
- Vegetation/temporary erosion mat-lined upper buttress fill sideslope; and
- Temporary, naturally degradable, straw waddles between the diversion berms for additional erosion control.

Details of each type of structure are included on Figure 3-2.

3.6.1 Monitoring Locations and Procedures

Stormwater management structures will be monitored visually by walking the structures and examining all components. Problem areas will be noted on the inspection form, graphically depicted, and photographed. At a minimum, these structures will be inspected for signs of excessive erosion, settlement, bank failure, breaches in the diversion berms, subsidence, burrowing animals, and blockage. Signs of potential problems include, but are not limited to, ponding water, gullying, sediment build-up, and depressions.

The perimeter channel lining and temporary diversion berm lining will be inspected for evidence of damage, displacement, undermining, scour, or deterioration. Repairs will be made to re-stabilize the channel in accordance with the design specifications. Permanent and temporary erosion control mat lining on the buttress fill sideslope will also be inspected. The erosion control mat will be inspected for holes, rips, and separation. In addition, any evidence of erosion rills or gullies will be noted during the inspection. The temporary check dams placed perpendicular to the flow lines of the berms will be inspected for excessive sediment and removed after vegetation is established. Riprap in the diversion berm and perimeter channel outfalls will be inspected for integrity and excessive sediment.

3.6.2 Maintenance Action Activities

If the inspections indicate that the existing stormwater management structures are not adequately controlling surface water run-on and runoff, maintenance actions will be taken.

Routine maintenance of the surface water controls will include removing any blockages, filling eroded areas, replacing erosion control mat, or repairing other disturbances as necessary. In the case of permanent erosion control mat repairs, they will be conducted in accordance with the manufacturer's specifications or equivalent matting will be used. Sediment may be removed periodically from the stormwater management structures to restore the design characteristics of the structure. Areas that exhibit excessive erosion may require placement of erosion control material or strengthening of the existing erosion control measures. Should areas of stormwater management continually show evidence of concern, the RFCA parties will be notified and consulted.

3.6.3 Institutional Controls

Institutional controls are used to control access and restrict activities at the Original Landfill to ensure the effectiveness of the engineered controls and the monitoring systems. Inspection at the Original Landfill will look for evidence that the institutional controls were violated or damage the physical controls. Inspections will be conducted to look for evidence of the following activities:

- Excavation(s) of the cover and in the immediate vicinity of the cover;
- Construction of roads, trails or buildings on the cover;
- Drilling of wells or use of groundwater for any purpose other than the accelerated action;

- Damage or removal of any signage or groundwater monitoring wells at the Original Landfill; and
- Evidence of unauthorized entry.

A checklist of these items is included on the inspection form found in Appendix A.

3.6.4 Condition of Monitoring Points

All established monitoring locations, such as groundwater wells, will be evaluated for ongoing integrity. The inspection will include documentation of any damage to the monitoring points that would impact their usefulness for inspections.

3.6.5 Site Conditions

During site inspections, signs, markers, and the overall condition of the Original Landfill site will be checked to determine continuing effectiveness of institutional and physical controls.

3.6.6 Reporting and Record Keeping

Inspection forms and findings will be included in the Annual Original Landfill Monitoring Reports discussed in Section 6.0. These annual reports will be submitted to the U.S. Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDPHE).

4.0 GROUNDWATER MONITORING PLAN

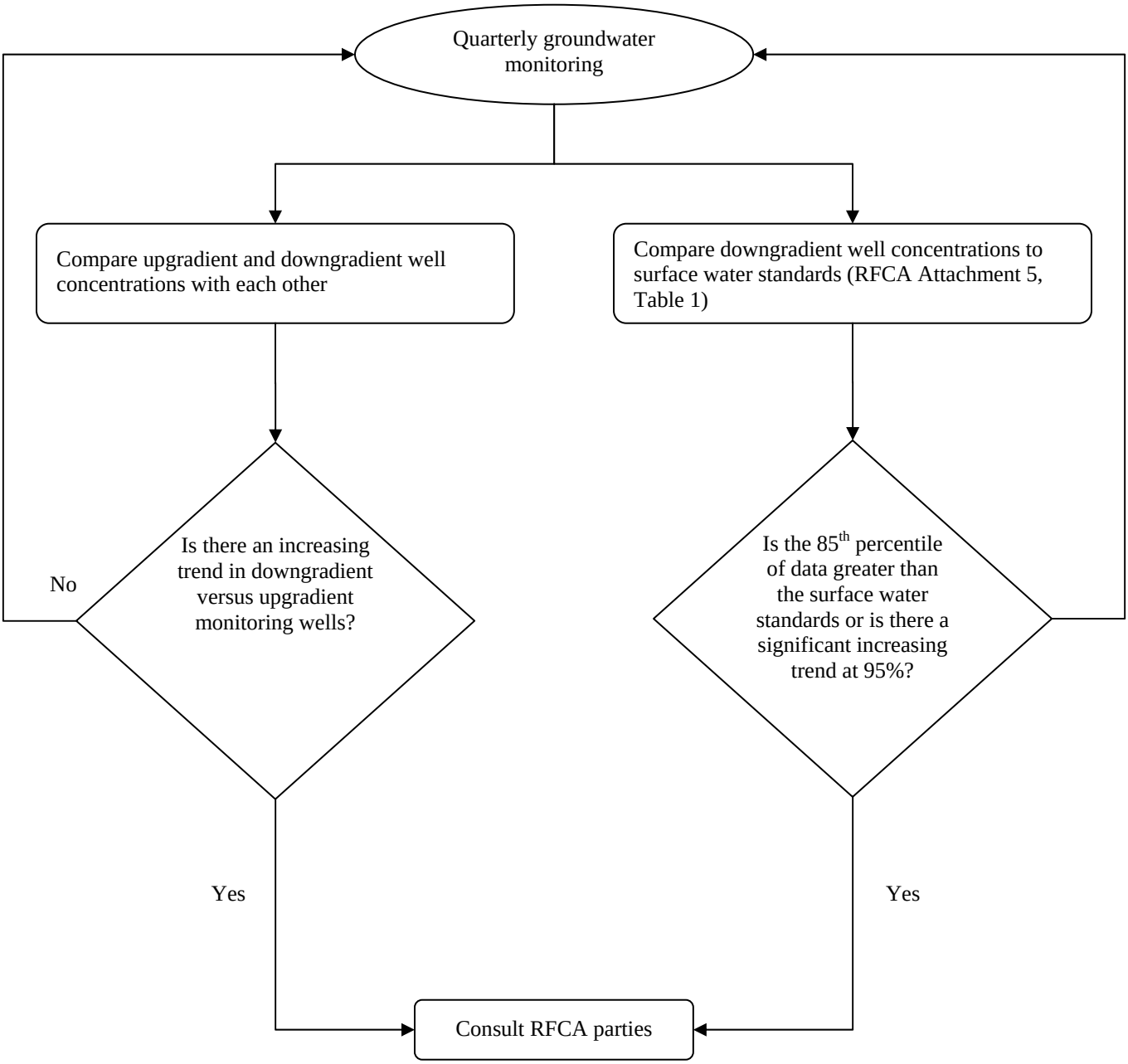
This section presents the groundwater monitoring plan for the Original Landfill during the post-closure period. The plan establishes consistent monitoring locations and frequencies for the monitoring period.

4.1 PURPOSE AND REQUIREMENTS

The Original Landfill groundwater monitoring plan has been implemented to determine groundwater quality impacts of the Landfill (DOE 2006). The groundwater monitoring system was implemented under the IMP (DOE 2005a) in accordance with 6 CCR Regulations 1007-3, 265.90[d]. Groundwater monitoring results will be used to evaluate upgradient versus downgradient groundwater quality at the Original Landfill. Downgradient groundwater will also be compared to surface water standards (RFCA Attachment 5, Table 1).

4.2 DATA QUALITY OBJECTIVES

Detailed data quality objective (DQO) information can be found in Section 3.3 of the IMP. Groundwater monitoring wells at the Original Landfill are categorized as RCRA monitoring wells under the IMP and undergo a certain decision statement, as outlined in Section 3.3.9.4 of the IMP. The following flowchart will be used to guide the decision statement:


Quarterly groundwater monitoring
Compare upgradient and downgradient well concentrations with each other
Compare downgradient well concentrations to surface water standards (RFCA Attachment 5, Table 1)
Is there an increasing trend in downgradient versus upgradient monitoring wells?
Is the 85th percentile of data greater than the surface water standards or is there a significant increasing trend at 95%?
No
Yes
Yes
Consult RFCA parties

4.3 WELL LOCATIONS

Well locations have been chosen in compliance with the IMP (DOE 2005) and include a total of four RCRA groundwater monitoring wells (Figure 4-1). Locations were selected and approved by both CDPHE and EPA. Of these, one is upgradient, and three are downgradient of the Original Landfill.

Upgradient monitoring wells include well P416589. Downgradient monitoring wells include wells 80005, 80105, and 80205. Monitoring well details are summarized in Table 4-1. Boring logs are included in Appendix B.

4.4 GROUNDWATER QUALITY SAMPLE PARAMETERS

Groundwater samples will be submitted for laboratory analysis for the following EPA-approved methods, in accordance with the IM/IRA (DOE 2006):

- SW-846 Method 8260B – Volatile Organic Compounds (VOCs)
- SW-846 Method 6010B – Metals (including uranium)
- SW-846 Method 7470A – Mercury
- SW-846 Method 8270C – Semivolatile Organic Compounds (SVOCs)

The analytical results of these methods for those analytes listed in Table 2 of RFCA Attachment 5 will be reported (See Appendix C).

4.5 SAMPLING PROCEDURES SUMMARY

Groundwater sampling will be conducted in accordance with RFETS Standard Operating Procedures (SOPs). The following sections summarize the groundwater sampling procedures that will be used to monitor groundwater conditions at the Original Landfill. Details include groundwater level measurements, conventional groundwater purging and sampling procedures, quality control (QC) field samples, decontamination procedures, and investigation-derived waste (IDW) management.

4.5.1 Groundwater Level Measurement

Water levels are measured to determine groundwater flow patterns, water level fluctuations, and the volume of water in a well for the calculation of purge volumes prior to sampling. Because this plan requires measuring water levels from a group of monitoring wells for hydrologic evaluation, such measurements will be conducted as a complete round, separate from any sampling efforts. The four RCRA monitoring wells will be included during water level measurements. Water levels will be measured in accordance with RFETS SOPs.

4.5.2 Conventional Groundwater Purging and Sampling

Monitoring wells will be purged before samples are withdrawn to prevent collection of non-representative stagnant water in a well. Well purging will be sufficient to increase the likelihood that the water collected is representative of the groundwater within the formation around the well. All purging and sampling operations will be conducted in accordance with RFETS SOPs.

4.5.3 Quality Control Field Samples

During implementation of the field sampling program, field quality assurance (QA)/QC samples will be collected to assess the reproducibility of the field collection techniques, the quality of preservation techniques and sample bottles, and the effectiveness of field decontamination procedures. QA/QC procedures will be conducted in accordance with RFETS SOPs.

4.5.4 Decontamination

Equipment used in monitoring and sampling must be properly decontaminated. Decontamination must effectively eliminate the potential for cross-contamination between sampling locations and must be conducted using the appropriate materials to prevent the introduction of external contaminants (such as phosphate from detergents, aromatic hydrocarbons from motor vehicles, or oil and grease from dirty hands). Decontamination procedures will be conducted in accordance with RFETS SOPs.

4.5.5 Investigation-Derived Waste

IDW that will accumulate during groundwater monitoring includes decontamination and purge water. The management of IDW will be conducted in accordance with RFETS SOPs.

4.6 LABORATORY PROCEDURES SUMMARY

Analytical methodologies and reporting limits (RLs), data reporting procedures, laboratory QA/QC procedures, laboratory data validation and contractor validation procedures will be conducted in accordance with EPA-approved methods. Groundwater samples will be submitted to an EPA-approved analytical laboratory for the analyses listed in Section 4.4.

Sample results are reported according to laboratory analytical method SOPs or contract specifications. The laboratory will report any analyte of interest detected at or above the RL as a positive value. Any analyte of interest not detectable or detected below the RL will be reported as “not detected” at the RL or an estimated value between the RL and the instrument or method detection limit. Data are generally reported in a tabular format or posted on maps and figures. RLs are adjusted for dilution when necessary.

4.7 DATA EVALUATION AND REPORTING

Groundwater monitoring results will be included in the Annual Original Landfill Monitoring Report~~s~~ discussed in Section 6.0. Groundwater monitoring will be conducted on a quarterly basis at the Original Landfill.

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5.0 SURFACE WATER MONITORING PLAN

As part of Original Landfill post-closure monitoring, surface water will be monitored at both upgradient and downgradient locations. This section presents the monitoring plan to determine whether surface water standards are met.

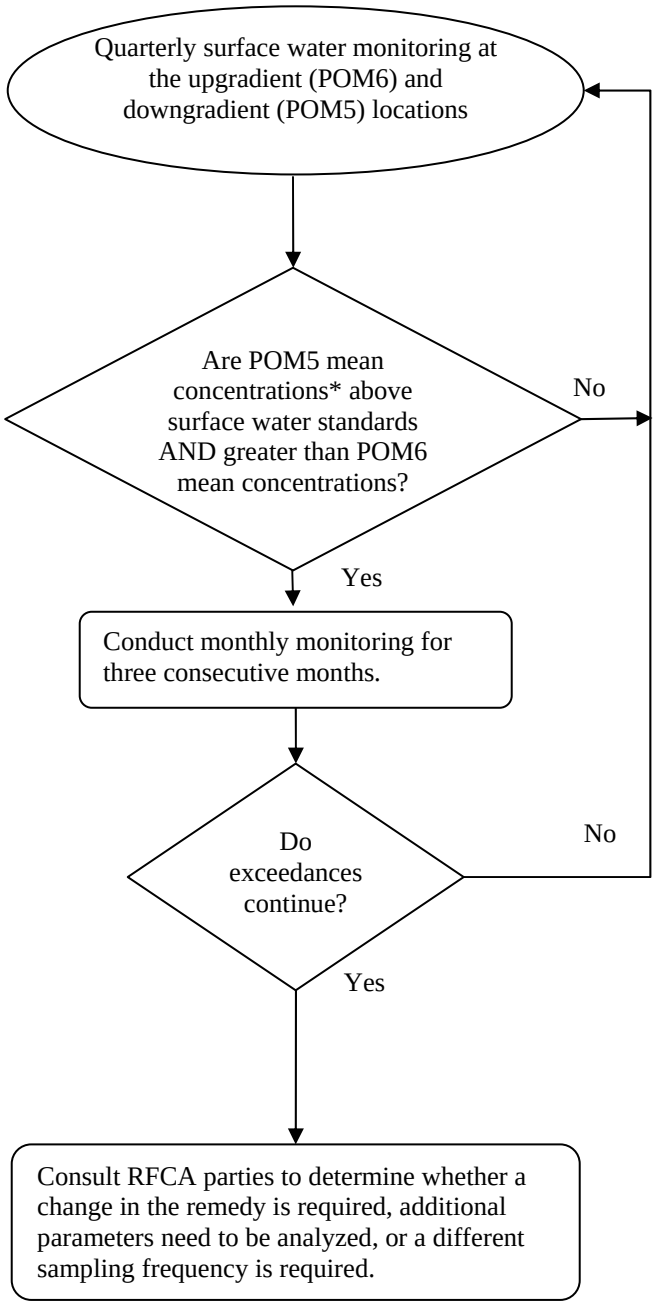
5.1 PURPOSE AND REQUIREMENTS

The Original Landfill surface water monitoring plan has been implemented to determine surface water quality impacts of the Original Landfill (DOE 2006). Applicable surface water standards are listed in the RFCA, Attachment 5, Table 1.

As detailed in the IM/IRA, monitoring requirements will consist of quarterly monitoring until the first CERCLA review. A validated exceedance of a surface water standard and value in the downstream station that is at least 50% greater than in the upstream station will trigger monthly monitoring for three consecutive months. Continued exceedances during the three-month period will trigger consultation between the RFCA parties to determine whether a change in the remedy is required, additional parameters need to be analyzed, or a different sampling frequency is required.

5.2 DATA QUALITY OBJECTIVES

Surface water monitoring DQO information can be found in the IMP, Section 2 (DOE 2005a). The following flowchart will be used to guide the decision statement.



*Mean concentration is the arithmetic average of individual results for the quarter

5.3 SAMPLE LOCATIONS

Sampling for water quality will be conducted at the two locations shown on Figure 4-1, POM5 (downgradient) and POM6 (upgradient)

5.4 SURFACE WATER SAMPLE PARAMETERS

Surface water samples will be submitted for laboratory analysis in accordance with the IM/IRA (DOE 2006) for the following EPA-approved method:

- SW-846 Method 8260B –VOCs
- SW-846 Method 6010B – Metals
- SW-846 Method 7470A – Mercury
- Alpha Spectrometry – Isotopic Uranium

The analytical results of these methods for those analytes listed in Table 1 of RFCA Attachment 5 will be reported.

5.5 SAMPLING PROCEDURES SUMMARY

The following sections detail the sampling procedures that will be used to monitor surface water. QC field samples, decontamination procedures, sample identification, and sample handling procedures are identical to those of the groundwater sampling.

Sampling Procedures

Surface water at the two locations will be sampled by directly placing a collection device or using a pond sampler device. The pond sampler can be purchased or easily fabricated with the following parts:

- One 250-milliliter (ml) polypropylene beaker (laboratory supply store);
- Adjustable clamp sized for 250-ml beakers (laboratory supply store);
- Aluminum telescoping tube equipped with bolt holes (swimming supply store); and
- Nuts/bolts to attach clamp to telescoping tube (hardware store).

Water from the sampler device will be poured directly into the sample containers. The device must be decontaminated in accordance with Section 4.5.4 between samples.

5.6 LABORATORY PROCEDURES SUMMARY

Analytical methodologies and RLs, data reporting procedures, laboratory QA/QC procedures, and laboratory data validation and contractor validation procedures are to be conducted in

accordance with EPA-approved methods. Samples will be submitted to an EPA-approved analytical laboratory for the analyses in Section 5.4.

5.7 REPORTING AND SCHEDULING

Surface water sampling results will be included in the Annual Original Landfill Monitoring Report discussed in Section 6.0. Surface water monitoring will be conducted on a quarterly basis at the Original Landfill.

6.0 REPORTING AND CONTACT INFORMATION

6.1 REPORTING

The complete Annual Original Landfill Monitoring Report, including inspection results, repairs, groundwater monitoring data, and surface water monitoring data if applicable, will be submitted to the RFCA parties. Any maintenance action activities will be detailed in the report. If serious conditions occur at any time requiring immediate attention, the RFCA parties will be notified immediately. The Annual Original Landfill Monitoring Report will include at a minimum:

- Monthly vegetation inspection forms for the first two growing seasons;
- All inspection forms/reports for the year;
- Notations of problems, maintenance action(s) taken, and maintenance or repairs as a result of the inspections;
- Any deviations from the Original Landfill Monitoring and Maintenance Plan and the rationale for such deviations;
- Summary of monitoring locations;
- Tables with depth to water, well elevations, and groundwater elevations;
- Table with groundwater results and associated qualifiers;
- Tables with surface water results and associated qualifiers;
- Figures with groundwater monitoring points and location(s) of problems and/or repairs; and
- Groundwater and surface water sampling forms.

During the year, DOE will transmit completed inspection forms as they become available, but in no case later than one month after the field activity is completed.

6.2 CONTACT INFORMATION

The point of contact and contact information for the Original Landfill during the monitoring and maintenance phase is as follows:

Scott Surovchak/Department of Energy
Rocky Flats Office of Legacy Management
12101 Airport Way, Unit A
Broomfield, CO 80021-2583
303-966-3551

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7.0 REFERENCES

Earth Tech, Inc., 2005, Final Design Analysis, Accelerated Action Design for the Original Landfill. May.

DOE, 1988, Remedial Investigation and Feasibility Study Plans for Low Priority Sites, Volume I – Site Descriptions, Groupings and Prioritization, June.

DOE, 1994, Technical Memorandum No. 15, Addendum to Final Phase I RFI/RI Work Plan, Amended Field Sampling Plan, Volume 2, Woman Creek Priority Drainage, Rocky Flats Plant, Golden, Colorado, May.

DOE, 2006, Final Interim Measure/Interim Remedial Action for the Original Landfill, Rocky Flats Environmental Technology Site, Golden, Colorado, Minor Modification, January.

DOE, 2005a, RFETS Integrated Monitoring Plan FY2005, Revision 1, Background Document; Rocky Flats Environmental Technology Site, Golden, Colorado, September.

DOE, 2005b, Rocky Flats, Colorado, Site Revegetation Plan, Rocky Flats Office of Legacy Management; Broomfield, Colorado, September

DOE, 2005c, Rocky Flats, Colorado, Site Vegetation Management Plan, Rocky Flats Office of Legacy Management, Broomfield, Colorado, December.

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TABLES

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TABLE 4-1
GROUNDWATER MONITORING WELLS
ORIGINAL LANDFILL

Well ID	Type	Installation Date	Screen Length (feet)	Borehole Depth (feet bgs)	Well Diameter (inches)	Depth to Top of Screen (feet bgs)	Depth to Bedrock (feet bgs)
P416589	upgradient	9/14/89	4	36.5	2	27.05	30.50
80005	downgradient	8/9/05	15	21.0	2	5.80	7.10
80105	downgradient	8/8/05	15	20.1	2	4.95	7.50
80205	downgradient	8/10/05	15	19.8	2	4.75	8.35

Notes:
bgs below ground surface

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FIGURES

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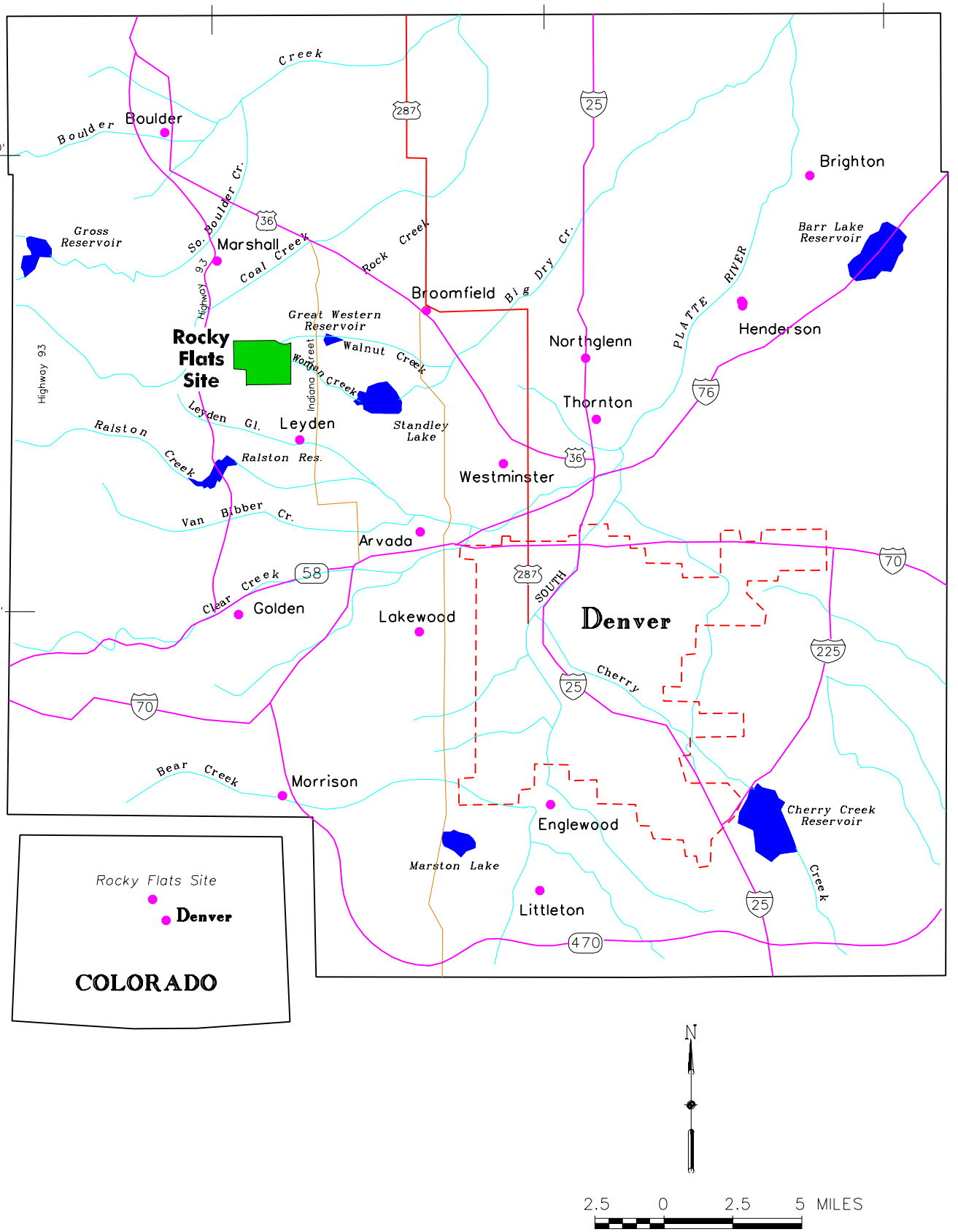

DATE: 12/8/2004

CAD FILE: GROUP\CAD\ROCKY_FLATS\NEWDESIGN_2004\PLFMM\LOCATION.DGN

EARTH TECH

FIGURE 1–1

LOCATION MAP

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

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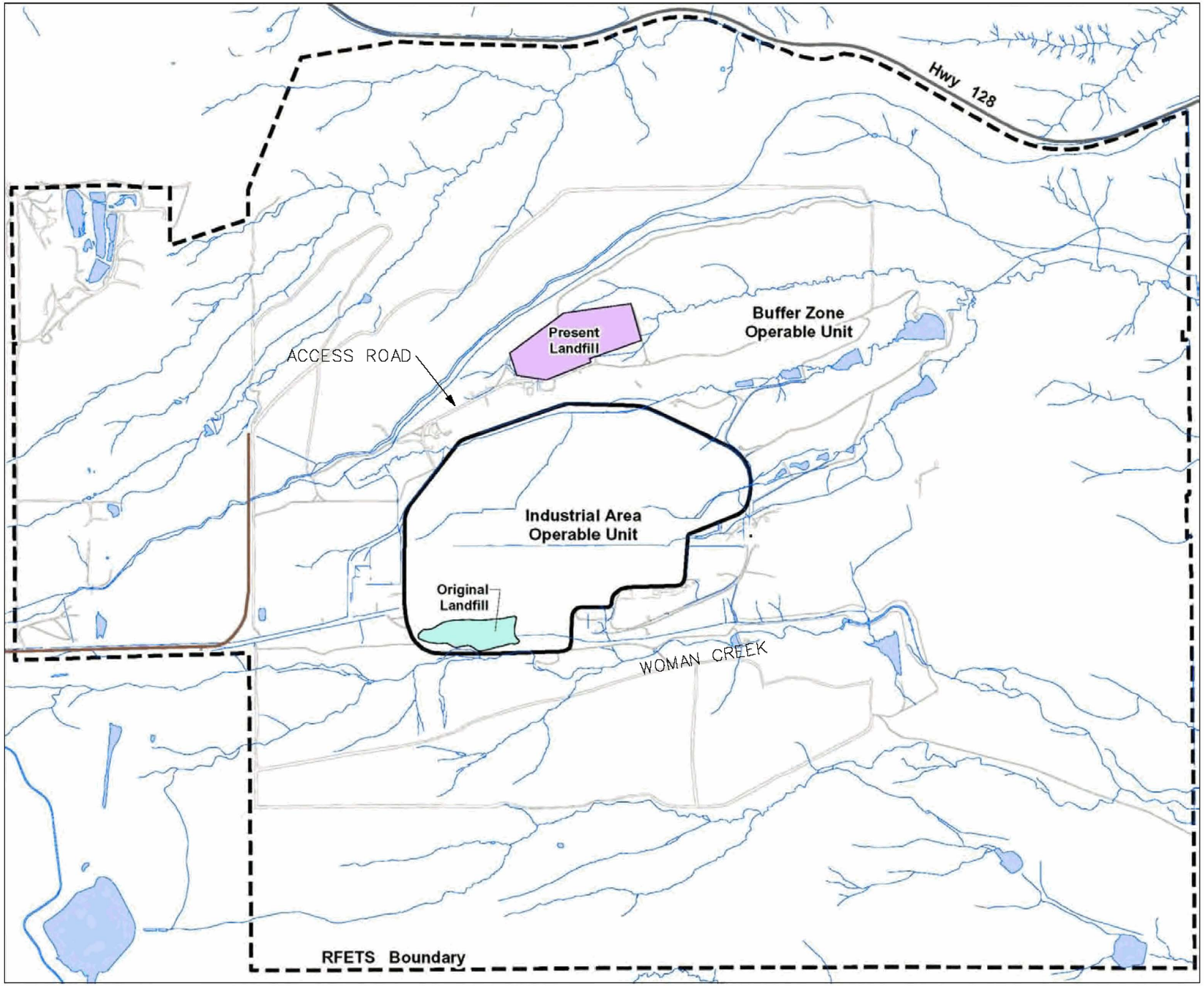
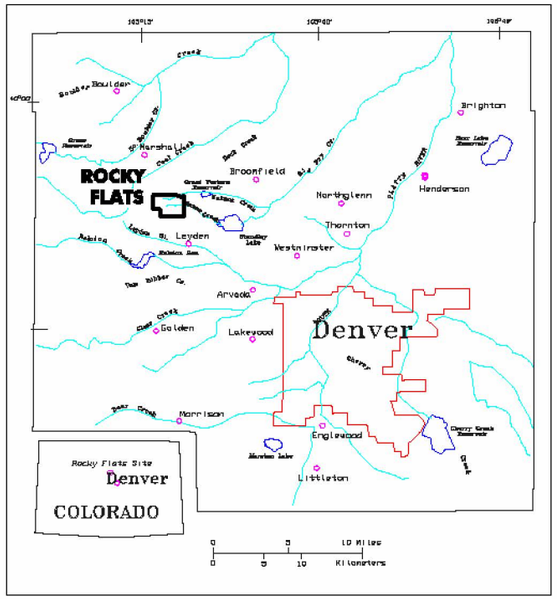




N

EARTH TECH

FIGURE 1-2

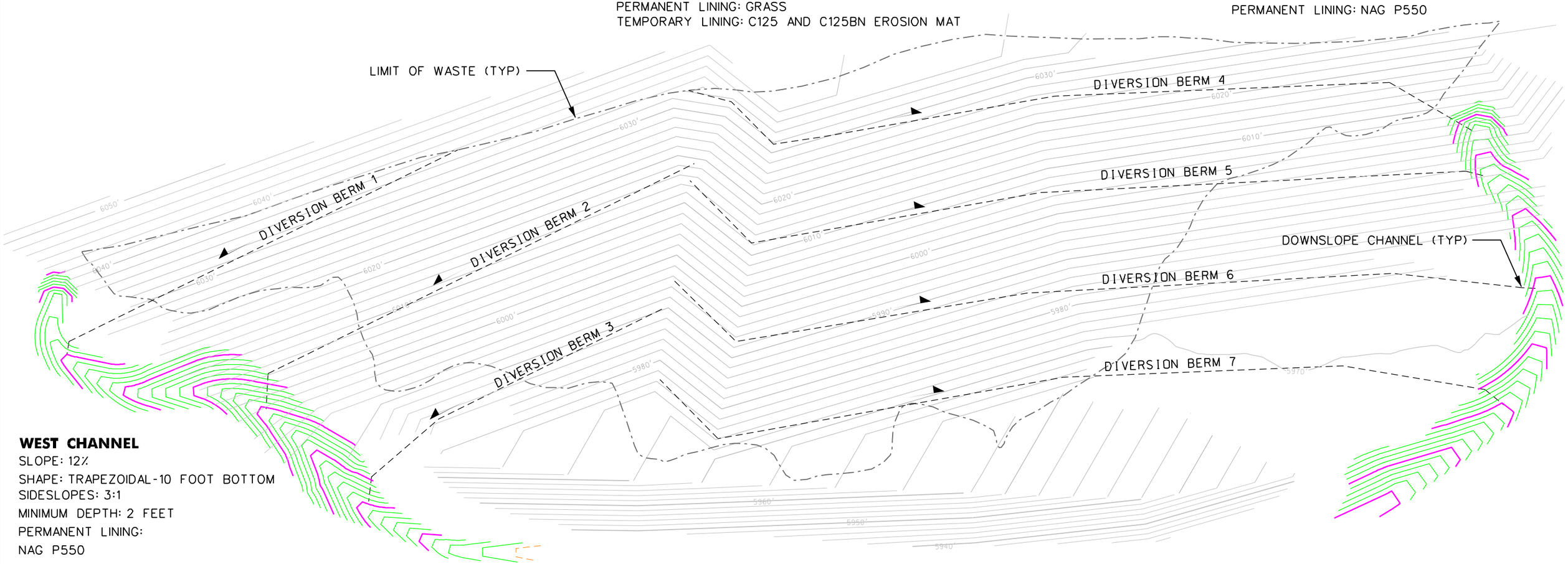
ORIGINAL LANDFILL SITE MAP

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

L:\GROUP\CAD\ROCKY_FLATS\OLF_805Figs\HaulRte1.dgn DATE: 8/23/05

DIVERSION BERMS 1,2,3,4,5,6,7
SLOPE: 2%
SHAPE: TRIANGULAR
HEIGHT: 3 FEET
PERMANENT LINING: GRASS
TEMPORARY LINING: C125 AND C125BN EROSION MAT

EAST CHANNEL
SLOPE: 12%
SHAPE: TRAPEZOIDAL-18 FOOT BOTTOM
SIDESLOPES: 3:1 TO 4:1
MINIMUM DEPTH: 2 FEET
PERMANENT LINING: NAG P550



WEST CHANNEL
SLOPE: 12%
SHAPE: TRAPEZOIDAL-10 FOOT BOTTOM
SIDESLOPES: 3:1
MINIMUM DEPTH: 2 FEET
PERMANENT LINING:
NAG P550

N

60 0 60 120 FEET

LEGEND
- - - - DIVERSION BERM
CHANNEL
— · — · LIMIT OF WASTE

E A R T H T E C H

FIGURE 2-1

ORIGINAL LANDFILL COVER

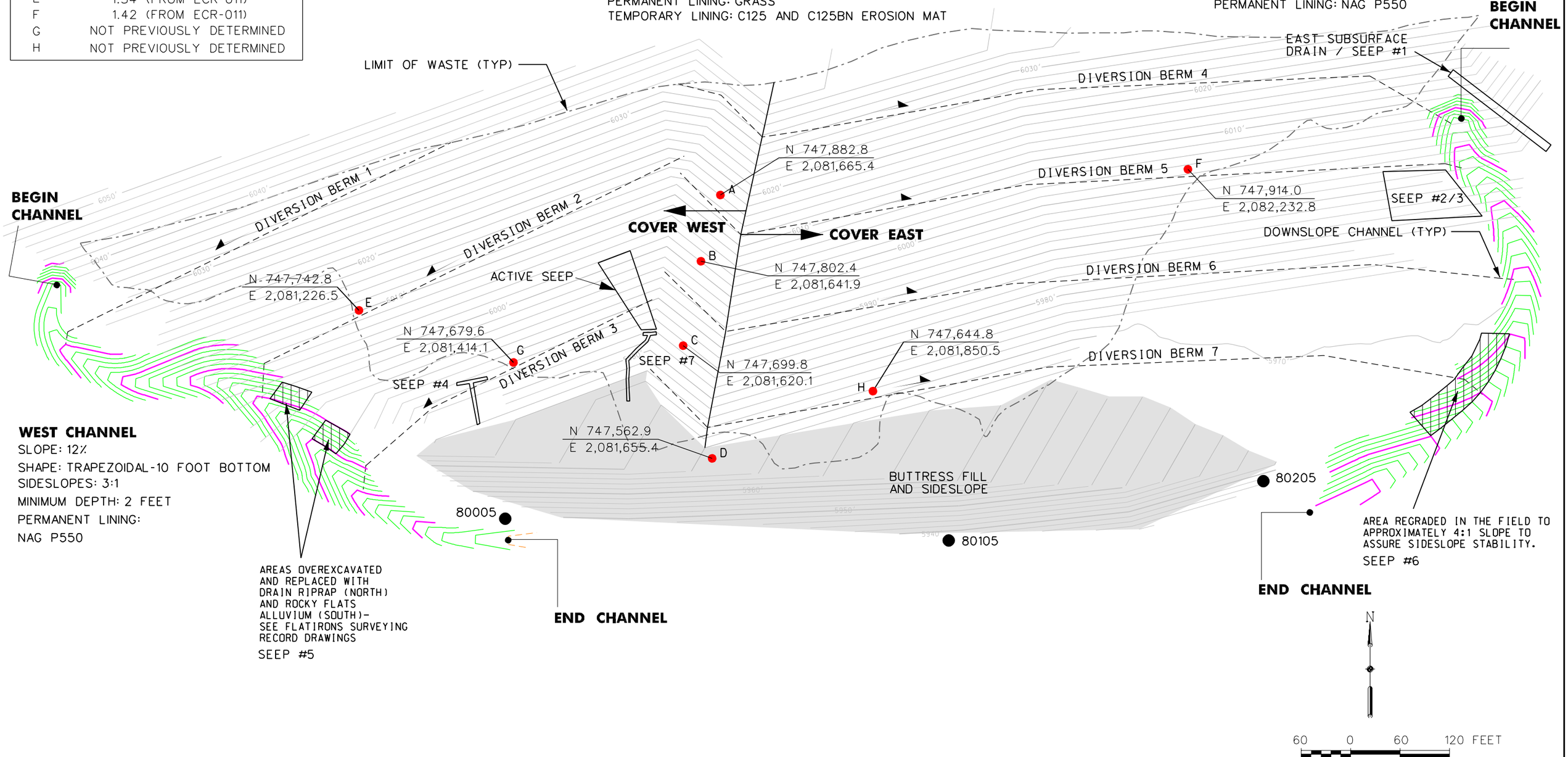
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

L\GROUP\CAD\ROCKY_FLATS\OLF_805Figs\Surfrev2.dgn DATE: 12/8/04

POINT	CALCULATED SETTLEMENT (FT)
A	2.86
B	2.54
C	1.45
D	1.99
E	1.34 (FROM ECR-011)
F	1.42 (FROM ECR-011)
G	NOT PREVIOUSLY DETERMINED
H	NOT PREVIOUSLY DETERMINED

DIVERSION BERMS 1,2,3,4,5,6,7
SLOPE: 2%
SHAPE: TRIANGULAR
HEIGHT: 3 FEET
PERMANENT LINING: GRASS
TEMPORARY LINING: C125 AND C125BN EROSION MAT

EAST CHANNEL
SLOPE: 12%
SHAPE: TRAPEZOIDAL-18 FOOT BOTTOM
SIDESLOPES: 3:1 TO 4:1
MINIMUM DEPTH: 2 FEET
PERMANENT LINING: NAG P550



WEST CHANNEL
SLOPE: 12%
SHAPE: TRAPEZOIDAL-10 FOOT BOTTOM
SIDESLOPES: 3:1
MINIMUM DEPTH: 2 FEET
PERMANENT LINING:
NAG P550

AREAS OVEREXCAVATED AND REPLACED WITH DRAIN RIPRAP (NORTH) AND ROCKY FLATS ALLUVIUM (SOUTH)- SEE FLATIRONS SURVEYING RECORD DRAWINGS
SEEP #5

LEGEND
- DIVERSION BERM
- CHANNEL
- LIMIT OF WASTE
- GROUNDWATER MONITORING WELL
- SETTLEMENT MONITORING LOCATION

EARTH TECH

FIGURE 3-1
ORIGINAL LANDFILL INSPECTIONS
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

L:\GROUP\CAD\ROCKY_FLATS\OLF_805Figs\fig3-1new.dgn DATE: 2/07/06

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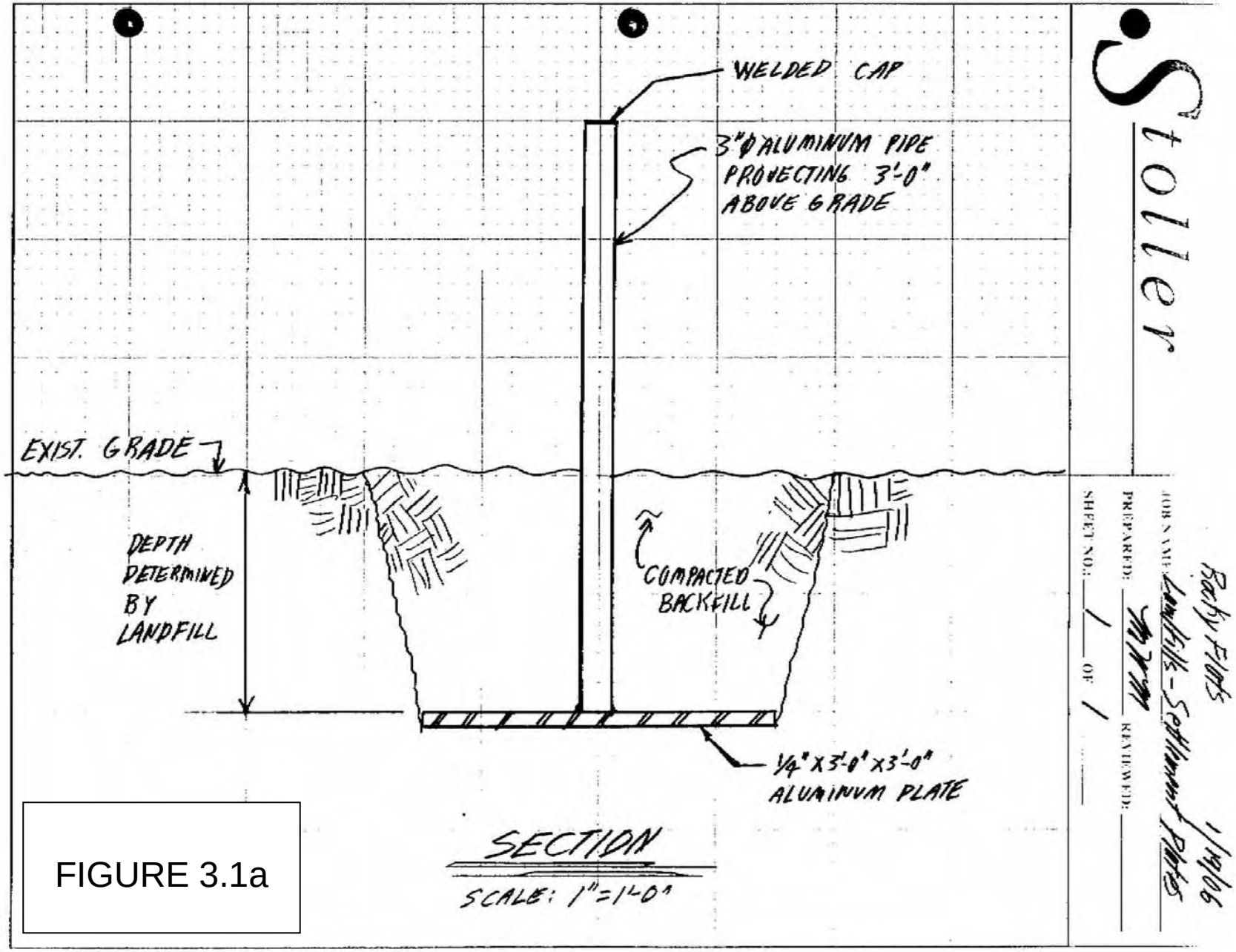
WELDED CAP
3"Ø ALUMINUM PIPE PROJECTING 3'-0" ABOVE GRADE
EXIST. GRADE
DEPTH DETERMINED BY LANDFILL
COMPACTED BACKFILL
1/4" X 3'-0" X 3'-0" ALUMINUM PLATE
SECTION
SCALE: 1"=1'-0"
Stoller
JOB NAME: Lowell Hill - Schlumpf Plots
PREPARED:
REVIEWED:
SHEET NO: 1 OF 1
Rocky Flats
1/19/06

FIGURE 3.1a

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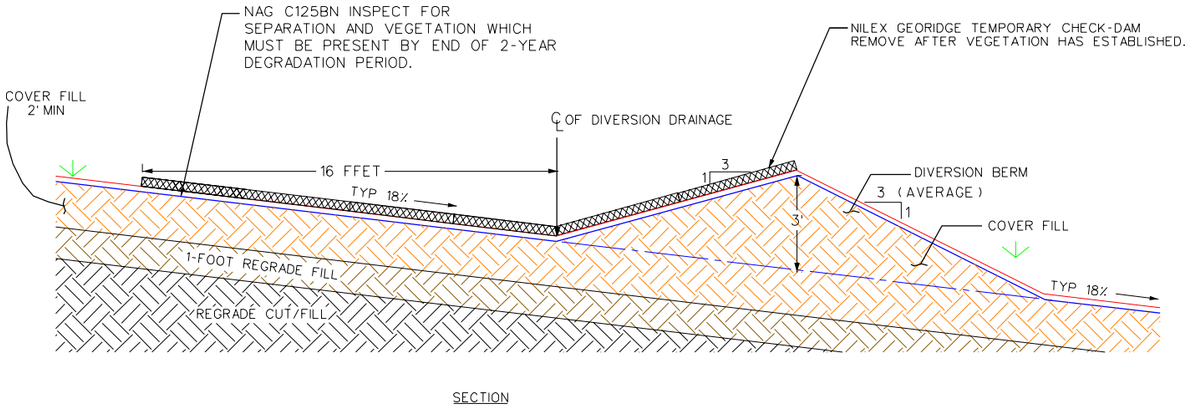
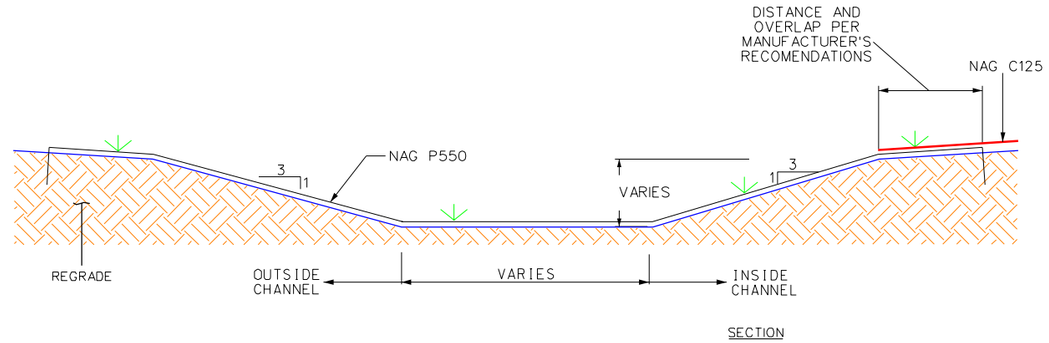


NOTE: IN AREAS OUTSIDE OF THE WASTE "FOOTPRINT" COVER SOIL MAY BE LESS THAN 2' (IN TRANSITION AREAS) OR NO COVER SOIL

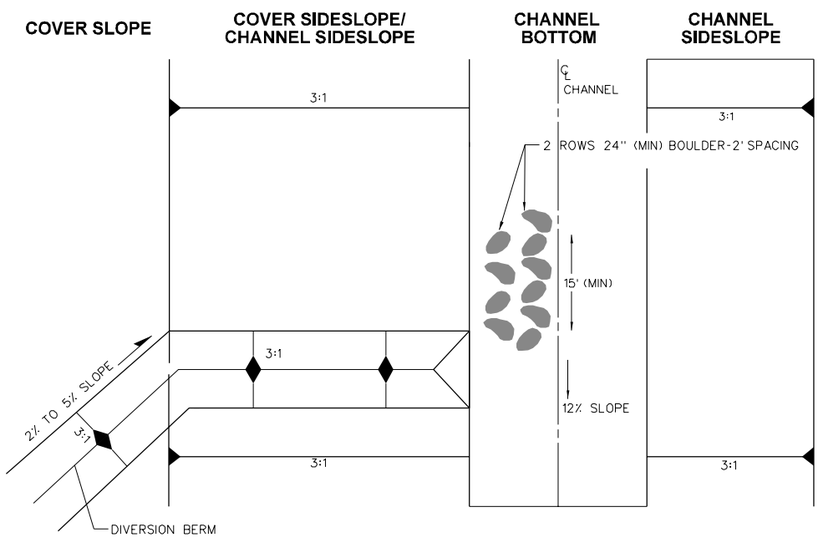
DIVERSION BERM (SECTION)

NTS



PERMANENT/GRASS-LINED CHANNEL DETAIL (SECTION)

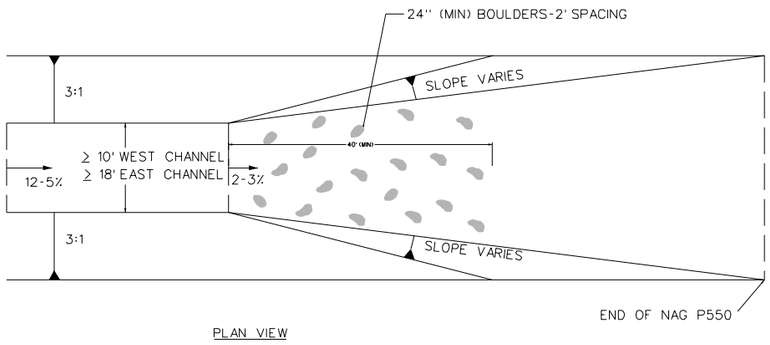
NTS



NOTE: NAG P550 EROSION MAT ON CHANNEL BOTTOM, CHANNEL SIDESLOPES, DOWNSLOPE CHANNEL BOTTOM, AND DOWNSLOPE CHANNEL SIDESLOPES.

DOWNSLOPE CHANNEL TRANSITION FROM DIVERSION BERM TO CHANNEL (PLAN VIEW)

NTS



END CHANNEL (PLAN VIEW)

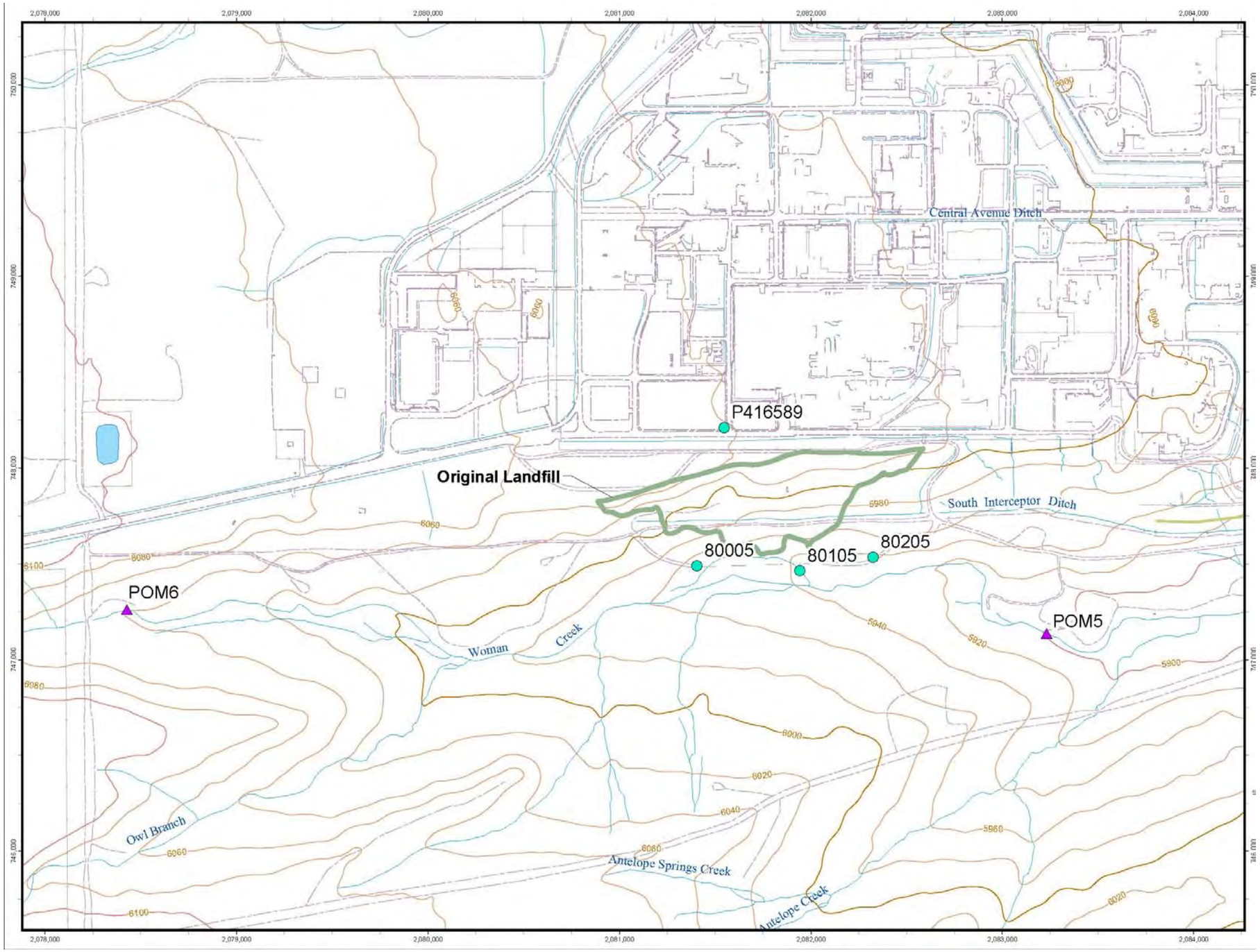
NTS

E A R T H T E C H

FIGURE 3–2

ORIGINAL LANDFILL STORMWATER MANAGEMENT STRUCTURE DETAILS

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO



N

250 0 250 500 FEET

E A R T H T E C H

FIGURE 4–1

ORIGINAL LANDFILL GROUNDWATER AND SURFACE WATER MONITORING

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

L\GROUP\CAD\ROCKY_FLATS\OLF_805Figs\GwSurf.dgn DATE: 8/26/05

APPENDIX A

ORIGINAL LANDFILL – MONITORING AND MAINTENANCE PROGRAM INSPECTION FORM

ORIGINAL LANDFILL – MONITORING AND MAINTENANCE PROGRAM

INSPECTION FORM

INSPECTOR: _____ DATE: _____TIME:_____REVIEWED BY:_____

TEMPERATURE: _____ WEATHER CONDITIONS: _____ REVIEW DATE:_____

METEOROLOGICAL STATION LOCATION: _____

SUBSIDENCE / CONSOLIDATION

REGION	EVIDENCE OF CRACKS?	EVIDENCE OF DEPRESSIONS?	EVIDENCE OF SINK HOLES?	EVIDENCE OF PONDING?	OTHER (DESCRIBE BELOW)
COVER – WEST	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
COVER – EAST	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
BUTTRESS FILL	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
DIVERSION BERM 1	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
DIVERSION BERM 2	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
DIVERSION BERM 3	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
DIVERSION BERM 4	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
DIVERSION BERM 5	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
DIVERSION BERM 6	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
DIVERSION BERM 7	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	

Settlement Plates on Top of cover to be inspected for integrity.
During Year 1, they will be surveyed quarterly, and annually thereafter.

Integrity intact?
☐ Yes ☐ No

MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

_____

_____

_____

SLOPE STABILITY

REGION	EVIDENCE OF SEEPS?	EVIDENCE OF BLOCK OR CIRCULAR FAILURE?	EVIDENCE OF SEEPS?	OTHER? (DESCRIBE BELOW)
COVER – WEST	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
COVER – EAST	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
BUTTRESS FILL SIDESLOPE	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
WEST PERIMETER CHANNEL SIDESLOPES	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST PERIMETER CHANNEL SIDESLOPES	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
COVER SEEPS (IF PRESENT)	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
			☐ Yes ☐ No	
			☐ Yes ☐ No	

MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

SOIL COVER

REGION	EVIDENCE OF SOIL DEPOSITION OR EROSION?	EVIDENCE OF EROSION RILLS/GULLIES?	EVIDENCE OF BURROWING ANIMALS?	OTHER (DESCRIBE BELOW)
COVER – WEST	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
COVER – EAST	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
BUTTRESS FILL	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
BUTTRESS FILL SIDESLOPE	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	

MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

VEGETATION

REGION	CONDITION OF GRASS	UNWANTED VEGETATION PRESENT*?	PERCENTAGE OF GRASS VERSUS BARE GROUND?	PERCENTAGE OF UNWANTED VEGETATION?
COVER- WEST		☐ Yes ☐ No		
COVER - EAST		☐ Yes ☐ No		
DIVERSION BERM 1		☐ Yes ☐ No		
DIVERSION BERM 2		☐ Yes ☐ No		
DIVERSION BERM 3		☐ Yes ☐ No		
DIVERSION BERM 4		☐ Yes ☐ No		
DIVERSION BERM 5		☐ Yes ☐ No		
DIVERSION BERM 6		☐ Yes ☐ No		
DIVERSION BERM 7		☐ Yes ☐ No		
WEST PERIMETER CHANNEL		☐ Yes ☐ No		
EAST PERIMETER CHANNEL		☐ Yes ☐ No		
UPPER BUTTERESS FILL SIDESLOPE		☐ Yes ☐ No		
LOWER BUTTRESS FILL SIDESLPOE		☐ Yes ☐ No		

* Unwanted vegetation includes weeds and deep-rooting trees.

MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

STORMWATER MANAGEMENT STRUCTURES

CHANNELS / LINING

STRUCTURE	EVIDENCE OF EXCESSIVE EROSION, GULLYING, SCOUR, OR UNDERMINING?	EVIDENCE OF SETTLEMENT/ SUBSIDENCE OR DEPRESSIONS?	EVIDENCE OF BREACHING OR BANK FAILURE?	EVIDENCE OF BURROWING ANIMALS?	EVIDENCE OF SEDIMENT BUILD-UP OR OTHER BLOCKAGE?	EVIDENCE OF LINING DETERIORATION, HOLES, RIPS, OR SEPARATION?	EVIDENCE OF LINING DISPLACEMENT?
DIVERSION BERM 1	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
DIVERSION BERM 2	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
DIVERSION BERM 3	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
DIVERSION BERM 4	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
DIVERSION BERM 5	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
DIVERSION BERM 6	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
DIVERSION BERM 7	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
CHECK DAMS	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
WEST PERIMETER CHANNEL	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
EAST PERIMETER CHANNEL	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

OTHER DEFICIENCIES?

MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

STORMWATER MANAGEMENT STRUCTURES (CONTINUED)

OUTFALLS

CHECK EACH STRUCTURE FOR EXCESSIVE EROSION AND SEDIMENT DEPTH. IF SEDIMENT DEPTH IS COMPROMISING THE DESIGN CHARACTERISTICS, REMOVE SEDIMENT.

STRUCTURE	CONDITION / SEDIMENT DEPTH
DIVERSION BERM OUTFALL 1	
DIVERSION BERM OUTFALL 2	
DIVERSION BERM OUTFALL 3	
DIVERSION BERM OUTFALL 4	
DIVERSION BERM OUTFALL 5	
DIVERSION BERM OUTFALL 6	
DIVERSION BERM OUTFALL 7	
WEST PERIMETER CHANNEL OUTFALL	
EAST PERIMETER CHANNEL OUTFALL	
FRENCH DRAIN OUTFALL (SID)	

OTHER DEFICIENCIES?

MAINTENANCE REQUIRED / COMMENTS/PHOTO LOG

"RUN-ON" CONTROL

AREA	ADVERSELY AFFECTING OLF?		
NORTH OF THE ORIGINAL LANDFILL	☐ Yes	☐ No	COMMENT:
WEST OF THE WEST PERIMETER CHANNEL	☐ Yes	☐ No	COMMENT:
EAST OF THE EAST PERIMETER CHANNEL	☐ Yes	☐ No	COMMENT:
NORTH OF WOMAN CREEK	☐ Yes	☐ No	COMMENT:

MAINTENANCE REQUIRED

INSTITUTIONAL CONTROLS

ITEM			
EVIDENCE OF EXCAVATION(S) OF COVER AND IMMEDIATE VICINITY OF COVER?	☐ Yes	☐ No	COMMENT:
EVIDENCE OF CONSTRUCTION OF ROADS, TRAILS ON COVER OR BUILDINGS?	☐ Yes	☐ No	COMMENT:
EVIDENCE OF UNAUTHORIZED ENTRY?	☐ Yes	☐ No	COMMENT:
EVIDENCE OF DRILLING OF WELLS OR USE OF GROUNDWATER?	☐ Yes	☐ No	COMMENT:
DAMAGE OR REMOVAL OF ANY SIGNAGE OR GROUNDWATER MONITORING WELLS?	☐ Yes	☐ No	COMMENT:

OTHER DEFICIENCIES/PHOTO LOG

ACTION ITEMS

DEFICIENCY	DATE NOTED	ACTION	DATE COMPLETED	COMMENTS

INSPECTOR SIGNATURE: _____ DATE: _____

REVIEWER SIGNATURE: _____ DATE:_____

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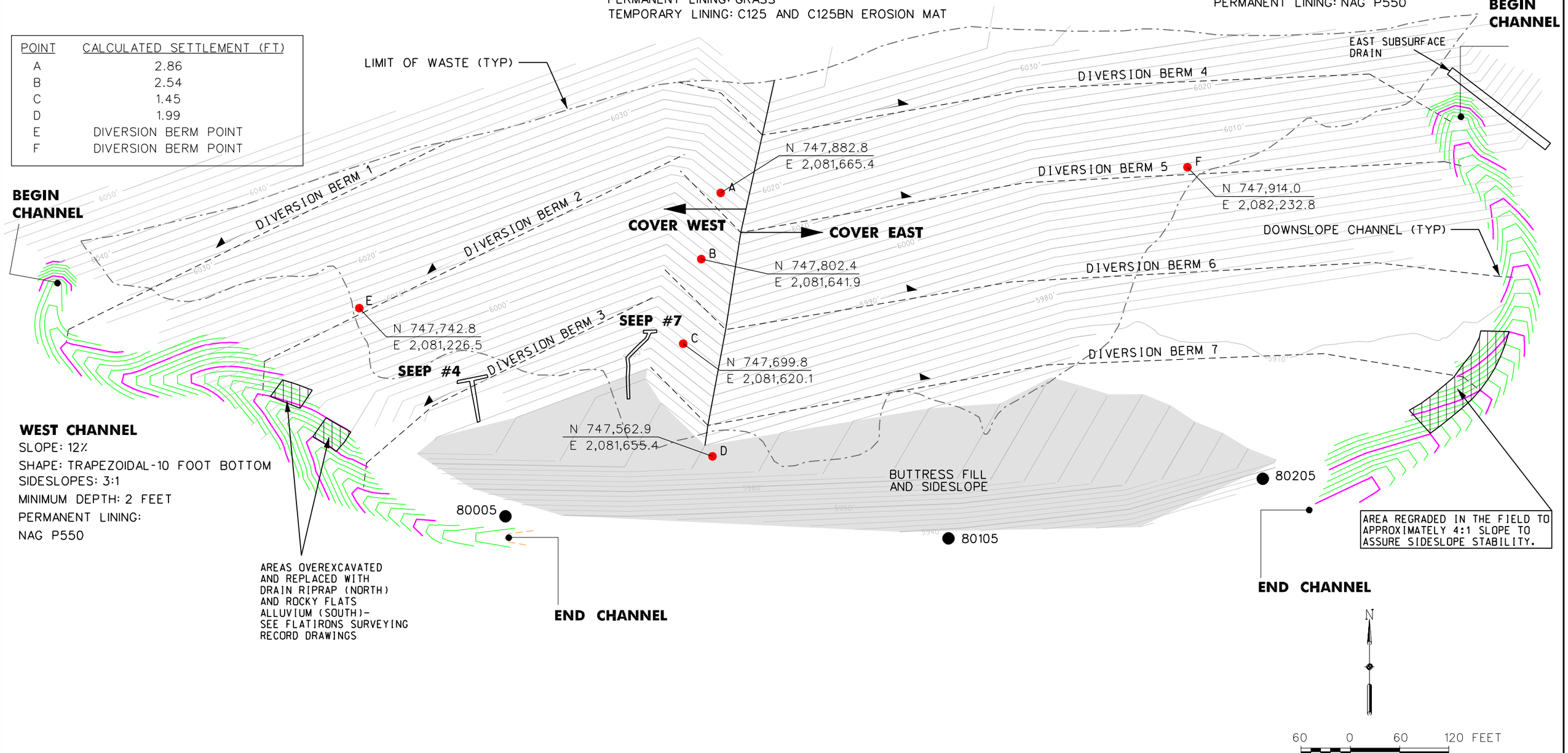
DIVERSION BERMS 1,2,3,4,5,6,7
SLOPE: 2%
SHAPE: TRIANGULAR
HEIGHT: 3 FEET
PERMANENT LINING: GRASS
TEMPORARY LINING: C125 AND C125BN EROSION MAT

EAST CHANNEL
SLOPE: 12%
SHAPE: TRAPEZOIDAL-18 FOOT BOTTOM
SIDESLOPES: 3:1 TO 4:1
MINIMUM DEPTH: 2 FEET
PERMANENT LINING: NAG P550

POINT	CALCULATED SETTLEMENT (FT)
A	2.86
B	2.54
C	1.45
D	1.99
E	DIVERSION BERM POINT
F	DIVERSION BERM POINT



WEST CHANNEL
SLOPE: 12%
SHAPE: TRAPEZOIDAL-10 FOOT BOTTOM
SIDESLOPES: 3:1
MINIMUM DEPTH: 2 FEET
PERMANENT LINING:
NAG P550

AREAS OVEREXCAVATED AND REPLACED WITH DRAIN RIPRAP (NORTH) AND ROCKY FLATS ALLUVIUM (SOUTH)- SEE FLATIRONS SURVEYING RECORD DRAWINGS

LEGEND
- DIVERSION BERM
- CHANNEL
- LIMIT OF WASTE
- GROUNDWATER MONITORING WELL
- SETTLEMENT MONITORING LOCATION

E A R T H T E C H

FIGURE 3-1
ORIGINAL LANDFILL INSPECTIONS
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

L\GROUP\CAD\ROCKY_FLATS\OLF_805Figs\fig3-1new.dgn DATE: 1/12/06

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APPENDIX B

GROUNDWATER WELL BORING LOGS / CONSTRUCTION SUMMARIES

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STATE PLANE COORDINATE		TOTAL DEPTH (FT) 36 5	GROUND ELEVATION (FT)	6041.20	OLD WELL NUMBER	P260-89	LOG OF BORING NUMBER
NORTH:	748211	AREA: PLANT	CASING DIAMETER (IN)	2-3/8 O.D.	GEOLOGIST	SPC	P416589
EAST	2081546	LOCATOR NUMBER: I8	BOREHOLE DIAMETER (IN)	7 25	DATE DRILLED	09/14/89	

REMARKS: Hollow Stem Auger Weston Log

GEOTECHNICAL SAMPLE DEPTH	SAMPLE NUMBER	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
										Asphalt
					6041	0			SM	Silty Sand - olive gray (5 Y 4/1), non-stratified F g. to v c g sand Trace gravel, poor sorting, sub-angular, quartzose, granite Dense, moist
	P76089002			2.00 /2.00	6040	1			CL	Gravelly Sandy Clay - olive black (5 Y 2/2), mod. brown (5 YR 3/4), mod reddish brown (10 R 4/6), non-stratified F g to v c g sand 1 cm to 4 cm gravel, poor sorting, sub-angular, quartzose. Very stiff, low plasticity, moist
	P76089003									
					6039	2			CL	Gravelly Sandy Clay - same as above, no olive black
									CL	Gravelly Sandy Clay - same as above. Varicolored, with grayish red (5 R 4/2), light brown (5 YR 5/6) Trace cobbles
	P76089004			1.40 /2.00	6038	3				
					6037	4			SC	Gravelly Clayey Sand - light brown (5 YR 5/6), pale yellowish brown (10 YR 6/2), non-stratified F g. to v c.g sand, 1 cm to 7 cm gravel, some silt, trace cobbles, poor sorting, sub-angular, quartzose Low to no plasticity, dense, moist
	P76089006									
	P76089007			1.10 /2.00	6036	5				
					6035	6			SC	Gravelly Clayey Sand - same as above Calcareous in part
	P76089008			1.20 /2.00	6034	7				
					6033	8			SC	Gravelly Clayey Sand - same as above, as indicated by cuttings
				0.00 /2.00	6032	9				
						10				

STATE PLANE COORDINATE		TOTAL DEPTH (FT): 36.5	GROUND ELEVATION (FT)	6041.20	OLD WELL NUMBER:	P260-89	LOG OF BORING NUMBER:
NORTH	748211	AREA: PLANT	CASING DIAMETER (IN)	2-3/8 O.D.	GEOLOGIST	SPC	P416589
EAST	2081546	LOCATOR NUMBER: I8	BOREHOLE DIAMETER (IN)	7.25	DATE DRILLED:	09/14/89	

REMARKS: Hollow Stem Auger. Weston Log.

CHEMICAL SAMPLE DEPTH / GEOTECHNICAL SAMPLE DEPTH	SAMPLE NUMBER	SAMPLE GRAIN SIZE (0% 50% 100%)	PERCENT RECOVERY (0% 100%)	RECOVERY/INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
				0.00/1.00	6031	10			SC	Gravelly Clayey Sand - same as above, as indicated by cuttings.
				0.00/1.00	6030	11			SC	Gravelly Clayey Sand - same as above, as indicated by cuttings.
	P260891214 P260891216			1.50/2.00	6029 6028	12 13			SC	Gravelly Clayey Sand - banded, varicolored, mod. red (5 R 5/4), pale reddish brown (10 R 5/4), light brown (5 YR 5/6), dark yellowish orange (10 YR 6/6), yellowish gray (5 Y 7/2), non-stratified. F.g. to v.c.g. sand, some gravel, some silt, poor sorting, sub-angular, quartzose. Low plasticity, iron staining, calcareous. 0.5 cm. lense of Silty Clay, dense to med. dense, damp.
	P260891415			0.40/0.70	6027	14			SC	Gravelly Clayey Sand - same as above, with scattered cobbles.
				0.00/1.30	6026	15			NO SAMPLE	NO SAMPLE.
	P260891618 P260891620			1.30/2.00	6025 6024	16 17			SC	Gravelly Clayey Sand - same as above. Increased clay content.
	P260891820			0.50/2.00	6023 6022	18 19			SM	Gravelly Silty Sand - same as above. Light brown (5 YR 5/6), light olive gray (5 Y 6/1). Some clay, quartzose.
						20				

STATE PLANE COORDINATE		TOTAL DEPTH (FT) 36 5	GROUND ELEVATION (FT)	6041 20	OLD WELL NUMBER:	P260-89	LOG OF BORING NUMBER:
NORTH:	748211	AREA: PLANT	CASING DIAMETER (IN)	2-3/8 0.0	GEOLOGIST	SPC	P416589
EAST	2081546	LOCATOR NUMBER I8	BOREHOLE DIAMETER (IN)	7 25	DATE DRILLED	09/14/89	

REMARKS: Hollow Stem Auger Weston Log

CHEMICAL SAMPLE DEPTH / GEOTECHNICAL SAMPLE DEPTH	SAMPLE NUMBER	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
					6021	20			SC	Gravelly Clayey Sand - same as above Light brown (5 YR 5/6), pale yellowish orange (10 YR 8/6), pale reddish brown (10 R 5/4), banded No cobbles
	P6092022			2.00 /2.00	6020	21				
	P6092024									
					6019	22			SC	Gravelly Clayey Sand - same as above Trace cobbles, quartzose to granites
	P6092224			0.90 /2.00	6018	23				
					6017	24			SC	Gravelly Clayey Sand - same as above, with very thin lenses (3 cm.) of very Silty Sand at 25.3' to 25.4'
	P6092426			1.60 /2.00	6016	25				
	P6092428				6015	26			CL	Gravelly Sandy Clay - same as above
							01/16/90		CL	Sandy Clay - pale reddish brown (10 R 5/4), dark yellowish orange (10 YR 6/6), light olive gray (5 Y 6/1), mottled, non-stratified V f g to f g sand. Some silt, very stiff, med plasticity, damp
	P6092628			2.00 /2.00	6014	27				
							09/14/89		SC	Clayey Sand - mod. reddish brown (10 R 4/6), light brown (5 YR 5/6), non-stratified F g to c g sand, some silt, poor sorting, sub-angular Iron staining, low plasticity, dense, damp
					6013	28				
	P6092830			1.40 /2.00	6012	29			SM	Silty Sand - same as above Some clay Trace of gravel, no plasticity, wet
	P6092831					30				

STATE PLANE COORDINATE		TOTAL DEPTH (FT) 36.5	GROUND ELEVATION (FT)	6041.20	OLD WELL NUMBER:	P260-89	LOG OF BORING NUMBER:
NORTH:	749211	AREA: PLANT	CASING DIAMETER (IN)	2-3/8 O.D.	GEOLOGIST:	SPC	P416589
EAST	2081546	LOCATOR NUMBER: I8	BOREHOLE DIAMETER (IN)	7.25	DATE DRILLED	09/14/89	

REMARKS: Hollow Stem Auger Weston Log.

CHEMICAL SAMPLE DEPTH / GEOTECHNICAL SAMPLE DEPTH	SAMPLE NUMBER	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
					6011	30			SM:	Silty Gravelly Sand - same as above
	P260893032			2.00 /2.00	6010	31			CLAYSTONE	Top of Bedrock Yellowish gray (5 Y 7/2), dusky yellowish orange (10 YR 6/6), mottled, blocky, med. high plasticity, weathered, oxidized, med. hard, damp, minor silty sand laminations
	P260893234				6009	32			CLAYSTONE	Same as above
	P260893135			0.20 /2.00	6008	33				
	P260893436			0.40 /1.00	6007	34			CLAYSTONE	Same as above - silty Trace sand, med plastic
					6006	35			CLAYSTONE	Same as above - some silt to silty
	P260893537			1.50 /1.50	6005	36				
					6004	37				TD = 36.5'
					6003	38				
					6002	39				
						40				

STATE PLANE COORDINATES AREA: GRND ELEV. (FT): 5957.54 CASING DIA (IN): 2"
NORTH: 747489.979 TOTAL DEPTH (FT): 21.0 BH DIA. (IN): 8"
EAST: 2081404.042 COMPLETION DATE: 8/9/05 GRID LOCATOR:
PROJECT: Original Landfill GEOLOGIST: E. Warp
REMARKS:
Routine well installation

LOG OF BORING NUMBER: 80005

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5961					
	Protective Casing, Steel, 6 in. ID.	3			
	Casing, Sch 40-PVC, 2 in. ID.				
5960		2			
5959		1			
5958		0			GC/CL: Gravelly, Sandy Clay with silt, brown (7.5YR4/4). 8 - 10% gravel (1/8" - 1/4" diameter, subangular to subrounded, composed of granite, schist, and quartzite). ~8% sand (coarse grained, subrounded to subangular). Clay has medium plasticity. Moist. 1" to 1-1/2" diameter cobbles of quartzite and granite at 0.4'.
5957		1			CL: Clay with trace gravel and sand, dark brown (7.5YR3/2). ~3 - 5% gravel (1/8" - 1/2" diameter, subangular), ~3 - 5% sand. Clay has medium plasticity. Shattered quartzite cobble at 0.6'. Roots at base of interval. Moist.
5956	Hydrated Bentonite Chips	2			CL: Clay with trace gravel and trace sand, brown (10YR4/3) with dark yellowish brown (10YR4/6) mottling. Possibly re-worked claystone with gravel and sand. Weak iron oxidation mottled throughout and disseminated at base. Trace roots. Moist.
5955		3			No recovery.
					CL: Clay with trace gravel and trace sand, same as interval from 0.8' to 1.3'. Moist.
5954		4			GP: Gravel/Cobbles, schist and quartzite cobbles (3/4" - 2" diameter, subangular) with gravel (1/4" - 1/2" diameter, subangular, composed of amphibolite (?)). Gravel is greenish gray (GLEY5/1).
					No recovery
5953					GC/CL: Sandy, Gravelly Clay with silt, dark brown (7.5YR3/2) clay matrix with ~30% gravel (1/4" - 3/4" diameter, subangular, composed of quartzite and schist). 5 - 10% sand (coarse grained,

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
					subangular to subrounded). Clay has medium plasticity. Moist. Shattered cobbles (1" - 2" diameter) at base of interval from 4.6' to 4.8'.
5952	Filter Pack, 16/40 Silica Sand	5			SC/CL: Silty, Sandy Clay with some gravel, brown (7.5YR4/3 to 7.5YR4/4). Sand and gravel increase at base of interval. ~35% sand from 5.1' to 5.4', sand is coarse grained, subangular. ~25% gravel (1/4" - 1/2" diameter, subangular) from 5.1' to 5.4'. Moist. Possibly fluvial in origin (?)
		6			No recovery.
5951	Screen Sch 40-PVC, 2 in ID, 0.010 in slots				
		7			SC/CL: Silty, Sandy Clay with some gravel, same as interval from 4.8' to 5.4'. Moist.
5950					SILTSTONE: TOP OF BEDROCK. Clayey Siltstone with some fine grained sand. Bedrock is gray (10YR6/1) with abundant yellowish brown (10YR5/6) mottling. Siltstone interbedded with claystone and fine grained sandy lenses. Some caliche as stringers and blebs throughout interval. Strong pervasive iron oxidation from 8.5' to 8.7' with ironstone fragments. Moist.
		8			
5949					
		9			
5948					SILTSTONE: Sandy Siltstone, grayish brown (10YR5/2) with light yellowish brown (10YR6/4) iron oxidation mottled throughout. Abundant very fine grained sand in siltstone. Friable. Caliche along internal bedding at 10.7'. Decreasing moisture to slightly moist.
		10			
5947					
		11			SILTSTONE: Clayey, Sandy Siltstone, yellowish brown (10YR5/6) with gray (10YR6/1) and light brownish gray (10YR6/2) mottling. Clayey lenses at 10.9' and from 11.65' to 11.8'. Black organic stringers associated with clayey lenses. Interval is friable and slightly fissile. Rip-up clasts common. Small healed fracture (45 deg) with iron oxidation at 11.95'. Abundant very fine grained sand from 11.2' to 11.4'. Slightly moist.
5946					
		12			
5945					SILTSTONE: Clayey Siltstone, yellowish brown (10YR5/6) with gray (10YR5/1) mottling from 12.4' to 13.0'. Color changes to brown (10YR5/3) from 13.0' to 14.0'. Decreasing very fine grained sand to trace. Black organic stringers common from 13.0' to 14.0'. Interval is competent, yet weak to moderately friable. Rip-up clasts common. Weak to moderate iron oxidation throughout. Slightly moist.
		13			
5944					
		14			

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5943					CLAYSTONE: Claystone with trace silt, gray (10YR5/1) with grayish brown (10YR5/2) and yellowish brown (10YR5/4) mottling. Weak to moderate pervasive iron oxidation. Some black organic stringers. Interval is firm and dense. Decreased moisture to very slightly moist.
		15			
5942					
		16			
5941					
		17			CLAYSTONE: Claystone, un-weathered, dark gray (2.5Y4/1) to gray (2.5Y5/1). Trace iron oxidation along internal fractures from 16.8' to 17.0', and at 17.0'. Interval is highly fissile and friable. Dry.
5940					
		18			
5939					
		19			No recovery.
5938					
		20			CLAYSTONE: Claystone, un-weathered, dark gray (2.5Y4/1). Dense and firm, weakly fissile, dry.
5937	Threaded End Cap - Sump, Sch				
		21			

STATE PLANE COORDINATES AREA:
NORTH: 747463.414
EAST: 2081942.494
PROJECT: Original Landfill
REMARKS:
Routine well installation

GRND ELEV. (FT): 5939.29
TOTAL DEPTH (FT): 20.15
COMPLETION DATE: 8/8/05
GEOLOGIST: E. Warp

CASING DIA (IN): 2"
BH DIA. (IN): 8"
GRID LOCATOR:

LOG OF BORING NUMBER: 80105

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5942	Protective Casing, Steel, 6 in ID. Casing, Sch 40-PVC, 2 in. ID	3			
5941		2			
5940		1			
5939		0			GC/CL: Gravel/Sandy Clay with silt mixture. Imported Qalrf fill. Strong brown (7.5YR4/6). 20 - 25% gravel (1/8" - 1" diameter, subrounded to subangular), predominately quartzite with less schist and granite. 20% sand (coarse grained, subangular to subrounded). Clay has medium plasticity. Dark brown (7.5YR3/2) clay lense from 0.4' to 0.5'. Disseminated caliche, tiny white specks common throughout interval. Moist.
5938		1			No recovery.
5937		2			GC/CL: Gravel/Sandy Clay with silt mixture, same as interval from 0.0' to 1.2'. Moist.
5936	Hydrated Bentonite Chips	3			No recovery
5935	Filter Pack, 16/40 Silica Sand	4			CL: Gravelly, Sandy Clay, dark brown (7.5YR3/2). Distinct color change. ~10% sand (coarse grained, subangular), 5 - 8% gravel (1/8" - 1/2" diameter, subrounded to subangular). Trace to some

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
					organic material (woodchips). Medium to high plasticity, very moist. Color change may indicate prior ground surface (before fill added).
		5			GC/CL: Gravelly, Sandy Clay, dark gray (7.5YR4/1) to brown (7.5YR4/4). ~30% sand (coarse grained, subangular), 20 - 25% gravel (1/8" to 1-1/2" diameter, subrounded to subangular). Possible fluvial deposit. Well graded, poorly sorted, very moist.
5934	Screen, Sch 40-PVC, 2 in ID. 0.010 in. slots				
		6			CL: Silty Clay. Re-worked bedrock. Light gray (10YR6/2) with brownish yellow (10YR6/6) mottling. Weak iron oxidation mottling. Trace caliche. [Very poor recovery, clay has been extruded like a "ribbon" due to a clogged cutting shoe.] Very moist.
5933					No recovery.
		7			CL: Silty Clay. Re-worked bedrock. Light gray (10YR7/1) with some light yellowish brown (10YR6/4) iron oxidation mottling. Trace alluvial clastics indicate not yet bedrock.
5932					CL: Clay with trace to some sand, gravel, and silt. Dark grayish brown (10YR4/2) with some light brownish gray (10YR6/2). 3 - 5% gravel (1/8" - 1/4" diameter), 3 - 5% sand (coarse grained, subangular). Weak to moderate iron oxidation mottled throughout. Very moist.
		8			SILTSTONE: TOP OF BEDROCK. Clayey Siltstone, gray (10YR6/1) with yellowish brown (10YR6/4) iron oxidation mottled throughout. Very subtle bedrock contact. [Very poor recovery, cutting shoe is clogged causing siltstone to appear "ribboned" in sample tube.] Very moist.
5931					No recovery.
		9			CLAYSTONE: Claystone, gray (10YR5/1) with yellowish brown (10YR5/6) mottling. Caliche blebs and stringers common throughout. Weak iron oxidation mottling. Massive texture. Moderately friable. Notable decrease in moisture to slightly moist.
5930					
		10			CLAYSTONE: Claystone, very dark gray (10YR3/1) to gray (10YR5/1). Massive texture. Abundant black organic stringers from 10.4' to 10.6'. Very rare caliche stringers. Moderately friable. No iron oxidation. Slightly moist.
5929					
		11			
5928					
		12			CLAYSTONE: Claystone, grayish brown (10YR5/2). Weak pervasive iron oxidation. Trace caliche blebs. Trace black organic material. Weakly friable. Organics or trace iron oxidation along internal fractures at 12.3', 12.6', and 13.4'. Decreased moisture to very slightly moist.
5927					
		13			
5926					

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
		14			
5925					SILTSTONE: Clayey Siltstone, light brownish gray (10YR6/2) with some light yellowish brown (10YR6/4) iron oxidation mottling throughout. Massive texture. Weakly friable. Trace black organic stringers. Trace iron oxidation on minor internal fractures at 15.1', 15.5', 15.8', and 16.3'. Trace moisture. Occasional rip-up clasts.
		15			
5924					
		16			
5923					
					No recovery.
		17			
5922					CLAYSTONE: Claystone, dark gray (10YR4/1) to very dark gray (10YR3/1). Very fissile, friable, and dry. Abundant black carbonaceous material from 18.0' to 18.5'.
		18			
5921					
		19			
5920					No recovery. Reamed with augers from 19.0' to 20.15'. Did not sample this interval.
		20	Threaded End Cap Sump. Sch 40-PVC		

STATE PLANE COORDINATES AREA: GRND ELEV. (FT): 5938.52 CASING DIA (IN): 2"
NORTH: 747535.636 TOTAL DEPTH (FT): 20.0 BH DIA. (IN): 8"
EAST: 2082324.443 COMPLETION DATE: 8/10/05 GRID LOCATOR:
PROJECT: Original Landfill GEOLOGIST: E. Warp
REMARKS:
Routine well installation

LOG OF BORING NUMBER: 80205

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5942	Protective Casing, Steel, 6 in ID.	4			
	Casing, Sch 40-PVC, 2 in. ID	3			
5941		2			
5940		1			
5939		0			
5938		1		GC/CL	GC/CL: Gravel/Sandy Clay with silt, strong brown (7.5YR4/6). 15 - 25% gravel (1/8" - 3/4" diameter, subrounded to subangular, predominately quartzite and granite). 20 - 25% sand (coarse grained, subangular). Clay has medium plasticity. Moist from 0.0' to 1.0'. Saturated, but not flowing, from 1.0' to 1.5'.
5937		2		CL	CL: Silty Clay with trace sand and trace gravel, dark brown (7.5YR3/2) with some yellowish brown (10YR5/4) mottling. Clay has medium plasticity. Granite clast (3/4" diameter, angular) at 1.7'. Saturated, but not flowing.
					No recovery
5936		3			CL: Clay with trace silt, trace gravel, and trace sand, brown (7.5YR4/3) from 2.0' to 2.2', yellowish brown (10YR5/4) to dark yellowish brown (10YR4/4) from 2.2' to 4.0'. Appears to be re-worked claystone bedrock (?). Interval is firm and dense but pliable due to moisture. Trace black organic stringers. Trace caliche blebs at base of interval. Roots and twigs common throughout. Gravel (1/4" - 1/2", subrounded) from 3.4' to 3.6', and at base of interval. Decreased moisture to very moist.
5935	Bentonite Chips	4			

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5934	Filter Pack. 16/40 Silica Sand; Screen, Sch 40-PVC, 2 in ID., 0.010 in. slots	4			CL: Clay (re-worked claystone), gray (10YR5/1) with trace yellowish brown (10YR5/6) mottling. Roots common throughout interval. Trace caliche blebs. Caliche stringer with iron oxidation halo at 5.1'. Slight color change from 5.9' to 6.7' to light brownish gray (10YR6/2) with faint mottling. Decreased moisture to moist.
5933		5			
5932		6			
		7			No recovery.
5931					CL: Clay with trace gravel (probably re-worked claystone), grayish brown (10YR5/2). Roots common. Soft and pliable. Saturated, free water from 7.6' to 8.0'. Gravel (1/2" diameter, subrounded) at 7.6' with trace iron oxidation in clay surrounding gravel clast.
5930		8			GC/CL: Gravelly Clay, dark brown (7.5YR3/3) with some strong brown (7.5YR5/6) iron oxidation at 8.15'. Strongly fractured and crumbly. 20 - 25% gravel (1/4" - 3/4" diameter, subrounded to subangular). Composition of gravel (?) - possible conglomerate, coated with iron oxide and manganese oxide. Interval is saturated with free water.
5929		9			CLAYSTONE: TOP OF BEDROCK. Claystone (bedrock) - possibly re-worked. Grayish brown (10YR5/2) to gray (10YR5/1) with minor yellowish brown (10YR5/6) mottling. Roots common. Trace caliche stringers. Interval competent from 8.35' to 9.0'; friable from 9.0' to 9.45'. Distinct decrease in moisture to very moist, further decreasing to moist at base.
5928		10			CLAYSTONE: Claystone, grayish brown (10YR5/2) to gray (10YR5/1) with trace brownish yellow (10YR6/8) iron oxidation mottling throughout. Massive texture. Interval is moderately friable. Slightly moist.
5927		11			
		12			No recovery.
5926					CLAYSTONE: Claystone, pale brown (10YR6/3). Massive texture. Trace iron oxidation along bedding planes. Silty lense (~1/8" thick) with iron oxidation at 13.8'. Firm and dense. Decreased moisture to very slightly moist. Trace silt at 12.5' and below.
		13			

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5925					
		14			CLAYSTONE: Claystone, gray (10YR5/1) to dark gray (10YR4/1). Massive textured. Trace iron oxidation along bedding planes (sub-horizontal). Disseminated caliche coating from 15.2' to 15.8' along vertical fracture with iron oxidation. Interval weakly friable. Trace black organic stringers. Decreased moisture to trace.
5924					
		15			
5923					
		16			
5922					
		17			
5921					
		18			CLAYSTONE: Claystone, dark gray (10YR4/1) to very dark gray (10YR3/1). Massive texture. Moderately fissile and friable. No iron oxidation. Trace moisture to dry.
5920					
		19			
5919					
		20	Conical Threaded End Cap - Sump, Sch 40-PVC		

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APPENDIX C

LIST OF ANALYTES

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RFCA Attachment 5 Analytes by Method - Surface Water

Method 353.2 - Nitrate

Analyte	CAS Reference Number	Notes
Nitrate	14797-55-8	

Method 7470A - Hg

Analyte	CAS Reference Number	Notes
Mercury, total	7439-97-6	

Method 6010B - Metals

Analyte	CAS Reference Number	Notes
Aluminum, dissolved	7429-90-5	
Antimony, total recoverable	7440-36-0	
Arsenic, total recoverable	7440-38-2	
Barium, total recoverable	7440-39-3	
Beryllium	7440-41-7	
Boron, total	7440-42-8	
Cadmium, dissolved	7440-43-9	
Chromium, Total Recoverable	7440-47-3	6010B chromium (total recoverable; 7440-47-3) compared to Cr III (16065-83-1) in RFCA
Copper, dissolved	7440-50-8	
Lead, dissolved	7439-92-1	
Manganese	7439-96-5	
Nickel, dissolved	7440-02-0	
Selenium	7782-49-2	
Silver, dissolved	7440-22-4	
Thallium	7440-28-0	
Zinc, dissolved	7440-66-6	

Method 8260B - VOCs

Analyte	CAS Reference Number	Notes
Acetone	67-64-1	
Acrolein	107-02-8	
Acrylonitrile	107-13-1	
Benzene	71-43-2	
Bromodichloromethane	75-27-4	
Bromoform [Tribromomethane]	75-25-2	
Bromomethane [Methyl Bromide]	74-83-9	
2-Butanone [Methylethyl ketone]	78-93-3	
Carbon disulfide	75-15-0	
Carbon tetrachloride	56-23-5	
Chlorobenzene	108-90-7	
Chloroethane	75-00-3	
Chloroform [Trichloromethane]	67-66-3	
Chloromethane [Methyl chloride]	74-87-3	
Chlorodibromomethane	124-48-1	8260B chlorodibromomethane compared to RFCA dibromochloromethane (same CAS)
1,2-Dibromo-3-chloropropane	96-12-8	
1,2-Dichlorobenzene	95-50-1	
1,3-Dichlorobenzene	541-73-1	
1,4-Dichlorobenzene	106-46-7	
1,1-Dichloroethane	75-34-3	
1,2-Dichloroethane	107-06-2	
1,1-Dichloroethene	75-35-4	
1,2-Dichloroethene (cis)	156-59-2	
1,2-Dichloroethene (trans)	156-60-5	
1,2-Dichloropropane	78-87-5	
trans- 1,3-Dichloropropene	10061-02-6	8260B for CAS# 10061-02-6; compare to RFCA 1,3-dichloropropylene (542-75-6)
Ethylbenzene	100-41-4	
Ethylene dibromide [1,2-Dibromomethane]	106-93-4	
Hexachlorobutadiene	87-68-3	
Hexachloroethane	67-72-1	
Methylene chloride [Dichloromethane]	75-09-2	
4-Methyl-2-pentanone [Isopropoacetone]	108-10-1	

Naphthalene	91-20-3	
Nitrobenzene	98-95-3	
Nitrosodibutylamine N	924-16-3	
Styrene	100-42-5	
1,1,2,2-Tetrachloroethane	79-34-5	
Tetrachloroethene	127-18-4	
Toluene	108-88-3	
1,2,4-Trichlorobenzene	120-82-1	
1,1,1-Trichloroethane	71-55-6	
1,1,2-Trichloroethane	79-00-5	
Trichloroethene	79-01-6	
Vinyl chloride	75-01-4	
o-xylene	95-47-6	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7
m-xylene	108-38-3	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7
p-xylene	106-42-3	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7

Method 8270C - SVOCs

Analyte	**CAS Reference Number**	**Notes**
Acenaphthene	83-32-9	
Acenaphthylene	208-96-8	
Aldrin	309-00-2	
Anthracene	120-12-7	
Benzidine	92-87-5	
alpha-BHC	319-84-6	
beta-BHC	319-85-7	
gamma-BHC [Lindane]	58-89-9	
Benzo(a)anthracene	56-55-3	
Benzo(a)pyrene	50-32-8	
Benzo(b)fluoranthene	205-99-2	
Benzo(g,h,i)perylene	191-24-2	
Benzo(k)fluoranthene	207-08-9	
Butylbenzylphthalate	85-68-7	

Carbofuran	1563-66-2	
Chlordane	57-74-9	8270C for chlordane (57-74-9); compared to RFCA cis-chlordane (5103-71-9)
bis(2-Chloroethyl)ether	111-44-4	
bis(2-Chloroisopropyl)ether	108-60-1	8270C for 108-60-1, which is a.k.a. "bis(2-…", compare to RFCA CAS# 39638-32-9
4-Chloro-3-methylphenol	59-50-7	
2-Chloronaphthalene	91-58-7	
2-Chlorophenol	95-57-8	
Chrysene	218-01-9	
4,4-DDD	72-54-8	
4,4-DDE	72-55-9	
4,4-DDT	50-29-3	
Demeton-S	126-75-0	8270C for 126-75-0 (demeton-S) and 298-03-3 (demeton-O); compare sum to RFCA demeton (8065-48-3)
Demeton-O	298-03-3	8270C for 126-75-0 (demeton-S) and 298-03-3 (demeton-O); compare sum to RFCA demeton (8065-48-3)
Dibenzo(a,h)anthracene	53-70-3	
Di-n-butylphthalate	84-74-2	
3,3-Dichlorobenzidine	91-94-1	
2,4-Dichlorophenol	120-83-2	
Dieldrin	60-57-1	
Diethylphthalate	84-66-2	
2,4-Dimethylphenol	105-67-9	
Dimethylphthalate	131-11-3	
4,6-Dinitro-2-methylphenol	534-52-1	
2,4-Dinitrophenol	51-28-5	
2,4-Dinitrotoluene	121-14-2	
2,6-Dinitrotoluene	606-20-2	
Dinoseb	88-85-7	
1,2-Diphenylhydrazine	122-66-7	
Endosulfan I	959-98-8	8270C for endosulphan I (959-98-8); compare to RFCA endosulphan alpha (95-99-88)
Endosulfan II	33213-65-9	8270C for endosulphan II (33213-65-9); compare to RFCA endosulphan beta (3321-36-59)
Endosulfan sulfate	1031-07-8	
Endrin (technical)	72-20-8	

Endrin aldehyde	7421-93-4	
bis(2-Ethylhexyl)phthalate	117-81-7	
Fluoranthene	206-44-0	
Fluorene	86-73-7	
Azinphos-methyl	86-50-0	8270C for Azinphos-Methyl (86-50-0); compare to guthion (86-50-0) in RFCA
Heptachlor	76-44-8	
Heptachlor epoxide	1024-57-3	
Hexachlorobenzene	118-74-1	
Hexachlorocyclopentadiene	77-47-4	
Indeno(1,2,3-cd)pyrene	193-39-5	
Isophorone	78-59-1	
Malathion	121-75-5	
Methoxychlor	72-43-5	
2-Methylphenol [o-Cresol]	95-48-7	
Mirex	2385-85-5	
Nitrophenol 4	100-02-7	
Nitrosodiethylamine N	55-18-5	
Nitrosodimethylamine N	62-75-9	
n-Nitrosodiphenylamine	86-30-6	
n-Nitrosodipropylamine	621-64-7	
Nitrosopyrrolidine N	930-55-2	
Parathion	56-38-2	
Pentachlorobenzene	608-93-5	
Pentachlorophenol	87-86-5	
Phenanthrene	85-01-8	
Phenol	108-95-2	
Pyrene	129-00-0	
1,2,4,5-Tetrachlorobenzene	95-94-3	
Toxaphene	8001-35-2	
2,4,6-Trichlorophenol	88-06-2	

RFCA Attachment 5 Analytes by Method - Groundwater

Method 353.2 - Nitrate

Analyte	CAS Reference Number	Notes
Nitrate	14797-55-8	

Method 7470A - Hg

Analyte	CAS Reference Number	Notes
Mercury, total	7439-97-6	

Method 6010B - Metals

Analyte	CAS Reference Number	Notes
Aluminum	7429-90-5	
Antimony	7440-36-0	
Arsenic	7440-38-2	
Barium	7440-39-3	
Beryllium	7440-41-7	
Cadmium	7440-43-9	
Chromium (total)	7440-47-3	
Cobalt	7440-48-4	
Copper	7440-50-8	
Lead (dissolved)	7439-92-1	
Lithium	7439-93-2	
Manganese	7439-96-5	
Molybdenum	7439-98-7	
Nickel	7440-02-0	
Selenium	7782-49-2	
Silver	7440-22-4	
Strontium	7440-24-6	
Thallium	7440-28-0	
Tin	7440-31-5	
Uranium	7440-61-1	

Vanadium	7440-62-2	
Zinc	7440-66-6	

Method 8260B - VOCs

Analyte	CAS Reference Number	Notes
1,1,1-Trichloroethane	71-55-6	
1,1,2,2-Tetrachloroethane	79-34-5	
1,1,2-Trichloroethane	79-00-5	
1,1-Dichloroethane	75-34-3	
1,1-Dichloroethene	75-35-4	
1,2,4-Trichlorobenzene	120-82-1	
1,2-Dibromo-3-chloropropane	96-12-8	
1,2-Dichlorobenzene	95-50-1	
1,2-Dichloroethane	107-06-2	
1,2-Dichloroethene (total)	75-35-4	
1,2-Dichloropropane	78-87-5	
1,3-Dichlorobenzene	541-73-1	
1,4-Dichlorobenzene	106-46-7	
2-Butanone [Methylethyl ketone]	78-93-3	
4-Methyl-2-pentanone	108-10-1	
Acetone [c]	67-64-1	
Benzene	71-43-2	
Bromodichloromethane	75-27-4	
Bromoform [Tribromomethane]	75-25-2	
Bromomethane [Methyl bromide]	74-83-9	
Carbon disulfide	75-15-0	
Carbon tetrachloride	56-23-5	
Chlorobenzene	108-90-7	
Chloroethane	75-00-3	
Chloroform [Trichloromethane]	67-66-3	
Chloromethane [Methyl chloride]	74-87-3	
cis-1,3-Dichloropropene	10061-01-5	
Chlorodibromomethane	124-48-1	8260B chlorodibromomethane compared to RFCA dibromochloromethane (same CAS)
Ethylbenzene	100-41-4	

Hexachlorobutadiene	87-68-3	
Hexachloroethane	67-72-1	
Methylene chloride [Dichloromethane]	75-09-2	
Naphthalene	91-20-3	
Nitrobenzene	98-95-3	
Styrene	100-42-5	
Tetrachloroethene	127-18-4	
Toluene	108-88-3	
trans-1,3-Dichloropropene	10061-02-6	
Trichloroethene	79-01-6	
Vinyl acetate	108-05-4	
Vinyl chloride	75-01-4	
o-xylene	95-47-6	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7
m-xylene	108-38-3	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7
p-xylene	106-42-3	8260B for o- (95-47-6), m- (108-38-3), p- (106-42-3); compare sum to RFCA xylene (total) (1330-20-7

Method 8270C - SVOCs

Analyte	CAS Reference Number	Notes
2,4,5-Trichlorophenol	95-95-4	
2,4,6-Trichlorophenol	88-06-2	
2,4-Dichlorophenol	120-83-2	
2,4-Dimethylphenol	105-67-9	
2,4-Dinitrophenol	51-28-5	
2,4-Dinitrotoluene	121-14-2	
2,6-Dinitrotoluene	606-20-2	
2-Chloronaphthalene	91-58-7	
2-Chlorophenol	95-57-8	
2-Methylnaphthalene	91-57-6	
2-Methylphenol	95-48-7	
2-Nitroaniline	88-74-4	
3,3-Dichlorobenzidine	91-94-1	
4,4-DDD	72-54-8	

4,4-DDE	72-55-9	
4,4-DDT	50-29-3	
4,6-Dinitro-2-methylphenol	534-52-1	
4-Chloroaniline	106-47-8	
4-Methylphenol	106-44-5	
4-Nitrophenol	100-02-7	
Acenaphthene	83-32-9	
Aldrin	309-00-2	
alpha-BHC	319-84-6	
Anthracene	120-12-7	
Aroclor-1016	12674-11-2	
Aroclor-1221	11104-28-2	
Aroclor-1232	11141-16-5	
Aroclor-1242	53469-21-9	
Aroclor-1248	12672-29-6	
Aroclor-1254	11097-69-1	
Aroclor-1260	11096-82-5	
Benzo(a)anthracene	56-55-3	
Benzo(a)pyrene	50-32-8	
Benzo(b)fluoranthene	205-99-2	
Benzo(k)fluoranthene	207-08-9	
Benzoic Acid	65-85-0	
Benzyl Alcohol	100-51-6	
beta-BHC	319-85-7	
bis(2-Chloroethyl)ether	111-44-4	
bis(2-Chloroisopropyl)ether	108-60-1	8270C for 108-60-1, which is a.k.a. "bis(2-…", compare to RFCA CAS# 39638-32-9
bis(2-Ethylhexyl)phthalate	117-81-7	
Butylbenzylphthalate	85-68-7	
Chrysene	218-01-9	
Dibenzo(a,h)anthracene	53-70-3	
Dibenzofuran	132-64-9	
Dieldrin	60-57-1	
Diethylphthalate	84-66-2	
Dimethylphthalate	131-11-3	
Di-n-butylphthalate	84-74-2	
Endosulfan I	959-98-8	

Endosulfan II	33213-65-9	
Endosulfan sulfate	1031-07-8	
Endrin (technical)	72-20-8	
Fluoranthene	206-44-0	
Fluorene	86-73-7	
gamma-BHC [Lindane]	58-89-9	
Chlordane	57-74-9	8270C for chlordane (57-74-9); compared to RFCA gamma-chlordane (12789-03-6)
Heptachlor	76-44-8	
Heptachlor epoxide	1024-57-3	
Hexachlorobenzene	118-74-1	
Hexachlorocyclopentadiene	77-47-4	
Indeno(1,2,3-cd)pyrene	193-39-5	
Isophorone	78-59-1	
Methoxychlor	72-43-5	
n-Nitrosodiphenylamine	86-30-6	
n-Nitrosodipropylamine	621-64-7	
Pentachlorophenol	87-86-5	
Phenol	108-95-2	
Pyrene	129-00-0	
Toxaphene	8001-35-2	

DOE–LM/1592–2008

Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan U.S. Department of Energy Rocky Flats Site

March 2008

U.S. Department of Energy

Office of Legacy Management

Work Performed Under DOE Contract No. DE–AM01–07LM00060
for the U.S. Department of Energy Office of Legacy Management.
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DOE-LM/1592-2008

Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan U.S. Department of Energy Rocky Flats Site

March 2008

Work Performed by S.M. Stoller Corporation under DOE Contract No. DE–AM01–07LM00060
for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado

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Table 4−1. Groundwater Monitoring Wells at the PLF 31

Appendixes

Appendix A Present Landfill Inspection Form
Appendix B Groundwater Well Boring Logs/Construction Summaries

Acronyms and Abbreviations

CAD/ROD	Corrective Action Decision/Record of Decision
CCR	*Code of Colorado Regulations*
CDPHE	Colorado Department of Public Health and Environment
DOE	U.S. Department of Energy
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FML	flexible membrane liner
GCL	geosynthetic clay liner
GWIS	Groundwater Intercept System
IDW	investigation-derived waste
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
IMP	Integrated Monitoring Plan
LM	Legacy Management
M&M Plan	Monitoring and Maintenance Plan and Post-Closure Plan
OU	Operable Unit
PLF	Present Landfill
PLFTS	Present Landfill Treatment System
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFLMA	Rocky Flats Legacy Management Agreement
RL	reporting limit
UHSU	upper hydrostratigraphic unit
VOC	volatile organic compound

End of current text

1.0 Introduction

This Monitoring and Maintenance Plan and Post-Closure Plan (M&M Plan) applies to the Present Landfill (PLF) (historical Individual Hazardous Substance Site [IHSS] 114) at the Rocky Flats Site (Rocky Flats). This PLF M&M Plan is a modification of the original PLF M&M Plan, approved in May 2006 as described further in this section, below.

The PLF M&M Plan fulfills the requirements for a post-closure plan in 6 *Code of Colorado Regulations* (CCR) 1007-3 §265.118 and the requirements of 6 CCR 1007-3 §265.121(a)(3).[1]

Under the Final Interim Measure/Interim Remedial Action (IM/IRA) for IHSS 114 and Resource Conservation and Recovery Act (RCRA) Closure for the Present Landfill (DOE 2004, DOE 2006a), a RCRA Subtitle C-compliant cover was selected to address closure of the PLF. The cover is a geosynthetic composite cover with a rock layer to deter burrowing animals and a 2-foot-thick topsoil layer, and includes installation of perimeter drainage channels to control surface water run-on and runoff around the PLF cover. The closure also included modification of the existing PLF Seep Treatment System (PLFTS). Construction of the PLF cover included removing sediments from the East Landfill Pond, drying the sediments, and placing the dried sediments under the PLF cover. Construction was completed in May 2005, with a minor drainage modification on the PLF east face completed in August 2005.

The original PLF M&M Plan was approved in May 2006, prior to the September 2006 Corrective Action Decision/Record of Decision (DOE, EPA and CDPHE 2006) (CAD/ROD) for Rocky Flats. Pursuant to the CAD/ROD Rocky Flats was configured into two Operable Units (OUs). The Central OU consolidates all areas of Rocky Flats that have remaining hazardous substance contamination and require additional remedial actions, including the PLF. The Peripheral OU surrounds the Central OU and includes the other generally unaffected portions of Rocky Flats that served as a buffer zone surrounding the former industrial area. Under the CAD/ROD, the final remedy is no action for the Peripheral OU, and institutional controls, physical controls, and continued monitoring for the Central OU.

The Rocky Flats Legacy Management Agreement (DOE, EPA, and CDPHE 2007) (RFLMA), signed by the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Colorado Department of Public Health and Environment (CDPHE), to implement the CAD/ROD became effective March 14, 2007. The PLF M&M Plan is incorporated by reference as an enforceable requirement of RFLMA (See RFLMA Attachment 2, "Legacy Management Requirements," Section 5.3.1). RFLMA terminated and superseded the Rocky Flats Cleanup Agreement (RFCA).

The May 2006 PLF M&M Plan referenced RFCA in certain sections. This modified M&M Plan is based on the outcome of consultation in accordance with RFLMA consultative process as documented in Regulatory Contact Record 2007-08, which was approved December 21, 2007. Therefore, this modified PLF M&M Plan revises the original PLF M&M Plan text as appropriate to recognize the implementation of the remedy under RFLMA. It also incorporates changes in inspection frequencies, completion of certain monitoring requirements that now may be phased

[1] 6 CCR 1007-3 §265.121is identified as an Applicable or Relevant and Appropriate Requirement in the CAD/ROD. Subsection (a)(3) refers to requirements for monitoring programs in 6 CCR 1007-3 §264.91 - §264.100.

out, clarification of vegetation inspection schedules and completion criteria, as anticipated in the original PLF M&M Plan.

Modifications to the PLF M&M Plan and to RFLMA requirements pertaining to the PLF monitoring and maintenance are subject to CDPHE review and approval in accordance with RFLMA Part 10, Amendment of Agreement and Modification of Attachments.

1.1 Purpose

The PLF M&M Plan is designed to meet the following objectives:

1. Describe the procedures to maintain the integrity and effectiveness of the final cover, including making repairs as necessary (Section 3.0);
2. Describe the features to maintain and monitor the groundwater monitoring system (Section 4.0); and
3. Present the PLFTS and East Landfill Pond Environmental Monitoring Plan (Section 5.0).

For consistency and simplicity, when specific evaluations and follow-up actions related to these objectives are contained in RFLMA requirements, the PLF M&M Plan refers to the RFLMA requirements.

1.2 Facility Location and Units

Rocky Flats is a government-owned facility formerly used for the fabrication of miscellaneous weapons components for national defense. Rocky Flats is located in Jefferson County, Colorado, approximately 16 miles northwest of Denver (Figure 1−1). The Central OU comprises approximately 1,309 acres situated in the central portion of the former Rocky Flats Environmental Technology Site. The PLF is located within the northern portion of the Central OU, as shown on Figure 1−2.

1.3 Site Operations

The PLF is located in the No Name Gulch drainage, at the western limit of headward erosion and pediment dissection. Beginning in 1968, a portion of the natural drainage at the headwaters of the No Name Gulch drainage was filled with soil from an on-site borrow area to a thickness of approximately 5 feet to construct a surface on which to begin landfilling operations. The PLF does not have a bottom liner. Waste delivered to the PLF was spread across the work area, compacted, and covered with a daily soil cover, eventually filling the valley to the top of the pediment. The PLF eventually consumed the West Landfill Pond; the East Landfill Pond is still present.

The PLF remained in operation until March 1998, at which time it was placed in a contingent closure status and seeded to stabilize soil and control erosion. Final closure was completed in 2005, in accordance with the PLF IM/IRA. The PLF occupies an area of approximately 20 acres. Waste material is generally thinnest along the boundaries and thickest along the east-west axis of the PLF. Thicknesses range from less than 1 foot to approximately 40 feet near the eastern face of the PLF.

Additional information can be found in the PLF IM/IRA.

2.0 Site Physical Description

This section describes the physical conditions at the PLF site such as topography, hydrology, climate and precipitation, hydrogeology, and site features, which include the final cover, the stormwater management system, the RCRA groundwater monitoring network, the PLFTS, and the East Landfill Pond.

2.1 Topography

The final topography of the PLF is as shown on the post-construction survey (Figure 2−1). The slopes of the landfill cover are generally between 3 to 5 percent in accordance with EPA guidance for landfill covers (EPA 2002). The east face of the PLF has a maximum slope of 4 horizontal to 1 vertical (4H:1V). Perimeter drainage channels were built to control surface water run-on and runoff and are sloped to drain to the east of the PLF below the East Landfill Pond dam. A diversion berm was built at the top of the east face to direct surface water into the perimeter channels. Two additional stormwater drainage channels were built to direct surface water at the toe of the east face.

2.2 Hydrology

The PLF is located within the No Name Gulch drainage. Perimeter channels have been constructed around the PLF to route stormwater off the cover and prevent run-on from the surrounding watersheds. On the northern side of the PLF, the western portion of the perimeter channel runs under a perimeter road through a culvert and east into a natural drainage that eventually joins the No Name Gulch drainage below (east of) the East Landfill Pond dam. The northeastern portion of the channel empties into the same natural drainage that eventually joins No Name Gulch below the East Landfill Pond dam. On the southern side of the PLF, the perimeter channel runs eastward above the East Landfill Pond and drops into the No Name Gulch drainage below the dam (Figure 2−1).

The Groundwater Intercept System (GWIS) was installed around the north, east, and south PLF perimeter in 1974 to reduce groundwater inflow to the PLF from the surrounding area. Two 900 foot soil-bentonite slurry walls were also installed on the north and south PLF perimeter in 1984 and tied into the north and south arms of the GWIS. The flow of groundwater from within the PLF to the north and south is also limited by the GWIS. Groundwater collected by the GWIS flows to the PLFTS.

A diversion berm constructed at the top of the east slope directs surface water from the cover away from the east face and into the perimeter channels. These channels and diversion berms limit runoff into the East Landfill Pond.

The East Landfill Pond covers approximately 2.5 acres. Recharge to the pond occurs from direct precipitation, groundwater discharge, PLFTS effluent, and surface water runoff from the surrounding hillslopes, including surface water discharge from the two riprap channels constructed on the east face of the PLF. Groundwater discharge is likely limited because of the relatively low hydraulic conductivity of the underlying weathered bedrock. At the discretion of DOE, the outlet valve in the dam may be left in the open position to limit the Pond water level,

resulting in a maximum surface water area of approximately 0.8 acre; or the valve may be closed to increase the associated wetland vegetation. Pond discharge via the emergency overflow spillway will only occur if and when the operations are changed or there is an abnormal condition.

2.3 Climate and Precipitation

Rocky Flats is located in the southern Rocky Mountains and has a continental, semiarid climate. The region is noted for large seasonal temperature variations, occasional dramatic short-term temperature changes, and strong, gusty winds that can exceed 100 miles per hour. Mean annual precipitation is approximately 15.5 inches, with approximately one-half of that amount occurring as snow.

2.4 Hydrogeology

In the area of the PLF, groundwater flows predominantly within the upper hydrostratigraphic unit (UHSU). The UHSU is composed of materials that include the Rocky Flats Alluvium, colluvium, Valley Fill Alluvium, and weathered bedrock (predominantly claystone). Unweathered bedrock is part of the lower hydrostratigraphic unit. The thickness of the weathered bedrock material varies considerably in the vicinity of the PLF, ranging from approximately 4 to 35 feet. In the past, the average depth to groundwater ranged from 5 to 15 feet in unconsolidated surficial deposits around the PLF.

2.5 Site Features

Site features at the PLF include the final cover, the stormwater management system, the RCRA groundwater monitoring network, the PLFTS, and the East Landfill Pond. Each of the site features is discussed in this plan. Monitoring procedures are provided in subsequent sections.

2.5.1 Final Cover

The final cover of the PLF includes the following components, beginning with the top layer:

- A 2-foot-thick soil layer to facilitate vegetation, route surface water, and protect the cover system below;
- A 1-foot-thick rock layer with soil in the interstices to deter burrowing animals from impacting the underlying geosynthetics;
- A 10-inch-thick rock cushion soil layer to protect the underlying geosynthetics from rocks;
- Geocomposite drainage net to act as a drainage layer to route infiltrating water off of the cover;
- Flexible membrane liner (FML) to act as an impermeable layer and prevent water infiltration to the waste material below;
- Geosynthetic clay liner (GCL) to act as a secondary impermeable layer and also to “heal” punctures in the FML by the swelling of the GCL; and
- A 6-inch-thick GCL cushion soil layer to protect the geosynthetics above. This layer also includes a barometric vent system to equalize atmospheric pressure under the cover.

Inspection and monitoring procedures to maintain the integrity and effectiveness of the final cover are included in Section 3.0.

2.5.2 Stormwater Management System

2.5.2.1 Introduction

The stormwater management plan is presented in Appendix H of the Present Landfill Design Submittal (Earth Tech, Inc. 2004). This appendix presents the results of calculations used to determine the stormwater run-on and runoff volumes to adequately design the perimeter channels and culverts. The calculations use a 100-year, 24-hour storm event and check the capacity of this design to handle a 1,000-year, 24-hour storm event. The contributing area for storm events is approximately 54 acres.

2.5.2.2 Applications

Effective stormwater management is achieved in the system by applying the following principles:

- Protect the land surface from erosion;
- Manage run-on and runoff, keeping velocities low; and
- Inspect and maintain the erosion and stormwater management practices (discussed in Section 3.0).

2.5.2.3 Erosion Control

Stormwater management features at the PLF have been designed with erosion control features to limit both short-term and long-term erosion (Figure 2−1). Erosion control is any practice that protects soil surfaces and prevents the soil particles from being detached by rainfall or wind. The PLF cover is covered with a NAG C125 temporary erosion mat and the cover sideslopes, perimeter channel bottom, perimeter channel sideslopes, and diversion berms are all covered with a NAG SC150 temporary erosion control mat. These mats have a design life of approximately 3 years, depending on weather conditions. This will limit short-term erosion until vegetation is established. Portions of the perimeter channel with steeper slopes are lined with riprap, a more robust erosion control measure. The diversion berm outfalls to the perimeter channel are also lined with riprap to prevent scouring. The cover of the cap has been seeded, mulched, and covered with erosion matting to limit erosion until vegetation is established. The east face and portions of the diversion berms have a more permanent erosion control mat (NAG C350) because the slope is longer and is more susceptible to erosion. Vegetation will also reduce erosion on the east face.

2.5.2.4 Run-on and Runoff Control

The PLF stormwater management system has two purposes:

- To collect, route, and discharge stormwater run-on and runoff while minimizing unnecessary ponding and subsequent infiltration into the cover; and
- To control erosion and sediment transport.

Run-on stormwater is conveyed from west of the PLF as overland flow and in intermittent, grassed waterways, and then enters the perimeter channel. Other run-on is from overland flow from the contributing areas on the non-PLF sides of the perimeter channel.

Runoff enters the perimeter channel from overland flow on the cover as well as grassed waterway flow from the diversion berms constructed on the top of the slope at the east face.

2.5.3 RCRA Groundwater Monitoring Network

Six RCRA monitoring wells are used for groundwater monitoring at the PLF as discussed in Section 4.0. Three RCRA wells are upgradient and three RCRA wells are downgradient of the PLF.

2.5.4 PLF Seep

A seep, known as the PLF seep, exists at the eastern end of the PLF. As part of final closure, subsurface strip drains were placed below the east face cover to collect water under the east face cover including the seep and route the water to the PLFTS. The PLFTS replaced a similar seep treatment system installed in 1996. This new PLFTS also collects and treats groundwater (if any) from the GWIS and flow from the east face subsurface strip drains. As part of the construction supporting the PLF closure, the existing GWIS pipelines were routed to the PLFTS (See Figure 5−1). Concentrations of most contaminants in the PLF seep have been reported below the RFLMA surface water standards; however, a few constituents may exceed these levels. Monitoring is discussed in Section 5.0.

2.5.5 East Landfill Pond

The East Landfill Pond will remain and receive treated water from the PLFTS and surface water from the east face and surrounding hillsides, as well as precipitation falling directly into the Pond. Monitoring of the Pond is discussed in Section 5.0.

2.5.6 Access Controls

Access controls will be maintained in accordance with the RFLMA requirements for physical controls, including signs. RFLMA requirements meet the intent of warning signs in accordance with 6 CCR 1007-3 §265.14.

3.0 Final Cover and Stormwater Management System Inspection and Monitoring

This section outlines the inspection and monitoring program to be undertaken at the PLF to ensure that the integrity of the cover is not compromised and continues to function as designed. Inspection and monitoring tasks include surface water and groundwater monitoring, monitoring and inspection of subsidence/consolidation, slope stability, soil cover, vegetation, stormwater management structures, and erosion in surrounding features so that maintenance actions can be taken in a timely manner.

DOE will follow RFLMA requirements for informing the other RFLMA Parties of any RFLMA reportable conditions resulting from conducting the inspection and monitoring program described in this PLF M&M Plan. Final plans and schedules for mitigating actions, if any, will be developed and approved in accordance with RFLMA requirements.

3.1 Inspection Procedures

The frequency for each inspection and monitoring item will be conducted as specified in RFLMA. Modifications to the inspection program, including inspection frequency, will be evaluated using the RFLMA consultative process, and approved as specified by RFLMA modification requirements. More frequent inspection may occur any time conditions warrant.

In accordance with the IM/IRA (DOE 2006a), to maintain integrity and effectiveness of the final cover, site inspections of the area will be conducted on a regular, periodic basis following construction of the final cover. In addition to regularly scheduled inspections, weather-related inspections will be conducted as follows:

- The PLF will be inspected after a storm event of 1 inch or more of rain in a 24-hour period; and
- The PLF will be inspected after significant melt of an accumulation of snow greater than 10 inches (assuming 10 inches of snow is equivalent to 1 inch of water).

Inspections will be performed by qualified personnel and reviewed by a competent professional. Inspections will encompass the following subjects, as described in Sections 3.2 through 3.8: subsidence/consolidation, slope stability, soil cover, vegetation, stormwater management structures, run-on erosion controls, and institutional controls and related matters. Inspections will be performed using a prescribed form containing a checklist of items that documents the evaluation of site conditions. The inspection form is presented in Appendix A. The inspection form will be signed and dated by the inspector and the reviewer. The findings and observations of the site inspection will be entered on the form and presented in an annual PLF monitoring report, as described in Section 6.1. Minor repairs or maintenance may be performed in conjunction with the inspection and will be noted on the inspection form.

3.2 Subsidence/Consolidation

Subsidence and consolidation at the PLF largely depend on how well the waste, cover, and fill were compacted when placed, and the waste thickness, age, rate of degradation, and composition. Waste subsidence or continued consolidation may result in differential settlement which generally occurs when one area of waste settles more readily than another because of differences in waste composition, degradation, compaction, thickness, and moisture content. Differential settlement across the PLF may create cracks on the surface, which would allow precipitation to infiltrate more easily. Differential settlement can also change the topography of the PLF and create areas on the surface where ponding of water can occur. Localized waste subsidence can manifest itself in the form of cracks, depressions, and sinkholes. Construction of the final cover system included placement of engineered fills and repair of unsuitable areas. In addition, the waste was compacted when placed, and decomposition is nearly complete as

indicated by measurement of PLF gases. Therefore, cover subsidence or consolidation is of little concern. Nevertheless, differential settlement may occur.

3.2.1 Monitoring Locations and Procedures

Subsidence/consolidation monitoring will be conducted to evaluate actual settlement compared to the expected settlement calculated in the final design and to observe areas of water ponding on the PLF surface or other indicators of differential settlement. Subsidence/consolidation at the PLF will be monitored by visually inspecting the surface of the PLF cover for cracks, depressions, heaving, and sinkholes. Visual inspections will involve traversing the PLF to gain perspective on regions of the PLF (i.e., every square foot of the PLF will not be inspected). In addition, the settlement plates (monument locations) were installed as shown on Figure 2−1. For each monument location, the calculated settlement from the final design will be established to be compared to measured settlement. (There is no calculated settlement plate data for plates H and I; these locations will be monitored for settlement trends based on their initial survey coordinates.) Areas of observed differential settlement, including ponding, will be staked, photographed, measured, and located on the PLF site map prior to any maintenance action. Survey Control Point 1006 (shown on Figure 2−1) will be maintained as the control for surveying the PLF.

3.2.2 Maintenance Activities

The maintenance actions that will normally occur to correct the effect of adverse differential settlement are to place additional soil and regrade the affected area. This action will eliminate the potential for ponding and/or correct the slope of the surface. Maintenance that addresses differential settlement will be photographed, and the area will be measured and located on the PLF site map. Replacement soil will be Rocky Flats Alluvium meeting the specifications in the Accelerated Action Design. This requirement will be met by stockpiling appropriate soil, identifying appropriate borrow locations, or ensuring that a supplier meets the specifications.

Settlement plate data will be tabulated and the measured settlement will be compared to the anticipated settlement calculated in the final design. Should measured settlement exceed 30 percent of the calculated maximum settlement and be expressed as differential settlement, the area will be photographed, located on the PLF site map, as described above, repaired, and reported in the inspection reports. Should the measured settlement exceed 90 percent of the calculated maximum settlement and be expressed as differential settlement, a qualified geotechnical engineer will be consulted to determine a maintenance action and the results of the geotechnical engineer's evaluation will be reported by DOE to CDPHE. The area(s) where maintenance actions have taken place will be specifically inspected and reported during subsequent periodic inspections of the cover for as long as detailed follow-up evaluation is needed to monitor any continued subsidence. DOE will follow RFLMA requirements for reportable conditions if differential settlement or localized subsidence appears to be substantial and likely to influence the integrity, and thus the effectiveness, of the existing cover and surface water drainage over the PLF after taking these maintenance actions.

3.3 Slope Stability

Some areas of the PLF site may be susceptible to instability due to lateral movement. Slope failures can be caused by the weight of the wastes and cover material, steeply regraded slopes, and seepage forces resulting from water infiltration. Seismic forces can also cause slope failures. Steep slopes produce less stable conditions and are more susceptible to failure. Slope failures can also occur within the waste mass, resulting in downslope sliding of the cover components. The cover system has been designed and constructed with applicable safety factors to guard against slope failure. Nevertheless, slope stability will be monitored to verify that slope failure is not in progress. In addition, if areas of slope stability concerns are found outside the boundaries of the PLF footprint but within the general area of the PLF, the area of the inspection will be expanded to include these areas.

3.3.1 Monitoring Locations and Procedures

Slope stability at the PLF will be monitored by visually inspecting the cover system sideslopes, perimeter channel sideslopes, east face slope, and area above the GWIS pipeline that was rerouted to the PLFTS (outside the PLF closure boundary) for signs of cracks, evidence of block failure, and evidence of circular failure. The inspection will categorize the observed cracking. Visual inspection will involve traversing the slope to gain a perspective of the entire slope. Particular attention will be provided at the drainage divide where the east (central) area meets both the north and south areas of the east face. Any areas where a surface seep is identified will be photographed, marked, located on the PLF site map, and monitored for signs of slope instability. Areas identified during the inspections as potential slope stability concerns will be photographed, located on the PLF site map, and staked for further monitoring. If adverse surface water flow into cracks is likely, actions such as filling the cracks or controlling surface water flows will be taken to prevent surface water from entering the cracked area. DOE will follow RFLMA requirements for reportable conditions if further monitoring indicates a continued stability concern after taking these maintenance actions and will consult a qualified geotechnical engineer.

In addition to the visual inspections, several sideslope monitoring points were placed on the east face slope and will be monitored for vertical and horizontal movement. These will be visually inspected on each field inspection and surveyed at the same frequency as the settlement plates. Observations gathered will be combined with the other inspection data to evaluate the overall performance of the east face.

3.3.2 Maintenance Activities

Based on the site monitoring data and consultation with a qualified geotechnical engineer, maintenance actions will be taken to address any potential slope failure at the PLF that would likely compromise the remedy. The actions may include, but not be limited to, regrading affected areas, filling areas, maintaining positive drainage of surface water, creating slopes ranging from 2 to 5 percent on top of the waste, and regrading steep sections to achieve sideslopes no greater than 4:1. Areas where maintenance actions have taken place will be closely monitored and documented for further slope stability concerns. DOE will follow RFLMA requirements for reportable conditions if inspections show continued slope stability concerns in an area of the PLF closure after taking these maintenance actions.

3.4 Soil Cover

The cover system at the PLF was designed and installed to meet the minimum soil erosion requirements from both water and wind erosion. During the post-closure period, it is important to ensure that both temporary and permanent erosion controls are functioning properly. Regardless, the soil cover thickness may change over time due to wind and water erosion. Subsidence due to waste settlement and lateral movement of wastes or slopes may also contribute to changes in differential soil cover thickness. Monitoring of the soil cover is conducted to verify the cover is performing in accordance with the design and the PLF system as a whole continues to meet performance objectives.

3.4.1 Monitoring Locations and Procedures

Monitoring of the soil cover at the PLF includes the following:

- Visually inspecting the soil cover for erosion or deposition areas;
- Visually inspecting the soil cover for signs of burrowing animals; and
- Visually inspecting the diversion berm, diversion berm outfalls, and the east face for erosion rills or excessive deposition.

Visual inspection involves traversing the slope to gain perspective of the entire area. Particular attention will be provided at the drainage divide where the east (central) area meets both the north and south areas of the east face. Signs of rill and gully erosion will be photographed, marked with stakes, measured, located on the PLF site map, and reported on the inspection form. Additionally, areas of observed soil deposition will also be photographed, marked, measured, located on the PLF site map, and reported on the inspection form.

3.4.2 Maintenance Activities

If monitoring indicates significant loss of soil over time, maintenance actions will be taken. If a gully is measured at equal to or more than 6 inches deep, maintenance actions will be implemented. The actions may include, but not be limited to, soil replacement, regrading the affected areas to match adjacent grades, and removing and relocating any deposited eroded soils (if necessary). The regraded areas will be vegetated to prevent further erosion. Erosion control measures will be implemented to prevent further erosion of cover soils (e.g., erosion control mat and/or revegetation), if necessary. The amount of soil used to fill areas of erosion will be estimated, recorded, and reported in the quarterly monitoring report. DOE will follow RFLMA requirements for reportable conditions if soil erosion concerns persist after taking these maintenance actions. Areas of soil deposition that hinder the flow of surface water in a stormwater channel will be removed to maintain the designed channel configuration and flow capacity. Maintenance of these areas will also be documented and reported in the quarterly report.

3.5 Vegetation

Vegetation is important at the PLF to aid with short-term and long-term erosion control although the design calculations have shown that the materials used for construction are resilient to water

and wind erosion. The approved PLF IM/IRA (Section 5.1) states: “Additionally, surface vegetation will be established on this soil layer to enhance resistance to surface erosion, prevent intrusion of noxious weeds and burrowing animals, and to provide an aesthetic appearance to the cover, using appropriate native seed mixes.” Section 6.1.1 of the PLF IM/IRA also states: “Vegetation of a soil cover is planned to further reduce erosion, although vegetation and weed control measures will be employed to maintain a healthy stand of vegetation consistent with the wildlife refuge end-state.” Vegetation inspections will ensure that vegetation is established properly. Maintenance of the cover vegetation will be consistent with the Revegetation Plan (DOE 2005a) and the Vegetation Management Plan (DOE 2006b) for site-wide vegetation management.

3.5.1 Monitoring Locations and Procedures

Vegetation at the PLF will be monitored by visual inspection by traversing the cover and visually inspecting for the health of the vegetation and for unwanted vegetation such as weeds. In addition, the vegetation at the PLF will be monitored annually as described in the Revegetation Plan. Once the success criteria listed below (from the Revegetation Plan) have been met, quantitative vegetation monitoring will be discontinued. The major goals of the plan are:

Quantitative grassland success criteria:

1. A minimum of 30 percent relative foliar cover of live desired species (seeded native species and/or non-seeded native species).
2. A minimum of 60 percent total ground cover comprised of litter cover, current year live vegetation basal cover, and rock cover.
3. A minimum of 50 percent of the seeded native species will be present at the revegetation site.
4. No single species will contribute more than 45 percent of the relative foliar cover (except in areas where dominance by a single species is appropriate for long-term wildlife and habitat management objectives).

Noxious weeds criteria:

1. Noxious weeds will be evaluated on a species-specific basis, and weed control will be employed as necessary using appropriate strategies in the Vegetation Management Plan to achieve the success criteria listed above.

3.5.2 Maintenance Activities

If visual inspections indicate vegetation concerns on the cover, maintenance action will be taken. Actions may include, but not be limited to, the following:

- Reseeding of the soil cover;
- Spot herbicide applications;
- Maintenance/repair of erosion controls; and
- Removal of deep-rooting trees or shrubs growing in the cap and repair of the area.

Maintenance of the cover vegetation will be consistent with the Revegetation Plan and the Vegetation Management Plan for site-wide vegetation management. DOE will notify and consult with CDPHE should an area consistently show vegetation concerns to determine if this condition could result in a RFLMA reportable condition.

3.6 Stormwater Management Structures

Stormwater management will be required at the PLF to ensure that existing stormwater control structures (man-made drainage features) are functioning adequately to achieve the following objectives:

- Prevent run-on and runoff from eroding or damaging the cover; and
- Limit transport of sediment from the disturbed areas to off-site drainage ways.

Existing stormwater controls at the PLF include the following (Figure 2−1):

- Diversion berm;
- Diversion berm outfall-north;
- Diversion berm outfall-south;
- Culvert 1;
- Culvert 2;
- Southwest culvert outfall;
- Vegetation-lined perimeter channel-north;
- Vegetation-lined perimeter channel-south;
- Riprap-lined perimeter channel;
- East face riprap channel-north;
- East face riprap channel-south; and
- NAG C350-lined east face (hillside).

Details of each type of structure are included on Figure 3−1.

3.6.1 Monitoring Locations and Procedures

Stormwater management structures will be monitored visually by walking the structures and examining all components. Problem areas will be noted on the inspection form, graphically depicted, and photographed. At a minimum, these structures will be inspected for signs of excessive erosion, settlement, bank failure, breaching of the diversion berms, subsidence, burrowing animals, and blockage. Signs of potential problems include, but are not limited to, gullying, sediment buildup, and depressions.

The perimeter channel lining will be inspected for evidence of damage, displacement, undermining, scour, or deterioration. Repairs will be made to restabilize the channel in accordance with the design specifications. Permanent (extended term) erosion control mat lining on the east face will also be inspected. The erosion control mat will be inspected for holes, rips,

and separation. In addition, any evidence of erosion rills or gullies will be monitored during the inspection.

3.6.2 Maintenance Activities

If the inspections indicate that the existing stormwater management structures are not adequately controlling surface water run-on and runoff, maintenance actions will be taken.

As necessary, routine maintenance of the surface water controls will include removing any blockages, filling eroded areas, replacing erosion control mat, or repairing other disturbances. Sediment will be removed from the stormwater management structures to restore the design characteristics of the structure. Areas that exhibit excessive erosion may require placement of erosion control material or strengthening of the existing erosion control measures. DOE will follow RFLMA requirements for reportable conditions if stormwater management structures continue to show evidence they are not adequately controlling surface water run-on and runoff after taking these maintenance actions.

3.7 Run-On Erosion Control

Erosion control inspections will take place in natural drainages around the PLF to prevent excess sediment load to the PLF system and to ensure erosion is not problematic. Natural drainages and slopes around the PLF to be inspected for excess erosion as shown on Figure 2−1 include the following:

- Natural drainage fed by Culvert 1;
- Natural drainage fed by the northeast portion of the perimeter channel;
- Natural drainage fed by the south perimeter channel; and
- Natural area sideslopes of the perimeter channel.

The inspection will include areas where flows from the channels discharge to the existing downstream land surface.

3.7.1 Monitoring Locations and Procedures

The natural drainages will be visually monitored to identify signs of soil erosion that could adversely impact the PLF or conditions that may cause an overload on existing stormwater management structures.

3.7.2 Maintenance Activities

If inspections indicate soil loss, excessive disturbance in the areas, the presence of erosion gullies, or other evidence of erosion, maintenance action will be taken. The slope areas are more susceptible to water erosion in the event of high-intensity rainfall and are of particular concern. Actions may include placing additional soil, regrading, and seeding of the affected areas. Other erosion control measures that may be implemented include, but are not limited to, placing erosion mat, riprap, straw bale barrier(s), and silt fencing. DOE will follow RFLMA requirements for reportable conditions if areas consistently show signs of erosion after taking these maintenance actions.

3.8 Institutional Controls and Other Inspections

In addition to the inspection and monitoring activities discussed above, the PLF site inspection will include assessment of other items related to institutional controls, the condition of established monitoring points, and site security. DOE will follow RFLMA requirements for informing the other RFLMA Parties of any RFLMA reportable conditions related to institutional controls and other inspections.

3.8.1 Institutional Controls

Institutional controls are specified in RFLMA Attachment 2, Table 4, "Institutional Controls for the Central Operable Unit." These institutional controls are used to control access and restrict activities at the PLF to ensure the effectiveness of the engineered controls and the monitoring systems. PLF inspections will monitor conditions that violate the institutional controls or damage the physical controls. Inspections will be conducted to look for evidence of the following activities:

- Excavation(s) of the cover and in the immediate vicinity of the cover;
- Construction of roads, trails, or buildings on the cover;
- Drilling of wells or use of groundwater except for remedy-related purposes;
- Disruption or damage of the seep treatment system;
- Damage or removal of any signage or groundwater monitoring wells at the PLF;
- Evidence of unauthorized entry, including damage from vehicular traffic; and
- Damage from burrowing animals.

A checklist of these items is included on the inspection form found in Appendix A.

3.8.2 Condition of Monitoring Points

All established monitoring locations, such as monitoring wells and the seep treatment system or other items placed to assist inspection efforts, will be evaluated for ongoing integrity. The inspection will include documentation of any damage to the monitoring points that would impact their usefulness for inspections.

3.8.3 Site Conditions

During site inspections, signs, markers, and the overall condition of the PLF site will be checked to determine continuing effectiveness of institutional and physical controls.

3.8.4 Reporting and Record Keeping

Inspection forms and findings will be included in the annual PLF monitoring reports discussed in Section 6.1, which will be included in the annual reports specified in RFLMA Attachment 2, Section 7.0, "Periodic Reporting Requirements."

4.0 Groundwater Monitoring Plan

This section presents the plan to maintain and monitor the groundwater monitoring system for the PLF during the post-closure period.

4.1 Purpose and Requirements

The constituents monitored, frequency of monitoring, and other requirements of §264.98 and the IM/IRA are specified in RFLMA Attachment 2, as outlined in this section. RFLMA Attachment 2 requirements replaced the RFCA Integrated Monitoring Plan (IMP) requirements (DOE 2005b). The PLF groundwater monitoring plan has been implemented to determine groundwater quality impacts of the PLF pursuant to the detection monitoring requirements of 6 CCR 1007-3, §264.91(d) and §264.98. The groundwater monitoring will be used to evaluate upgradient versus downgradient groundwater quality at the PLF as set forth in RFLMA, Attachment 2.

4.2 Data Quality Objectives

The PLF groundwater monitoring data quality objectives (DQOs) were generally developed using EPA guidance documents. Quality assurance/quality control (QA/QC) requirements are specified in RFLMA Attachment 2, Section 5.0, “Monitoring Requirements.” Groundwater monitoring wells at the PLF are categorized in RFLMA as RCRA monitoring wells and monitoring results will be evaluated in accordance with RFLMA Attachment 2, Figure 10, “RCRA Wells,” which incorporates the DQO process.

4.3 Well Locations

Well locations were selected and approved by CDPHE and EPA. Six RCRA groundwater monitoring wells, three downgradient and three upgradient (Figure 2−1), are employed.

Upgradient monitoring wells include wells 70193, 70393, and 70693. Downgradient monitoring wells include wells 73005, 73105, and 73205. Monitoring well details are summarized in Table 4−1. Boring logs are included in Appendix B.

4.4 Sampling Procedures Summary

Groundwater sampling will be conducted in accordance with Legacy Management (LM) operational documents related to monitoring as provided in RFLMA Attachment 2, Section 5.0, “Monitoring Requirements.” Groundwater monitoring will include water level measurements, conventional groundwater purging and sampling, QC field samples, and proper equipment decontamination. Investigation-derived waste (IDW) (e.g., for purge and decontamination waters) will also be managed in accordance with the LM operational documents.

.

4.5 Laboratory Procedures Summary

Analytical methodologies and reporting limits (RLs), data reporting procedures, laboratory QA/QC procedures, and laboratory data validation and contractor validation procedures are to be conducted in accordance with EPA-approved methods. Groundwater samples will be submitted to an EPA-approved analytical laboratory for the following analyses:

- SW-846 Method 8260B—Volatile organic compounds (VOCs);
- SW-846 Method 6010B—Metals; and
- SW-846 Method 7470A—Mercury.

The remedy performance standards for surface water are in RFLMA Attachment 2, Table 1, "Surface Water Standards." Sampling criteria for surface water are presented in RFLMA Attachment 2, Table 2, "Water Monitoring Locations and Sampling Criteria." The analytical results obtained by these methods will be reported as described in Section 4.6.

Sample results are reported according to laboratory analytical method Standard Operating Procedures or contract specifications. The laboratory will report any analyte of interest detected at or above the RL as a positive value. Any analyte of interest not detectable or detected below the RL will be reported as "not detected" at the RL or an estimated value between the RL and the instrument or method detection limit. Data are generally reported in a tabular format or posted on maps and figures. RLs are adjusted for dilution when necessary.

4.6 Reporting and Schedule

Groundwater monitoring results will be included in the quarterly and annual reports specified in RFLMA Attachment 2, Section 7.0, "Periodic Reporting Requirements." The annual PLF monitoring reports, discussed in Section 6.1, will be included in the RFLMA annual reports.

5.0 Present Landfill Seep and East Landfill Pond Environmental Monitoring Plan

As part of PLF closure, the PLFTS, a passive seep interception and treatment system, was installed to treat PLF seep water and GWIS water. Effluent from the PLFTS eventually flows to the East Landfill Pond. This section presents the monitoring plan for PLFTS influent and effluent as well as the East Landfill Pond, as required by the DQO process, if PLFTS effluent exceeds RFLMA Attachment 2, Table 1, "Surface Water Standards."

5.1 Purpose and Requirements

The PLF Seep and East Landfill Pond Monitoring Plan is implemented to determine surface water quality impacts of the PLF. Sampling parameters, sampling frequency and applicable surface water standards are listed in RFLMA, Attachment 2, Table 1, "Surface Water Standards," and Table 2, "Water Monitoring Locations and Sampling Criteria." The decision framework for this sampling is found in RFLMA Attachment 2, Figure 11.

5.2 Data Quality Objectives

The PLF surface water monitoring DQOs were generally developed using EPA guidance documents. QA/QC requirements are specified in RFLMA Attachment 2, Section 5.0, "Monitoring Requirements." PLFTS influent, effluent, and East Landfill Pond (when required) monitoring results will be evaluated in accordance with RFLMA Attachment 2, Figure 11, "Groundwater Treatment Systems," which incorporates the DQO process.

5.3 Sample Locations

Sampling will be conducted at both the influent and effluent of the PLFTS at the locations shown on Figure 5−1 in accordance with RFLMA Attachment 2 requirements. Flow at the seep influent (pipe from south manhole) to the PLFTS will be manually measured (calibrated bucket and stopwatch) when a sample is collected. GWIS north and south influent enters the north manhole at two locations. The north manhole is the designated sampling point for the GWIS. In accordance with RFLMA Attachment 2, Figure 11, and after consultation with CDPHE, sampling of the GWIS was discontinued for monitoring purposes. Any subsequent GWIS sampling will be as required in RFLMA Attachment 2. The PLFTS effluent sample will be collected from the base of the treatment unit or after the last step.

If East Landfill Pond sampling is required as discussed in Sections 5.1 and 5.2, a sample will be collected near the pond discharge location (Figure 5−1).

5.4 Sampling Procedures Summary

Surface water sampling will be conducted in accordance with LM operational documents related to monitoring as provided in RFLMA Attachment 2, Section 5.0, "Monitoring Requirements." Surface water monitoring will include QC field samples and proper equipment decontamination. IDW (e.g., for excess sample and decontamination waters) will also be managed in accordance with the LM operational documents.

5.5 Laboratory Procedures Summary

Analytical methodologies and RLs, data reporting procedures, laboratory QA/QC procedures, and laboratory data validation and contractor validation procedures are to be conducted in accordance with EPA-approved methods. Samples will be submitted to an EPA-approved analytical laboratory for the following analyses:

- SW-846 Method 8260B—VOCs;
- SW-846 Method 6010B—Metals;
- SW846 Method 8270C—Semivolatile organic compounds;
- Alpha Spectrometry—Isotopic uranium or SW-846 Method 6010B—Metals (uranium) as appropriate for the applicable standard in RFLMA; and
- EPA-600/4-79-020 Method 353.2—Nitrate/nitrite.

The surface water monitoring details are in RFLMA Attachment 2, Table 2, "Water Monitoring Locations and Sampling Criteria." The analytical results obtained by these methods will be reported as described in Section 5.6.

Sample results are reported according to laboratory analytical method Standard Operating Procedures or contract specifications. The laboratory will report any analyte of interest detected at or above the RL as a positive value. Any analyte of interest not detectable or detected below the RL will be reported as "not detected" at the RL or an estimated value between the RL and the instrument or method detection limit. Data are generally reported in a tabular format or posted on maps and figures. RLs are adjusted for dilution when necessary.

5.6 Reporting and Schedule

PLFTS and East Landfill Pond sampling results will be included in the quarterly and annual reports specified in RFLMA Attachment 2, Section 7.0, "Periodic Reporting Requirements." The annual PLF monitoring reports, discussed in Section 6.1, will be included in the RFLMA annual reports.

5.7 Seep Treatment System Inspections

During sampling of the PLFTS, the system components will be inspected to ensure proper operation. The PLFTS is shown on Figure 5−1 and includes the following components:

- Former seep treatment system influent pipe;
- East face strip drain influent pipe;
- Concrete manholes (two);
- GWIS influent pipes (two);
- Treatment unit influent pipes (two);
- Treatment unit, which includes 10 steps; and
- Treatment unit effluent pipe.

The concrete manholes and treatment unit will be inspected for signs of damage as will the piping contained within. The influent and effluent pipes within the manhole and the PLFTS effluent pipe will be inspected for signs of blockage.

6.0 Reporting and Contact Information

6.1 Reporting

The annual PLF monitoring report, including inspection results, repairs, groundwater monitoring data, PLFTS monitoring data, and East Landfill Pond monitoring data if applicable, will be submitted as part of the RFMLA annual report. Any maintenance actions during the year will be detailed in the report. DOE will follow RFLMA requirements for reportable conditions and potentially impacted communities will be notified immediately of conditions that occur at any

time that require immediate attention. The annual PLF monitoring report will include at a minimum:

- All inspection forms/reports for the year, including vegetation information;
- Notations of problems, actions taken, maintenance, or repairs as a result of the inspections;
- Any deviations from this M&M Plan and the rationale for such deviations;
- Summary of monitoring locations;
- Tables with depth to water, well elevations, and groundwater elevations;
- Table with groundwater results and associated qualifiers;
- Tables with PLFTS sampling results and associated qualifiers;
- Tables with GWIS sampling (if required by RFLMA) results;
- Tables with East Landfill Pond sampling results if applicable;
- Figures with groundwater monitoring points, East Landfill Pond monitoring points, and location(s) of problems and/or repairs; and
- Groundwater and seep/PLFTS/East Landfill Pond water sampling forms, as appropriate.

During the year, DOE will transmit completed inspection forms as they become available, but in no case later than 1 month after the field activity is completed.

6.2 Contact Information

The point of contact and contact information for the PLF during the monitoring and maintenance phase is as follows:

Scott Surovchak/U.S. Department of Energy
Rocky Flats Office of Legacy Management
11025 Dover St., Suite 1000
Westminster, CO 80021
Ph. (720) 377-9682

7.0 References

DOE (U.S. Department of Energy), 2004. *Final Interim Measure/Interim Remedial Action for IHSS 114 and RCRA Closure for the RFETS Present Landfill*, Rocky Flats Environmental Technology Site, Golden, Colorado, August.

DOE (U.S. Department of Energy), 2005a. *Rocky Flats, Colorado, Site Revegetation Plan*, Rocky Flats Office of Legacy Management, Broomfield, Colorado, December.

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DOE (U.S. Department of Energy), 2006a. *Final Interim Measure/Interim Remedial Action for IHSS 114 and RCRA Closure for the RFETS Present Landfill, Rocky Flats Environmental Technology Site*, Golden, Colorado, Minor Modification, January.

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Earth Tech, Inc, 2004. *Final Design Analysis and Design Calculations, Accelerated Action Design for the Present Landfill*, October.

EPA (U.S. Environmental Protection Agency), 2002. *Technical Guidance for RCRA/CERCLA Final Covers*, April.

Figures

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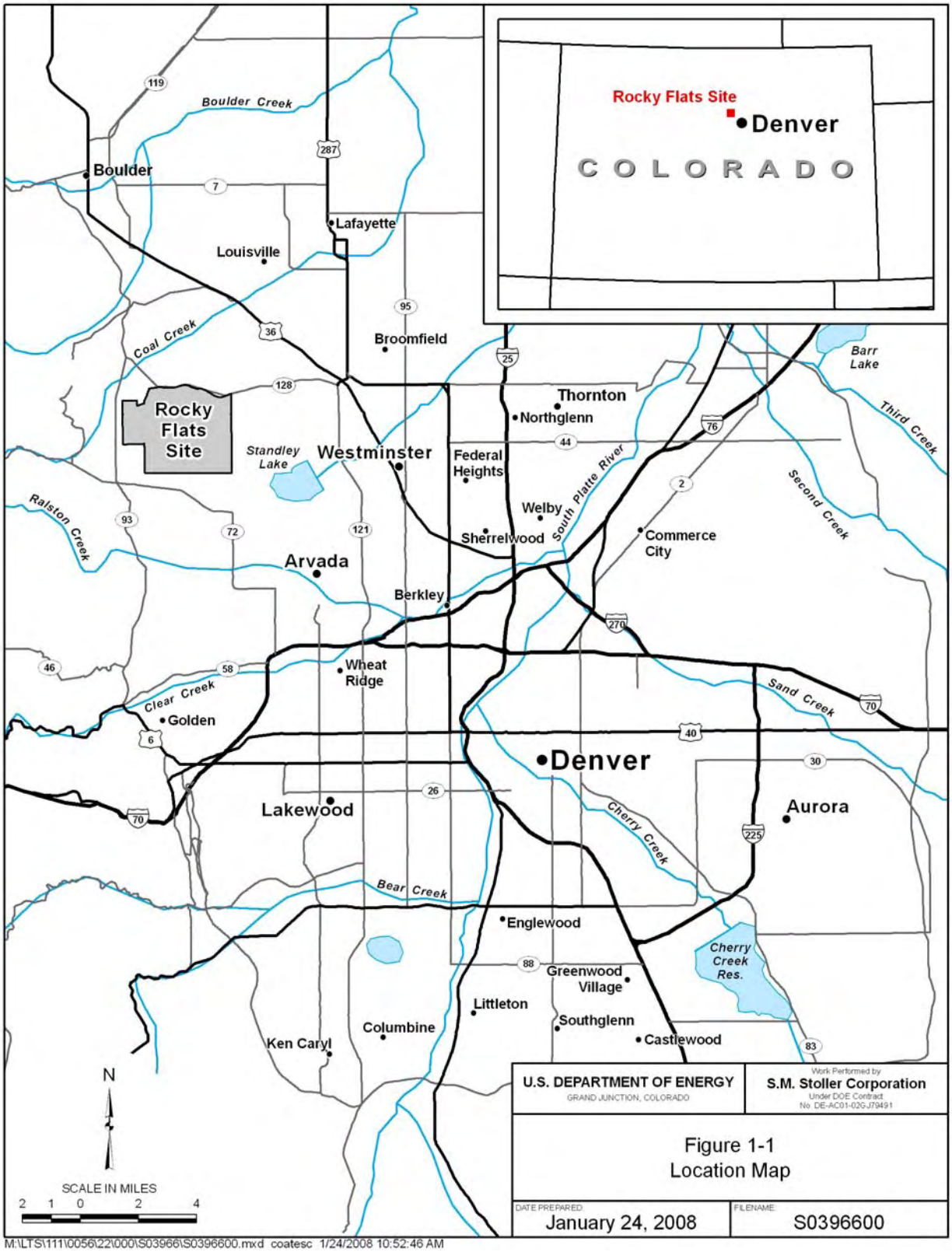
Rocky Flats Site
Denver
COLORADO
Boulder
Boulder Creek
Lafayette
Louisville
Coal Creek
Broomfield
Rocky Flats Site
Standley Lake
Westminster
Thornton
Northglenn
Federal Heights
South Platte River
Barr Lake
Third Creek
Second Creek
Ralston Creek
Welby
Sherrelwood
Commerce City
Arvada
Berkley
Wheat Ridge
Clear Creek
Golden
Sand Creek
Denver
Lakewood
Aurora
Cherry Creek
Bear Creek
Englewood
Cherry Creek Res.
Greenwood Village
Littleton
Southglenn
Columbine
Ken Caryl
Castlewood
N
SCALE IN MILES
2 1 0 2 4
U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO
Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE-AC01-02G-J79491
Figure 1-1
Location Map
DATE PREPARED
January 24, 2008
FILENAME
S0396600
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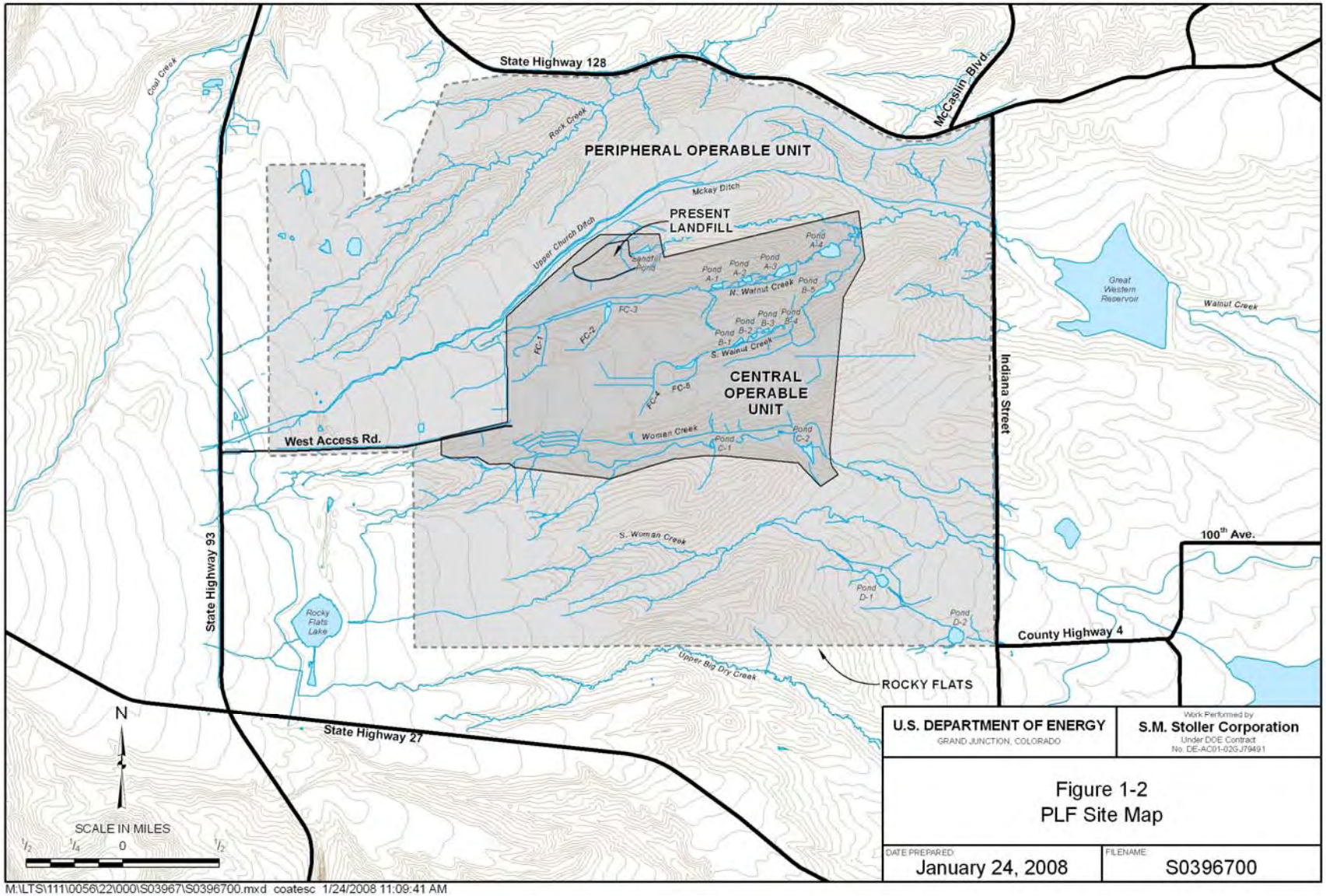
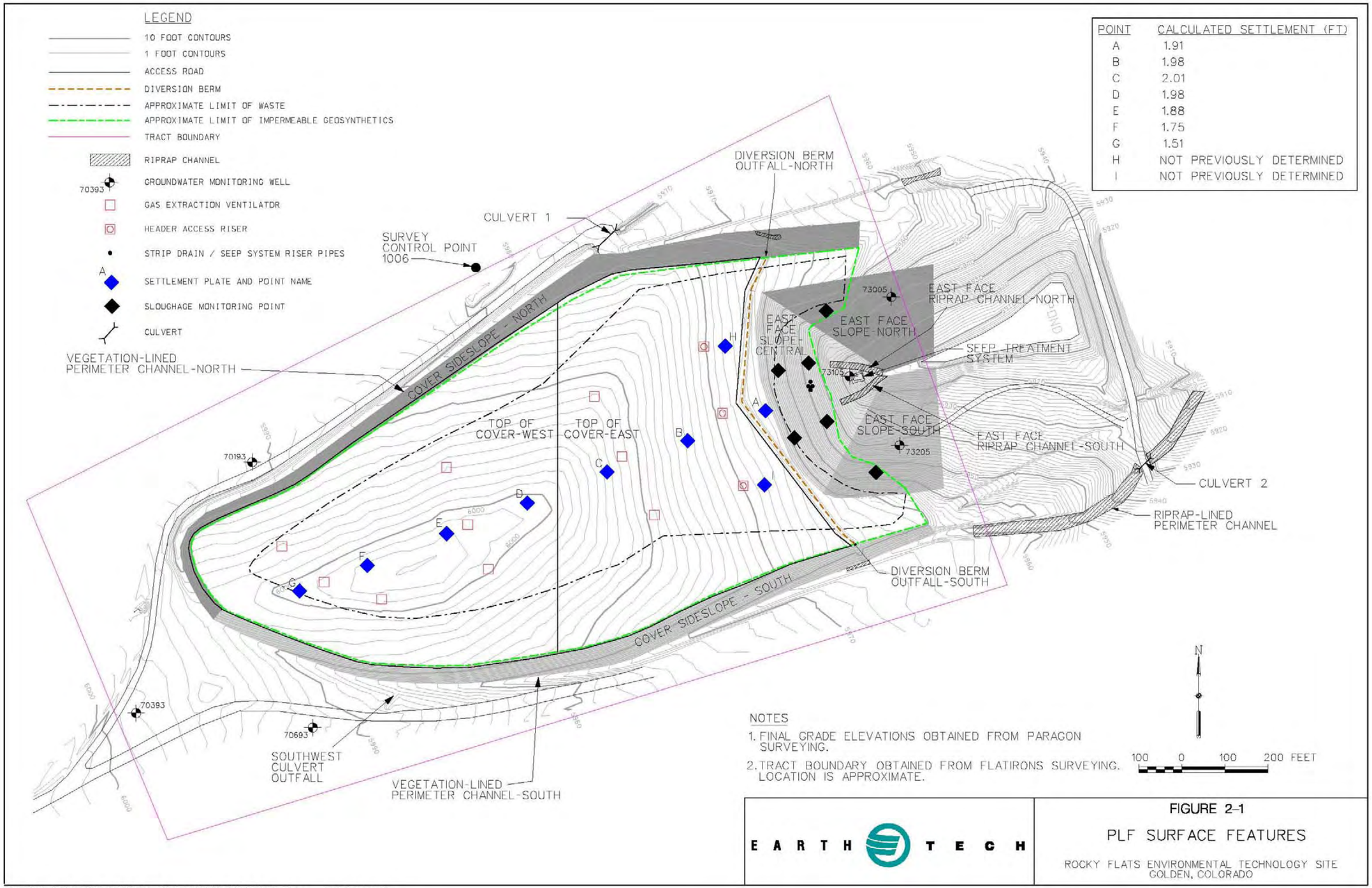

State Highway 128
McCaslin Blvd.
Coal Creek
Rock Creek
PERIPHERAL OPERABLE UNIT
Mckay Ditch
PRESENT LANDFILL
Upper Church Ditch
Landfill Pond
Pond A-1
Pond A-2
Pond A-3
Pond A-4
N. Walnut Creek
Pond B-5
Great Western Reservoir
Walnut Creek
FC-3
FC-2
FC-1
Pond B-3
Pond B-4
Pond B-2
Pond B-1
S. Walnut Creek
CENTRAL OPERABLE UNIT
FC-4
FC-5
Indiana Street
West Access Rd.
Woman Creek
Pond C-1
Pond C-2
100th Ave.
S. Woman Creek
Pond D-1
Pond D-2
State Highway 93
Rocky Flats Lake
County Highway 4
Upper Big Dry Creek
ROCKY FLATS
N
State Highway 27
SCALE IN MILES
1/2 1/4 0 1/2
U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION, COLORADO
Work Performed by
S.M. Stoller Corporation
Under DOE Contract
No. DE-AC01-02GJ79491
Figure 1-2
PLF Site Map
DATE PREPARED
January 24, 2008
FILENAME
S0396700
M:\LTS\111\0056\22\000\S03967\S0396700.mxd coatesc 1/24/2008 11:09:41 AM



POINT	CALCULATED SETTLEMENT (FT)
A	1.91
B	1.98
C	2.01
D	1.98
E	1.88
F	1.75
G	1.51
H	NOT PREVIOUSLY DETERMINED
I	NOT PREVIOUSLY DETERMINED

NOTES

1. FINAL GRADE ELEVATIONS OBTAINED FROM PARAGON SURVEYING.
2. TRACT BOUNDARY OBTAINED FROM FLATIRONS SURVEYING. LOCATION IS APPROXIMATE.

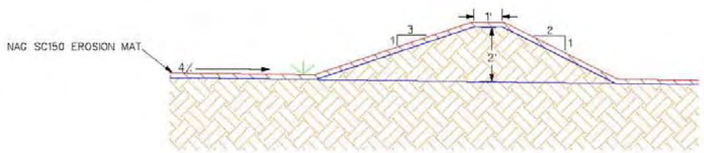
EARTH TECH

FIGURE 2-1

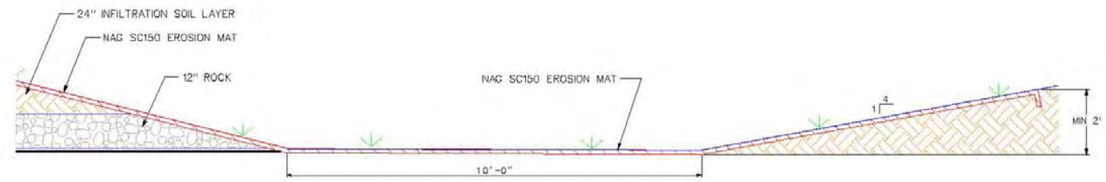
PLF SURFACE FEATURES

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

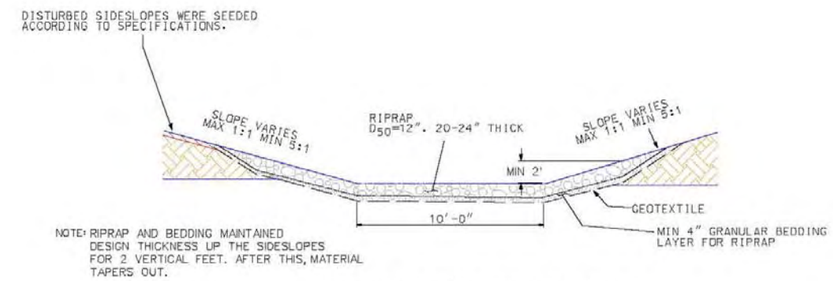
L:\GROUP\CAD\ROCKY_FLATS\New_Design2004\PLFM&M\PLFRev1.dgn DATE: 4/20/06



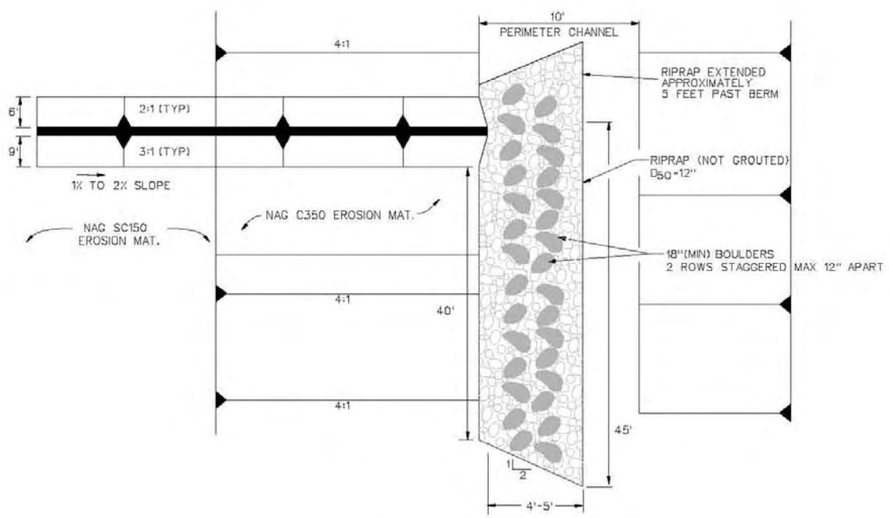
DIVERSION BERM
NTS



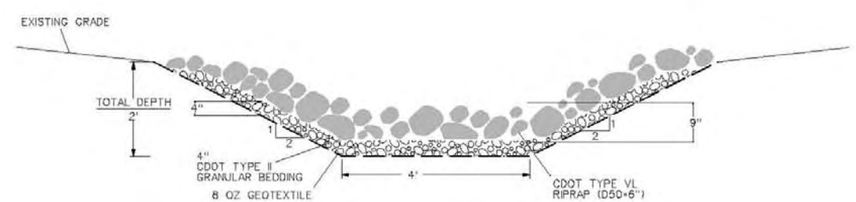
VEGETATION-LINED PERIMETER CHANNEL
NTS



RIPRAP-LINED PERIMETER CHANNEL
NTS



DIVERSION BERM OUTFALL
NTS



EAST FACE RIPRAP CHANNEL SECTION
NTS

E A R T H T E C H

FIGURE 3-1
PLF STORMWATER MANAGEMENT STRUCTURE DETAILS
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

L\GROUP\CAD\ROCKY_FLATS\New_Design2004\PLFM&M\StormDet1.dgn DATE: 8/23/05

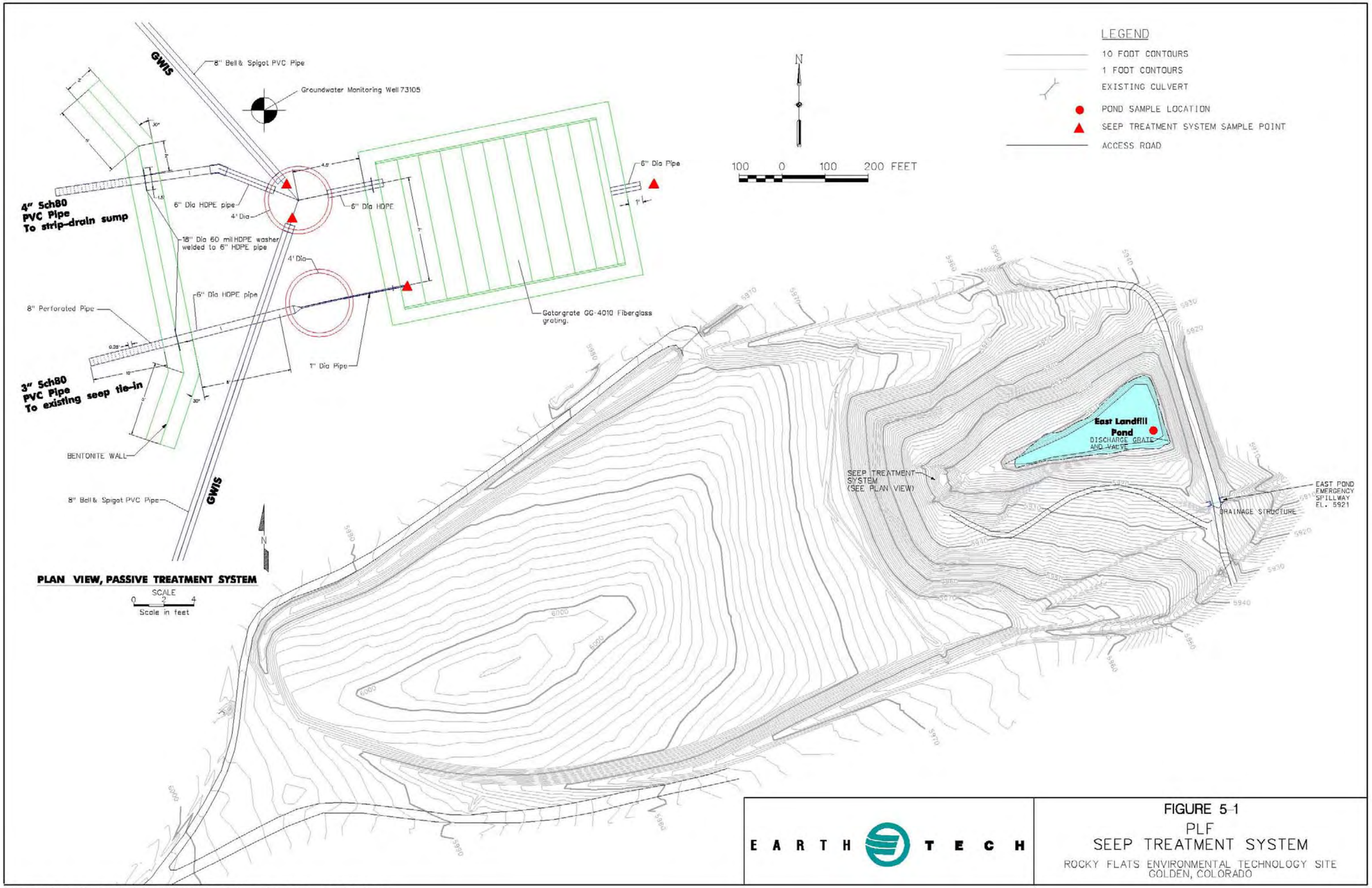

LEGEND
10 FOOT CONTOURS
1 FOOT CONTOURS
EXISTING CULVERT
POND SAMPLE LOCATION
SEEP TREATMENT SYSTEM SAMPLE POINT
ACCESS ROAD
N
100 0 100 200 FEET
GWIS
8" Bell & Spigot PVC Pipe
Groundwater Monitoring Well 73105
4" Sch80 PVC Pipe To strip-drain sump
6" Dia HDPE pipe
4' Dia
6" Dia HDPE
6" Dia Pipe
18" Dia 60 mil HDPE washer welded to 6" HDPE pipe
4' Dia
8" Perforated Pipe
6" Dia HDPE pipe
Gatorgrate GG-4010 Fiberglass grating.
1" Dia Pipe
3" Sch80 PVC Pipe To existing seep tie-in
BENTONITE WALL
8" Bell & Spigot PVC Pipe
GWIS
PLAN VIEW, PASSIVE TREATMENT SYSTEM
SCALE
0 2 4
Scale in feet
East Landfill Pond
DISCHARGE GRATE AND VALVE
SEEP TREATMENT SYSTEM (SEE PLAN VIEW)
EAST POND EMERGENCY SPILLWAY EL. 5921
DRAINAGE STRUCTURE
EARTH TECH
FIGURE 5-1
PLF
SEEP TREATMENT SYSTEM
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO
L:\GROUP\CAD\ROCKY_FLATS\New_Design2004\PLFM&M\SeepLoc1.dgn DATE: 8/23/05

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Table

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Table 4−1. Groundwater Monitoring Wells at the PLF

Well ID	Type	Installation Date	Screen Length (feet)	Borehole Depth (feet bgs)	Well Diameter (inches)	Depth to Top of Screen (feet bgs)	Depth to Bedrock (feet bgs)
70193	Upgradient	1/15/93	15	39.4	2	22.30	19.50
70393	Upgradient	2/2/93	15	26.0	2	7.80	22.80
70693	Upgradient	12/4/92	20	30.3	2	8.50	28.50
73005	Downgradient	6/27/05	20	28.0	2	4.60	0.00
73105	Downgradient	6/27/05	20	27.7	2	5.65	12.50
73205	Downgradient	6/27/05	25	32.0	2	4.55	4.20

Notes:
bgs below ground surface

End of current text

Appendix A

Present Landfill Inspection Form

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PRESENT LANDFILL – MONITORING AND MAINTENANCE PROGRAM

INSPECTION FORM

INSPECTOR: _____ DATE: _____TIME: _____ REVIEWED BY: _____

TEMPERATURE: _____ WEATHER CONDITIONS: _____REVIEW DATE: _____

METEOROLOGICAL STATION LOCATION: _____

SUBSIDENCE/CONSOLIDATION

REGION	EVIDENCE OF CRACKS?	EVIDENCE OF DEPRESSIONS?	EVIDENCE OF SINK HOLES?	EVIDENCE OF PONDING?	OTHER (DESCRIBE BELOW)
TOP OF COVER – WEST	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
TOP OF COVER – EAST	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
COVER SIDESLOPE – NORTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
COVER SIDESLOPE – SOUTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST FACE SLOPE – NORTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST FACE SLOPE – SOUTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST FACE SLOPE – CENTRAL	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST FACE SLOPE – NORTH SEEP*	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	

Settlement Plates and side-slope monitoring points to be inspected for integrity.
During Year 1, they will be surveyed quarterly, and annually thereafter

Integrity intact?
☐ Yes ☐ No

MAINTENANCE REQUIRED/COMMENTS/PHOTO LOG

_____

_____

_____

* AREA OF SEEP IS OUTSIDE OF LANDFILL COVER AND EAST OF THE COVER ANCHOR TRENCH

SLOPE STABILITY

REGION	EVIDENCE OF CRACKS?	EVIDENCE OF BLOCK OR CIRCULAR FAILURE?	EVIDENCE OF SEEPS?	OTHER (DESCRIBE BELOW)
COVER SIDESLOPE – NORTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
COVER SIDESLOPE – SOUTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
PERIMETER CHANNEL OUTER SLOPE – NORTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
PERIMETER CHANNEL OUTER SLOPE – SOUTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST FACE SLOPE – NORTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST FACE SLOPE – SOUTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST FACE SLOPE – CENTRAL	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST FACE SLOPE – NORTH SEEP*	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	

MAINTENANCE REQUIRED/COMMENTS/PHOTO LOG

_____

_____

_____

_____

* AREA OF SEEP IS OUTSIDE OF LANDFILL COVER AND EAST OF THE COVER ANCHOR TRENCH

SOIL COVER

REGION	EVIDENCE OF SOIL DEPOSITION OR EROSION?	EVIDENCE OF EROSION RILLS/GULLIES?	EVIDENCE OF BURROWING ANIMALS?	OTHER (DESCRIBE BELOW)
TOP OF COVER – WEST	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
TOP OF COVER – EAST	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
COVER SIDESLOPE – NORTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
COVER SIDESLOPE – SOUTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST FACE SLOPE – NORTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST FACE SLOPE – SOUTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
EAST FACE SLOPE –- CENTRAL	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
AREA WHERE EAST SLOPE CENTRAL MEETS EAST SLOPE NORTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
AREA WHERE EAST SLOPE CENTRAL MEETS EAST SLOPE SOUTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
	VENT CAPS IN PLACE & SECURE?	**STANDPIPES IN GOOD CONDITION?**	**BIRDS OR INSECTS IN VENT CAPS?**	
COVER – BAROMETRIC VENTS	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	

MAINTENANCE REQUIRED/COMMENTS/PHOTO LOG

_____

_____

_____

VEGETATION

REGION	CONDITION OF GRASS	UNWANTED VEGETATION PRESENT*?	OTHER (DESCRIBE BELOW)
TOP OF COVER – WEST		☐ Yes ☐ No	
TOP OF COVER – EAST		☐ Yes ☐ No	
EAST FACE SLOPE – NORTH		☐ Yes ☐ No	
EAST FACE SLOPE – SOUTH		☐ Yes ☐ No	
EAST FACE SLOPE – CENTRAL		☐ Yes ☐ No	
COVER SIDESLOPE – NORTH		☐ Yes ☐ No	
COVER SIDESLOPE – SOUTH		☐ Yes ☐ No	
VEGETATION-LINED PERIMETER CHANNEL – NORTH		☐ Yes ☐ No	
VEGETATION-LINED PERIMETER CHANNEL – SOUTH		☐ Yes ☐ No	

* Unwanted vegetation includes weeds and deep-rooting trees.

MAINTENANCE REQUIRED/COMMENTS/PHOTO LOG

SEEP TREATMENT SYSTEM

REGION	EVIDENCE OF PLUGGING, OBSTRUCTIONS, OR EXCESS DEBRIS?	EVIDENCE OF CRACKS OR DETERIORATION?	OTHER (DESCRIBE BELOW)
GWIS INLET PIPES	☐ Yes ☐ No	☐ Yes ☐ No	
STRIP DRAIN INLET PIPE	☐ Yes ☐ No	☐ Yes ☐ No	
NORTH MANHOLE OUTLET PIPE	☐ Yes ☐ No	☐ Yes ☐ No	
SOUTH MANHOLE OUTLET PIPE	☐ Yes ☐ No	☐ Yes ☐ No	
TREATMENT UNIT	☐ Yes ☐ No	☐ Yes ☐ No	
TREATMENT UNIT OUTLET PIPE	☐ Yes ☐ No	☐ Yes ☐ No	
NORTH MANHOLE	☐ Yes ☐ No	☐ Yes ☐ No	
SOUTH MANHOLE	☐ Yes ☐ No	☐ Yes ☐ No	
TREATMENT UNIT GRATING	NA	☐ Yes ☐ No	

MAINTENANCE REQUIRED/COMMENTS/PHOTO LOG

STORMWATER MANAGEMENT STRUCTURES

CHANNELS/LINING

STRUCTURE	EVIDENCE OF EXCESSIVE EROSION, GULLYING, SCOUR, OR UNDERMINING?	EVIDENCE OF SETTLEMENT/ SUBSIDENCE OR DEPRESSIONS?	EVIDENCE OF BREACHING OR BANK FAILURE?	EVIDENCE OF BURROWING ANIMALS?	EVIDENCE OF SEDIMENT BUILD-UP OR OTHER BLOCKAGE?	EVIDENCE OF LINING DETERIORATION, HOLES, RIPS, OR SEPARATION?	EVIDENCE OF LINING DISPLACEMENT?
DIVERSION BERM	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
VEGETATION-LINED PERIMETER CHANNEL – NORTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
VEGETATION-LINED PERIMETER CHANNEL – SOUTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
RIPRAP-LINED PERIMETER CHANNEL	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
C350-LINED EAST FACE	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
EAST FACE RIPRAP CHANNEL – NORTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
EAST FACE RIPRAP CHANNEL – SOUTH	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	

OTHER DEFICIENCIES?

_____

_____

MAINTENANCE REQUIRED/COMMENTS/PHOTO LOG

_____

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STORMWATER MANAGEMENT STRUCTURES (CONTINUED)

OUTFALLS

CHECK EACH STRUCTURE FOR EXCESSIVE EROSION AND SEDIMENT DEPTH. IF SEDIMENT DEPTH IS COMPROMISING THE DESIGN CHARACTERISTICS, REMOVE SEDIMENT.

STRUCTURE	CONDITION/SEDIMENT DEPTH
DIVERSION BERM OUTFALL – NORTH	
DIVERSION BERM OUTFALL – SOUTH	
CULVERT 1 OUTFALL	
CULVERT 2 OUTFALL	
SOUTHWEST CULVERT OUTFALL	

CULVERTS

CHECK EACH STRUCTURE FOR BLOCKAGE, SURROUNDING CONDITIONS, BREACHING, SEDIMENT BUILD-UP, AND INLET/OUTLET CONDITIONS.

STRUCTURE	CONDITION
CULVERT 1	
CULVERT 2	
SOUTHWEST CULVERT	

MAINTENANCE REQUIRED/PHOTO LOG

"RUN-ON" EROSION CONTROL

AREA	ADVERSELY AFFECTING PLF?		
RUN-ON INTO PERIMETER CHANNEL – NORTH	☐ Yes	☐ No	COMMENT:
RUN-ON INTO PERIMETER CHANNEL – SOUTH	☐ Yes	☐ No	COMMENT:
NATURAL DRAINAGE FED BY CULVERT 1	☐ Yes	☐ No	COMMENT:
NATURAL DRAINAGE FED BY NORTHEAST PERIMETER CHANNEL	☐ Yes	☐ No	COMMENT:
NATURAL DRAINAGE FED BY RIPRAP	☐ Yes	☐ No	COMMENT:

MAINTENANCE REQUIRED/PHOTO LOG

INSTITUTIONAL CONTROLS

ITEM			
EVIDENCE OF EXCAVATION(S) OF COVER AND IMMEDIATE VICINITY OF COVER?	☐ Yes	☐ No	COMMENT:
EVIDENCE OF CONSTRUCTION OF ROADS OR TRAILS ON COVER OR BUILDINGS?	☐ Yes	☐ No	COMMENT:
EVIDENCE OF UNAUTHORIZED ENTRY?	☐ Yes	☐ No	COMMENT:
EVIDENCE OF DRILLING OF WELLS OR USE OF GROUNDWATER?	☐ Yes	☐ No	COMMENT:
DISRUPTION OR DAMAGE OF SEEP TREATMENT SYSTEM?	☐ Yes	☐ No	COMMENT:
DAMAGE OR REMOVAL OF ANY SIGNAGE OR GROUNDWATER MONITORING WELLS?	☐ Yes	☐ No	COMMENT:

OTHER DEFICIENCIES/PHOTO LOG

ACTION ITEMS

DEFICIENCY	DATE NOTED	ACTION	DATE COMPLETED	COMMENTS

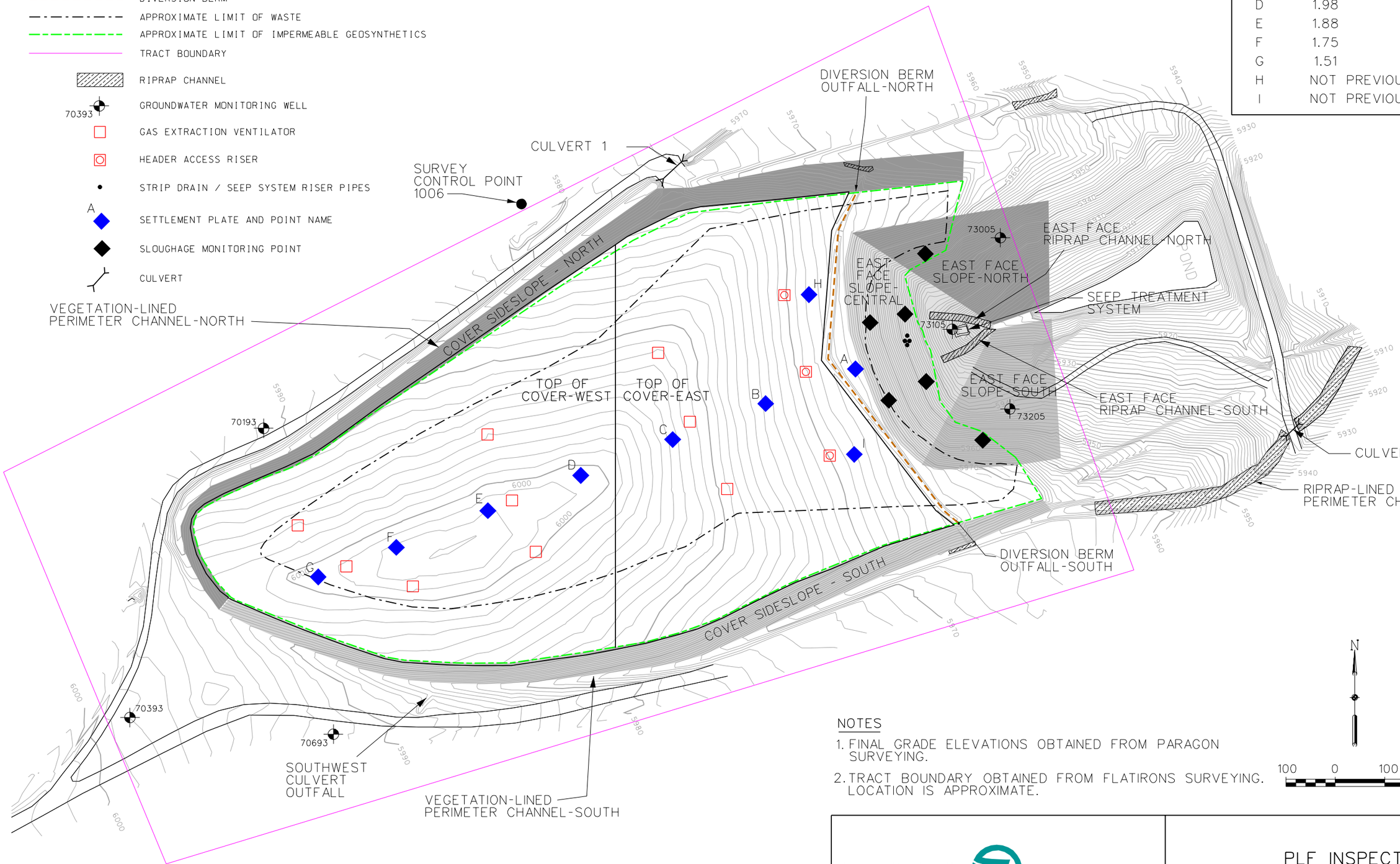
INSPECTOR SIGNATURE: _____ DATE: _____

REVIEWER SIGNATURE: _____ DATE: _____

LEGEND

- 10 FOOT CONTOURS
- 1 FOOT CONTOURS
- ACCESS ROAD
- DIVERSION BERM
- APPROXIMATE LIMIT OF WASTE
- APPROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- TRACT BOUNDARY
- RIPRAP CHANNEL
- 70393 GROUNDWATER MONITORING WELL
- GAS EXTRACTION VENTILATOR
- HEADER ACCESS RISER
- STRIP DRAIN / SEEP SYSTEM RISER PIPES
- A SETTLEMENT PLATE AND POINT NAME
- SLOUGHAGE MONITORING POINT
- CULVERT

POINT	CALCULATED SETTLEMENT (FT)
A	1.91
B	1.98
C	2.01
D	1.98
E	1.88
F	1.75
G	1.51
H	NOT PREVIOUSLY DETERMINED
I	NOT PREVIOUSLY DETERMINED



NOTES

1. FINAL GRADE ELEVATIONS OBTAINED FROM PARAGON SURVEYING.
2. TRACT BOUNDARY OBTAINED FROM FLATIRONS SURVEYING. LOCATION IS APPROXIMATE.

EARTH TECH

PLF INSPECTIONS

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

L\GROUP\CAD\ROCKY_FLATS\New_Design2004\PLFM&M\plfinsp3.dgn DATE: 4/25/06

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Appendix B

Groundwater Well Boring Logs/Construction Summaries

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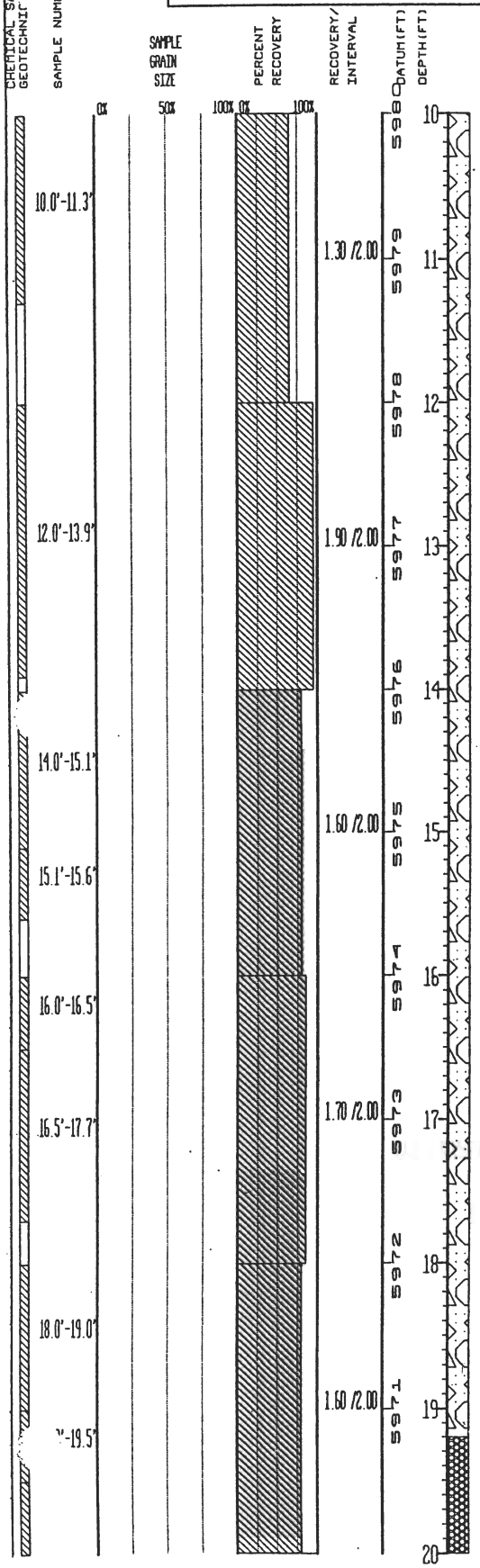
STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 39.4	GROUND ELEVATION (FT)	5990.00	PROJECT NUMBER:	9890973	LOG OF BORING NUMBER:
NORTH:	752688	AREA: OU7 PRESENT LANDFILL	CASING DIAMETER (IN):	2	GEOLOGIST:	JAB/KJT	70193
EAST:	2082674	LOCATOR NUMBER: 12J	BOREHOLE DIAMETER (IN):	10.25	DATE DRILLED:	01/15/93	

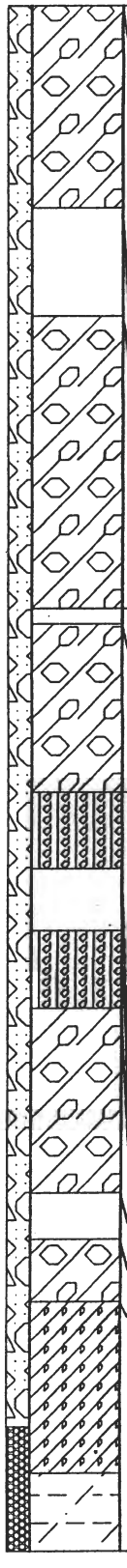
REMARKS: MOBIL DRILL B-57; HSA, CEMENT GROUT 0.0'-19.5', BENTONITE SEAL 19.5'-21.5', SAND 21.5'- 37.6', NATURAL BACK- FILL 37.6'-39.4'; CENTRALIZERS PLACED 18.5' AND 38.55'; HOLE DIAMETER 10.25" 0.0'- 37.5' AND 3.0" 37.5' - 39.4'; 2.0' SUMP 37.3'- 39.3' DEPTH TO BEDROCK 19.5'.

CHEMICAL SAMPLE DEPTH / GEOTECHNICAL SAMPLE DEPTH	SAMPLE NUMBER	SAMPLE GRAIN SIZE (0% – 50%)	PERCENT RECOVERY (100% 0% 100%)	RECOVERY/INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
0.0'-1.4'				1.40 /2.00	5990 5989	0–1			GM:	Sandy Gravel with some silt. Dark brown (7.5 YR 3/2). Coarse to fine gravel (max=2 1/2", mean=1 1/2"diam), very fine to coarse sand (mean=medium) in clayey silt matrix. Well graded subangular to subrounded gravel and sand composed mainly of quartzite and quartz with some granite, feldspar metamorphic frags. Not bedded, slightly moist. 65% Gravel, 20% sand, 10% silt, and 5% clay.
										No core recovery (1.4'-2.0')
2.0'-3.5'				1.90 /2.00	5988 5987	2–3			SM:	Gravelly sand with some silt and clay. Reddish brown (2.5 YR 4/4). Fine to medium gravel (max=2", mean=3/4"diam), very fine to coarse sand (mean=medium), in a silty clay matrix. Well graded. Angular to subangular gravel and sand comprised of granite, quartzite, schist, and quartz. Gravel strongly weathered and often ground to powder. Not bedded, moist. 39% Gravel, 43% sand, 13% silt, and 5% clay.
3.5'-3.9'					5986	4			GW:	Sandy Gravel. Light olive brown (2.5 Y 5/3). Fine to coarse gravel (max=2", mean=1 1/4"diam), angular to subrounded. Very fine to coarse sand (mean=coarse), subangular to subrounded. Gravel and sand mainly composed of rock frags, weathered granite, schist, and quartzite. Not bedded, slightly moist. 45% Gravel, 46% sand, 7% silt, 2% clay.
4.0'-6.0'				2.00 /2.00	5985	5				No core recovery (3.9'-4.0')
									GW:	Same as above
6.0'-7.1'				1.10 /2.00	5984 5983	6–7			SM:	Gravelly sand with some silt. Light olive brown (2.5 Y 5/6 to 2.5 Y 6/4). Coarse to fine gravel (max=2 1/2", mean=1" diam) and very fine to coarse (mean=coarse) sand, in clayey silt matrix. Well graded. Angular to subrounded gravel and sand composed of quartzite, quartz, granite, schist, with some sand of feldspar and mafic minerals. Not bedded, moist. 30% Gravel, 45% sand, 16% silt, 9% clay.
										No core recovery (7.1'-8.0')
8.0'-8.5'					5982	8			SM:	Same as above
8.5'-9.4'				1.60 /2.00	5981	9–10			SC:	Clayey Sand with Some silt and gravel. Light yellowish brown (2.5 Y 6/4). Coarse to fine gravel (max=2", mean=1/2"diam) and very fine to coarse sand (mean=fine) in silty clay matrix. Well graded. Angular to subangular sand and gravel composed of quartzite, quartz, granite, and feldspar. Not bedded, moist. 21% Gravel, 39% sand, 28% clay, and 12% silt.
										No core recovery (9.4'-10.0')

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 39.4	GROUND ELEVATION (FT):	5990.00	PROJECT NUMBER:	989073	LOG OF BORING NUMBER:
NORTH:	752688	AREA: OU7 PRESENT LANDFILL	CASING DIAMETER (IN):	2	GEOLOGIST:	JAB/KJT	70193
EAST:	2082674	LOCATOR NUMBER: 12J	BOREHOLE DIAMETER (IN):	10.25	DATE DRILLED:	01/15/93	

REMARKS: MOBIL DRILL B-57; HSA, CEMENT GROUT 0.0'-19.5', BENTONITE SEAL 19.5'-21.5', SAND 21.5'- 37.6', NATURAL BACK- FILL 37.6'-39.4'; CENTRALIZERS PLACED 18.5' AND 38.55'; HOLE DIAMETER 10.25" 0.0'- 37.5' AND 3.0" 37.5' - 39.4'; 2.0' SUMP 37.3'- 39.3' DEPTH TO BEDROCK 19.5'.





UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
	No core recovery (9.4'-10.0')
GC:	Sandy Gravel with some clay. Light yellowish brown (2.5 Y 6/4). Coarse to fine gravel (max=2 1/2", mean=1 1/4"diam) and very fine to coarse sand (mean=fine) in silty clay matrix. Well graded. Angular to rounded gravel, some broken by drilling, subangular to subrounded sand. Gravel composed of quartzite, granite, and some schist. Sand composed of quartz, rock fragments, feldspars and micas. Not bedded, moist. 44% Gravel, 39% sand, 12% clay, and 5% silt.
	No core recovery (11.3'-12.0')
GC:	Sandy Gravel with some clay. Strong brown (7.5 YR 5/6). Very coarse to fine gravel (max=3", mean=1"diam) and very fine to coarse sand (mean=coarse) in silty clay matrix. Well graded angular to subrounded gravel and subangular to subrounded sand. Gravel composed of quartzite, quartz, granite, schist; sand composed of quartz, feldspar, quartzite, granite, micas and mafic minerals. Moist to wet. 45% Gravel, 32% sand, 15% clay, and 8% silt
	No core recovery (13.9'-14.0')
GC:	Same as above
SM:	Silty Gravelly Sand. Light yellowish brown (2.5 Y 6/4) to light brown (7.5 YR 6/4). Coarse to fine gravel (max=2 1/2", mean=3/4"diam) and very fine to coarse sand (mean=coarse) in clayey silt matrix. Well graded. Angular to subrounded gravel and sand composed of quartzite, quartz, granite, and schist with some sand of feldspar, micas, mafic minerals. Not bedded, saturated. 18.5% Gravel, 55.5% sand, 20% silt, and 6% clay.
	No core recovery (15.6'-16.0')
SM:	Same as above
GC:	Sandy Gravel with some clay. Same as interval from 12.0' to 15.1'.
	No core recovery (17.7'-18.0')
GC:	Same as above. Saturated.
SC:	Clayey Gravelly Sand. Light brownish gray (2.5 Y 6/2) to dark brown (7.5 YR 4/4) Fine gravel and very fine to coarse sand (mean=medium) composed of same composition as above. Decreasing sand and gravel with depth - transition to bedrock clay. Clay is of low plasticity. Crudely bedded at boundary with reworked bedrock. Moist. 10% Gravel, 45% sand, 35% clay, and 10% silt.

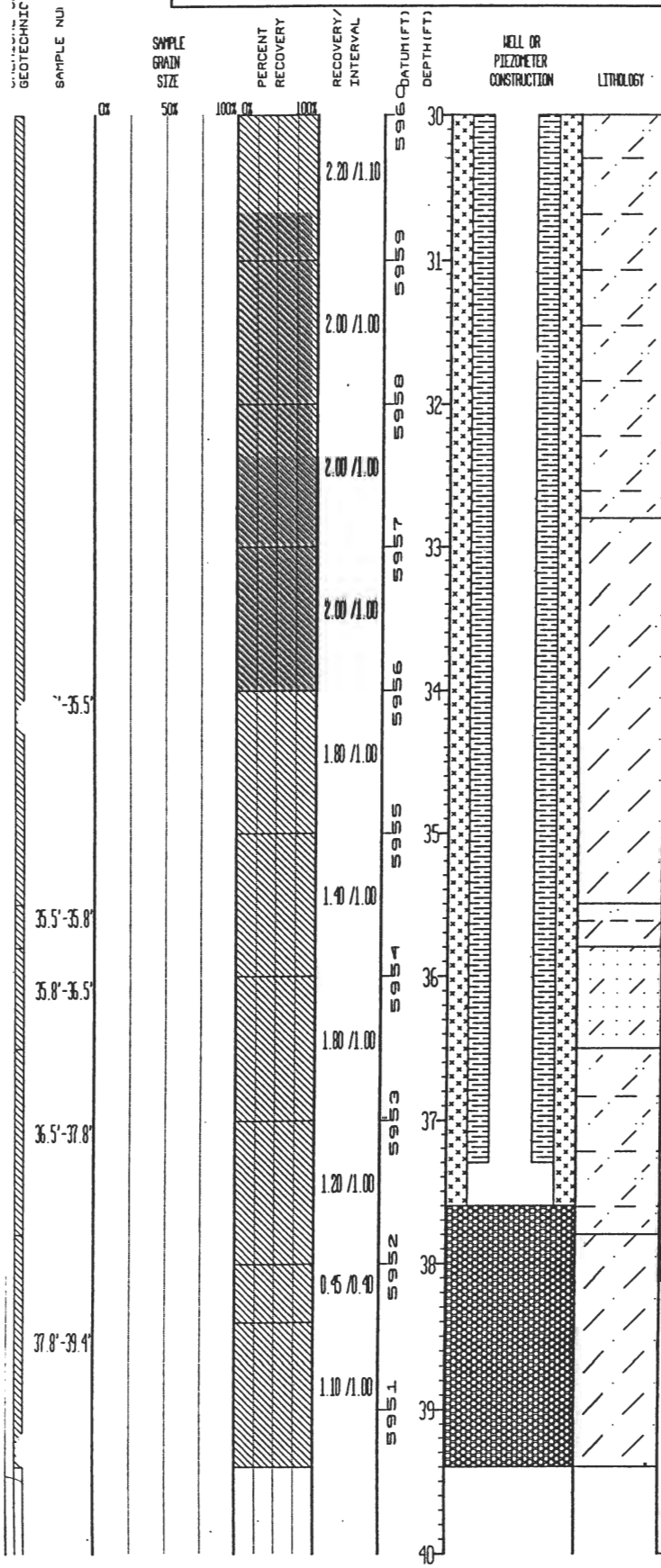
STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 39.4	GROUND ELEVATION (FT):	5990.00	PROJECT NUMBER:	989073	LOG OF BORING NUMBER:
NORTH:	752688	AREA: 007 PRESENT LANDFILL	CASING DIAMETER (IN):	2	GEOLOGIST:	JAB/KJT	70193
EAST:	2082674	LOCATOR NUMBER: 12J	BOREHOLE DIAMETER (IN):	10.25	DATE DRILLED:	01/15/93	

REMARKS: MOBIL DRILL B-57; HSA, CEMENT GROUT 0.0'-19.5', BENTONITE SEAL 19.5'-21.5', SAND 21.5'- 37.6', NATURAL BACK- FILL 37.6'-39.4'; CENTRALIZERS PLACED 19.5' AND 38.55'; HOLE DIAMETER 10.25" 0.0'- 37.5' AND 3.0" 37.5' - 39.4'; 2.0' SUMP 37.3'- 39.3' DEPTH TO BEDROCK 19.5'.

GEOTECHNICAL SAMPLE DEPTH	SAMPLE NO.	SAMPLE GRAIN SIZE (0% 50% 100%)	PERCENT RECOVERY (0% 100%)	RECOVERY/INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
					5970	20	01/15/93 ▽		SILTY CLAYSTONE	Silty Claystone with trace of very fine sand. Light olive gray (5 Y 6/2) to olive yellow (2.5 Y 6/8) where stained by Fe-oxides, moderately sorted, porosity=18%, no cement, moderately to highly friable, massive claystone with mottled coloring due to weathering, increasing silt content with depth. Moist. 20% Silt and 80% clay.
19.5'-22.0'				2.00 /2.00	5969	21				
					5968	22			CLAYEY SILTSTONE	Clayey Siltstone with some very fine sand. Gray (5 Y 6/1) to light yellowish brown (2.5 Y 6/4) and olive yellow (2.5 Y 6/8), moderately sorted, porosity=20%-25%, no cement, highly to moderately friable, composed of varying proportions of clay and silt, siltstone often contains up to 10% of very fine sand, mottled coloring due to weathering, thin and irregular subparallel bedding to disturbed bedding, not fractured, moist to wet. 5% Sand, 65% silt, and 30% clay.
				2.20 /2.00	5967	23				
					5966	24				
22.0'-26.8'				1.00 /1.00	5965	25				
				1.00 /1.00	5964	26				
				1.40 /0.90	5963	27			CLAYEY SILTSTONE	Clayey Siltstone. Light olive brown (2.5 Y 5/6) to olive yellow (2.5 Y 6/8), variable porosity 10%-25%, no cement, highly friable, silt and clay vary throughout interval but bedding is not apparent, much of core heavily damaged during drilling, mottled due to Fe-oxide staining, weathered not fractured (except where damaged), moist to wet (saturated) bottom 0.5' of interval stained bright olive yellow (Fe-hydroxide stain). Carbonaceous fragments present, especially from 30.0'-31.0'. 60% Silt and 40% clay.
				1.70 /1.00	5962	28				
				1.10 /1.00	5961	29				
				1.70 /1.00		30				
26.8'-32.8'										

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 39.4	GROUND ELEVATION (FT):	5990.00	PROJECT NUMBER:	989073	LOG OF BORING NUMBER:
NORTH:	752688	AREA: OU7 PRESENT LANDFILL	CASING DIAMETER (IN):	2	GEOLOGIST:	JAB/KJT	70193
EAST:	2082674	LOCATOR NUMBER: 12J	BOREHOLE DIAMETER (IN):	10.25	DATE DRILLED:	01/15/93	

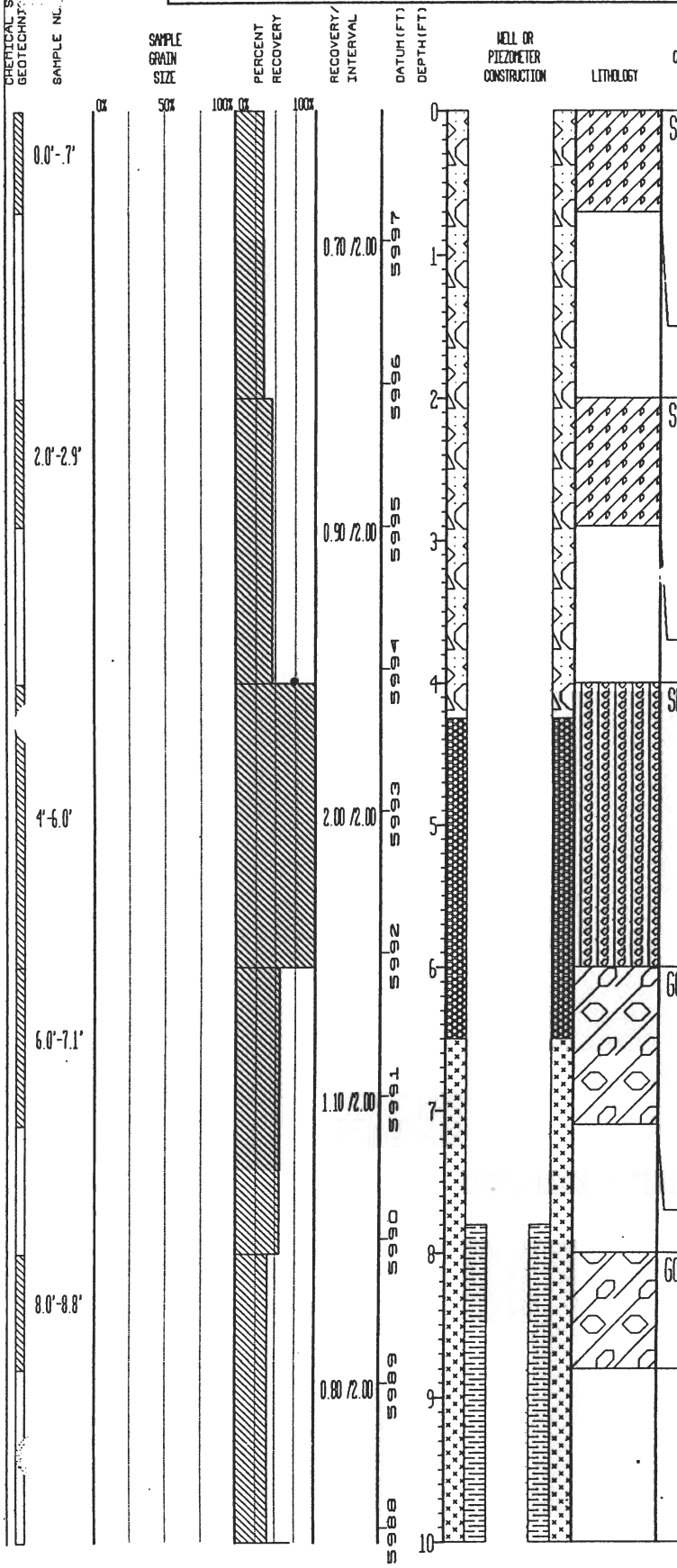
REMARKS: MOBIL DRILL B-57; HSA, CEMENT GROUT 0.0'-19.5', BENTONITE SEAL 19.5'-21.5', SAND 21.5'- 37.6', NATURAL BACK- FILL 37.6'-39.4'; CENTRALIZERS PLACED 18.5' AND 38.55'; HOLE DIAMETER 10.25" 0.0'- 37.5' AND 3.0" 37.5' - 39.4'; 2.0' SUMP 37.3'- 39.3' DEPTH TO BEDROCK 19.5'



UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
CLAYEY SILTSTONE:	Clayey Siltstone. Light olive brown (2.5 Y 5/6) to olive yellow (2.5 Y 6/8), variable porosity 10%-25%, no cement, highly friable, silt and clay vary throughout interval but bedding is not apparent, much of core heavily damaged during drilling, mottled due to Fe-oxide staining, weathered not fractured (except where damaged), moist to wet (saturated) bottom 0.5" of interval stained bright olive yellow (Fe-hydroxide stain). Carbonaceous fragments present, especially from 30.0'-31.0'. 60% Silt and 40% clay.
SILTSTONE:	Siltstone with some clay. Light olive brown (2.5 Y 5/4) to olive yellow (2.5 Y 6/8), porosity = 20%-25%, no cement, highly to moderately friable, clay content varies, sub-horizontal bedding occurs in siltiest intervals, not fractured but damaged during drilling, moist. 85% Silt and 15% clay.
SILTY CLAYSTONE:	Silty Claystone. Dark grayish brown (2.5 Y 4/2), porosity = 10%-15%, no cement, slightly to moderately friable, grades into overlying siltstone, not bedded, not fractured but broken during drilling, slightly moist. 70% Clay and 30% sand.
SILTY SANDSTONE:	Silty Sandstone. Light gray (5 Y 6/1) to olive yellow (2.5 Y 6/6), very fine sand, moderately sorted, porosity = 25%, no cement, highly friable, intermixed with claystone and siltstone but not bedded. 70% Sand, 25% silt, and 5% clay.
CLAYEY SILTSTONE:	Clayey Siltstone. Dark gray (5 Y 4/1) to dark grayish brown (2.5 Y 4/2), porosity varies from 10% to 25%, no cement, slightly to moderately friable, Fe-oxide stains present but limited, thin irregular planar bedding. 60% Silt and 40% clay.
SILTSTONE:	Siltstone with some clay. Light olive brown (2.5 Y 5/4) to gray (5 Y 5/1), porosity=20%-25%, no cement, moderately friable, clay content varies (max=25%) in thin 1" intervals within siltstone, irregular bedding, subhorizontal, not fractured, moist. 85% Silt and 15% clay. Total Depth 39.4'.

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 26.00	GROUND ELEVATION (FT):	5997.90	PROJECT NUMBER:	989073	LOG OF BORING NUMBER:
NORTH:	752090	AREA: 007 PRESENT LANDFILL	CASING DIAMETER (IN):	2	GEOLOGIST:	J. BOYLAN	70393
EAST:	2082389	LOCATOR NUMBER: 12J	BOREHOLE DIAMETER (IN):	7	DATE DRILLED:	02/02/93	

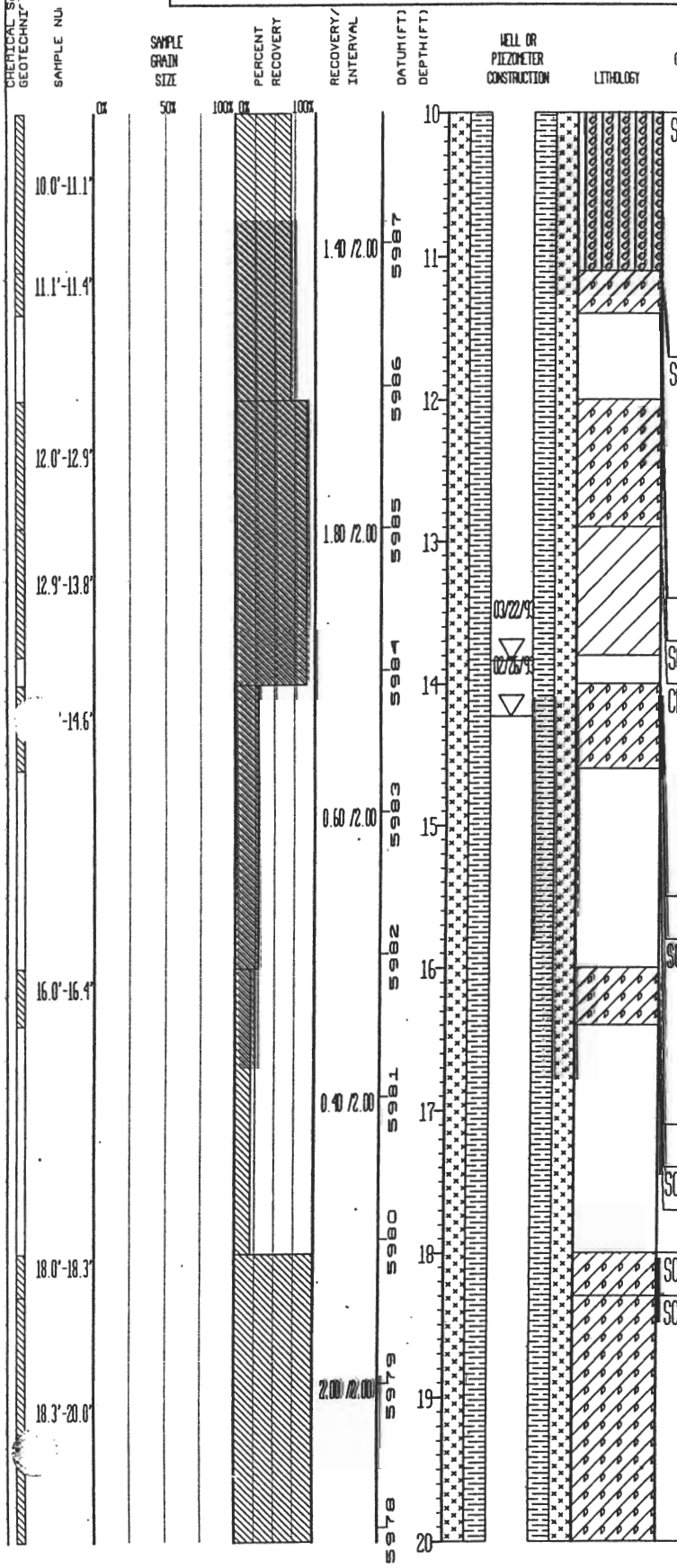
REMARKS: MOBIL DRILL B-57; HSA; CEMENT GROUT 0.0'-4.25', BENTONITE SEAL 4.25'-6.5', SAND 6.5'-24.5', NATURAL BACKFILL 24.5'-26'; CENTRALIZERS PLACED AT 3.8' AND 24.2'; 2' SUMP 22.8'-24.8'; DEPTH TOBEDROCK 22.8'.



UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
SC:	Gravelly Sand with silt and clay. Very dark grayish brown (10 YR 3/2). Coarse to fine sand (mean=fine) with coarse to fine gravel (max=3", mean=0.5"diam). Sand subangular to subrounded comprised of quartz, trace of dark minerals. Gravel subangular to subrounded, comprised of quartzite and igneous rock frags. Not bedded, well graded. Slightly moist. 19% Gravel, 67% sand, 7% clay, and 7% silt.
	No core recovery (0.7'-2.0').
SC:	Gravelly Clayey Sand. Grayish brown (2.5 Y 5/2), dark grayish brown (2 Y 4/3) and dark reddish gray (2.5 YR 4/6) staining. Coarse to fine sand (mean=fine) with coarse to fine gravel. Sand subangular to subrounded, comprised of quartz and a trace of dark minerals and rock frags. Gravel subangular to subrounded, comprised of igneous rock frags and quartzite. Not bedded, poorly sorted. Slightly moist. 15% Gravel, 63% sand, 14% clay, and 8% silt.
	No core recovery (2.9'-4.0').
SM:	Gravelly Sand. Light olive brown (5 Y 5/3) to olive brown (5 Y 5/3), becoming dark yellowish brown (10 YR 4/6) at base. Sand coarse to fine (mean=fine). Gravel coarse to fine (max=3", mean=1" diam). Sand subangular to subrounded, comprised of quartz with a trace of dark minerals and rock frags. Gravel subangular to subrounded comprised of quartzite and igneous rock frags. Not bedded, poorly sorted. Slightly moist. 32% Gravel, 50% sand, 7% clay, and 11% silt.
GC:	Sandy Gravel. Dark yellowish brown (10 YR 4/4) with very dark gray (2.5 YR N3) cobbles. Coarse to fine gravel (max=3", mean=2"diam), fractured; subangular to subrounded; comprised of igneous frags with some smaller granite and quartzite frags. Sand coarse to fine; subangular to subrounded; comprised of quartz, trace of dark minerals, and rock frags. Fines upward, possibly two graded (fining up) sequences. Slightly moist. 50% Gravel, 35% sand, and 15% fines.
	No core recovery (7.1'-8.0').
GC:	Same as above. See description 6.0'-7.1'.
	No core recovery (8.8'-10.0').

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 26.00	GROUND ELEVATION (FT): 5997.90	PROJECT NUMBER: 989073	LOG OF BORING NUMBER:
NORTH:	752090	AREA: 007 PRESENT LANDFILL	CASING DIAMETER (IN): 2	GEOLOGIST: J. BOYLAN	70393
EAST:	2082389	LOCATOR NUMBER: 12J	BOREHOLE DIAMETER (IN): 7	DATE DRILLED: 02/02/93	

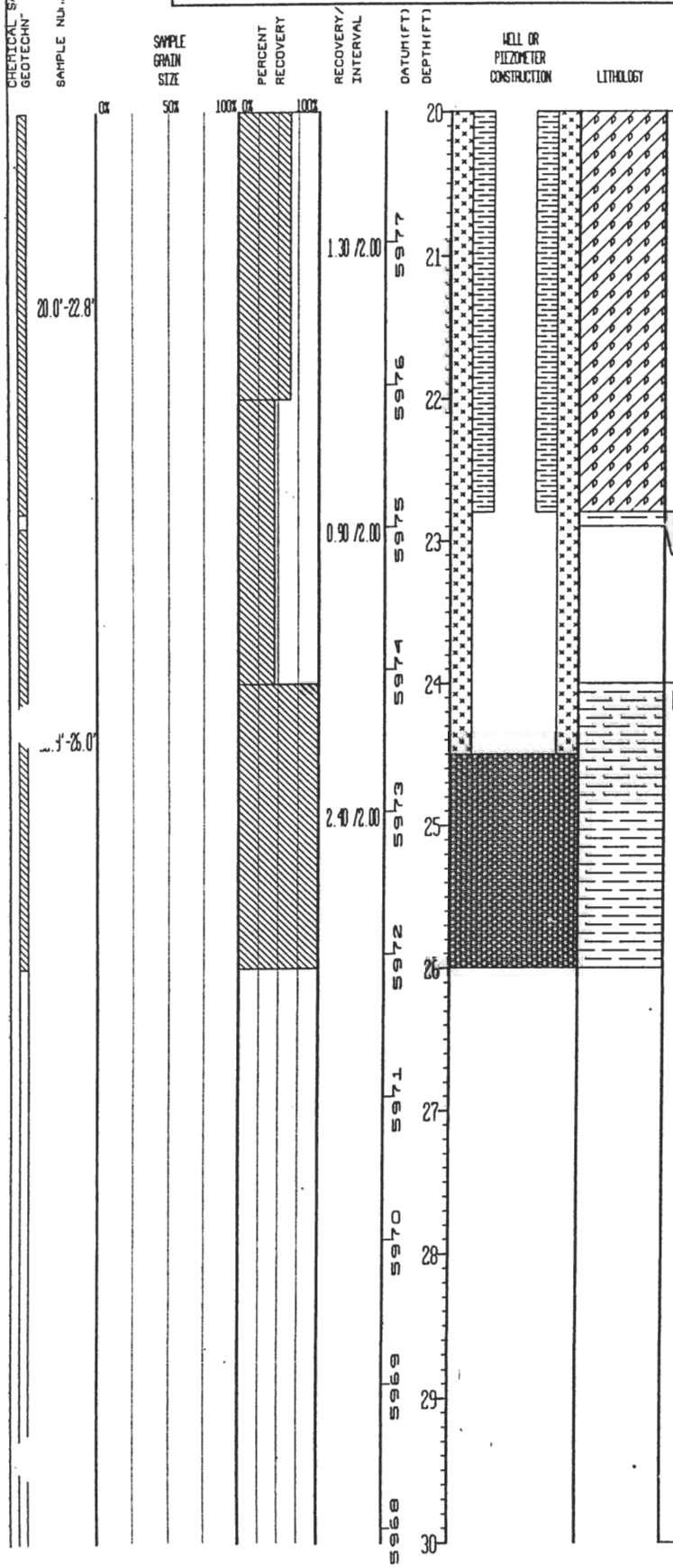
REMARKS: MOBIL DRILL B-57; HSA; CEMENT GROUT 0.0'-4.25', BENTONITE SEAL 4.25'-6.5', SAND 6.5'-24.5', NATURAL BACKFILL 24.5'-26'; CENTRALIZERS PLACED AT 3.8' AND 24.2'; 2' SUMP 22.8'-24.8'; DEPTH TO BEDROCK 22.8'.



UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
SM:	Gravelly Sand. Dark yellowish brown (10 YR 4/4) to olive gray (5 Y 5/2) with reddish brown (5 YR 4/4) staining. Fine to coarse sand (mean=fine) and coarse to fine gravel (max=2", mean=0.5" diam). Sand subangular to subrounded, comprised of quartz with a trace of mica and dark minerals. Gravel subangular to subrounded, comprised of igneous rock frags and pegmatitic quartzite. No bedding. Slightly moist. 30% Gravel, 50% sand, and 20% fines.
SC:	Sand with some gravel and clay. Light olive brown (5 Y 5/4) to brown (10 YR 5/3). Coarse to fine (mean=fine) sand and coarse to fine gravel (max=2", mean=0.5" diam). Sand subangular to subrounded, comprised of quartz with a trace of mica and dark minerals. Gravel subangular to subrounded, comprised of granitic, mafic, igneous, arkosic, and quatzite rock frags. No bedding. Slightly moist. 14% Gravel, 71% sand, and 10% clay, and 5% silt.
	No core recovery (11.4'-12.0').
SC:	Same as above. See description 11.0'-11.4'.
CL:	Sandy Clay with some gravel and silt. Mottled dark yellowish brown (10 YR 4/6) and light olive gray (5 Y 6/2). Coarse to fine gravel (max=2.5", mean=0.5" diam) and coarse to fine (mean=medium) sand. Gravel and sand angular to subrounded, comprised mainly of quartzite and schist. Low to moderate plasticity. Moderately well graded. No bedding. Slightly moist. 15% Gravel, 35% sand, 35% clay, and 15% silt.
	No core recovery (13.8'-14.0').
SC:	Gravel, sand, clay mixture. Strong brown (7.5 YR 5/6) to yellowish brown (10 YR 5/4). Gravels broken during drillling (>3" diam) and very coarse to very fine sand (mean=medium). Sand angular to subrounded. Poorly to moderately graded. Igneous and metamorphic gravels; sand is predominantly quartz. No bedding. Slightlly moist. 20% Gravel, 50% sand, and 30% fines.
	No core recovery (14.6'-16.0').
SC:	Same as above See description 14.0'-14.6'.
	No core recovery (16.4'-18.0').
SC:	Same as above See description 14.0'-14.6'.
SC:	Sand with gravel and clay. Light yellowish brown (2.5 Y 6/3) dominates to 20.0'. Fine to coarse gravel (max=2", mean= .25"-.5") and very fine to very coarse sand (mean=fine to medium) Grains subangular to subrounded, comprised of quartz and quarztitic metamorphic rock frags with abundant fe-oxide grains below 20.0'. Moderately well graded, no bedding. Coarser below 21.0'. Slightlly moist. 7% Gravel, 82% sand, 4% silt, and 7% clay.

STATE PLANE COORDINATE:	TOTAL DEPTH (FT): 26.00	GROUND ELEVATION (FT): 5997.90	PROJECT NUMBER: 989073	LOG OF BORING NUMBER:
NORTH: 752090	AREA: OU7 PRESENT LANDFILL	CASING DIAMETER (IN): 2	GEOLOGIST: J. BOYLAN	70393
EAST: 2082389	LOCATOR NUMBER: 12J	BOREHOLE DIAMETER (IN): 7	DATE DRILLED: 02/02/93	

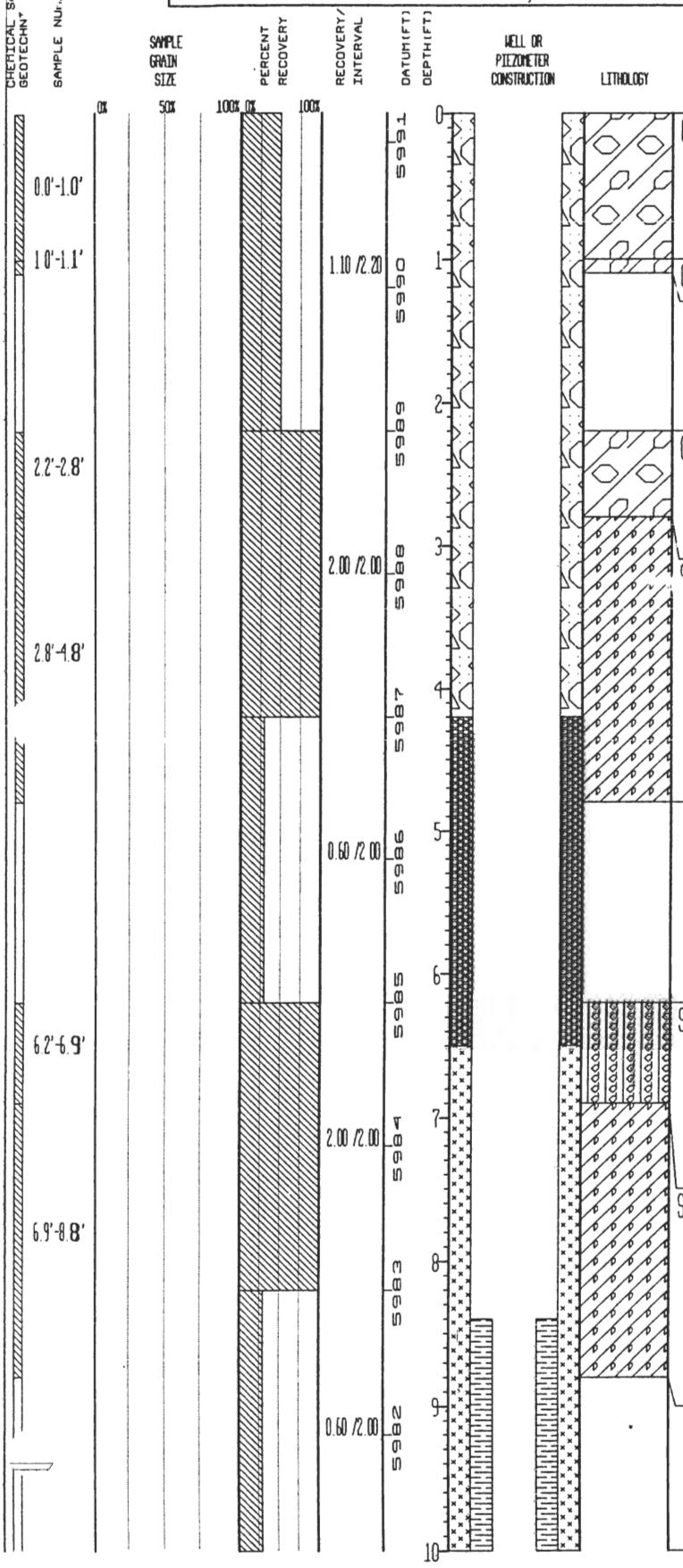
REMARKS: MOBIL DRILL B-57; HSA; CEMENT GROUT 0.0'-4.25', BENTONITE SEAL 4.25'-6.5', SAND 6.5'-24.5', NATURAL BACKFILL 24.5'-26'; CENTRALIZERS PLACED AT 3.8' AND 24.2'; 2' SUMP 22.8'-24.8'; DEPTH TO BEDROCK 22.8'.



UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
SC:	Same as above. See description 18.3'-20.0', with a color change to strong brown (7.5 YR 5/6, 4/6) to reddish yellow (7.5 YR 6/6). Coarsens below 21.0'.
CLAYSTONE:	Claystone. Top of bedrock 22.8'. See description below
	No core recovery (22.9'-24.0').
CLAYSTONE:	Claystone. Light brownish gray (2.5 Y 6/2) above 25.0' to light olive brown (2.5 Y 5/3), yellowish brown (10 YR 5/6, 5/8) and dark yellowish brown (10 YR 4/6, 3/6). Core is thin, extruded due to gravel clast pushed by auger. Trace to some silt. Porosity=5%-10%. Argilloceous cement plus Fe-oxide in yellowed areas. Non- to slightly- friable. No apparent bedding. Slightly moist. 95% Clay and 5% silt. Total Depth 26.0'.

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 30.3	GROUND ELEVATION (FT):	5991.20	PROJECT NUMBER:	989073	LOG OF BORING NUMBER:
NORTH:	752070	AREA: 007 PRESENT LANDFILL	CASING DIAMETER (IN):	2	GEOLOGIST:	JAB/KJT	70693
EAST:	2082799	LOCATOR NUMBER: 11J	BOREHOLE DIAMETER (IN)	10.25	DATE DRILLED:	12/04/92	

REMARKS: MOBIL DRILL B-57; HSA; CEMENT GROUT 0 0'-4.2', BENTONITE SEAL 4.2'-6.5', SAND 6.5'-30.5', NO BACKFILL, NO CENTRALIZERS PLACED; BOREHOLE DIAMETER 10.25" 0'-28.5' AND 3" 28.5'-30', 2.1' SUMP 28.4'- 30.5'; DEPTH TO BEDROCK 28.5'



UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
GC:	Clayey Gravel with some Silt and Sand. Dark brown (7.5 YR 3/2) well graded coarse to fine gravel (max=1.5" diam) and fine to coarse sand in silty clay matrix. Subangular to angular sand and gravel composed of quartz and feldspar frags. Moist 70% Gravel, 10% clay, 10% sand, and 5% silt
GC	See description below. Same as 2.2'-2.8'
	No core recovery (1.1'-2.2')
GC:	Sandy Clayey Gravel. Dark red (2.5 YR 3/6) well graded fine to coarse gravel and sand in silty clay matrix. Subangular sand and gravel, slightly moist. 45% Gravel, 30% sand, 25% clay, and 5% silt
SC:	Gravelly Clayey Sand with some silt. Dark brown (7.5 YR 4/4) fine to coarse gravel (max=3" diam) and fine to coarse sand in silty clay matrix. Well graded, angular to subangular gravel composed of weathered rock frags (igneous and metamorphic), quartz, and feldspar. Sand composed of quartz and feldspar. Gravel and sand strongly weathered with some secondary clay. Slightly moist. 30% Gravel, 35% sand, 20% clay, and 15% silt
	No core recovery (4.8'-6.2')
SM:	Sandy Gravel with some silt. Light olive brown (2.5 Y 5/6) to black (N2). Poorly graded medium to fine gravel in fine to coarse sand and silt matrix with a trace of clay. Gravel and sand subangular to subrounded. Matrix contains tarry substance (creosote?). Moist. 40% Gravel, 50% sand, 8% silt, and 2% clay
SC:	Gravelly Sand with trace of clay. Brown (7.5 YR 5/4) to strong brown (7.5 YR 5/6). Well graded, coarse to fine gravel (max=2" diam) and sand (mean=coarse) in silty clay matrix. Angular to subangular gravel (broken) and subangular sand. Gravel composed of rock frags and quartz. Sand composed of rock frags, quartz, feldspar, and micas. Moist. 27% Gravel, 65% sand, 5% clay, and 3% silt
	No core recovery (8.8'-10.2')

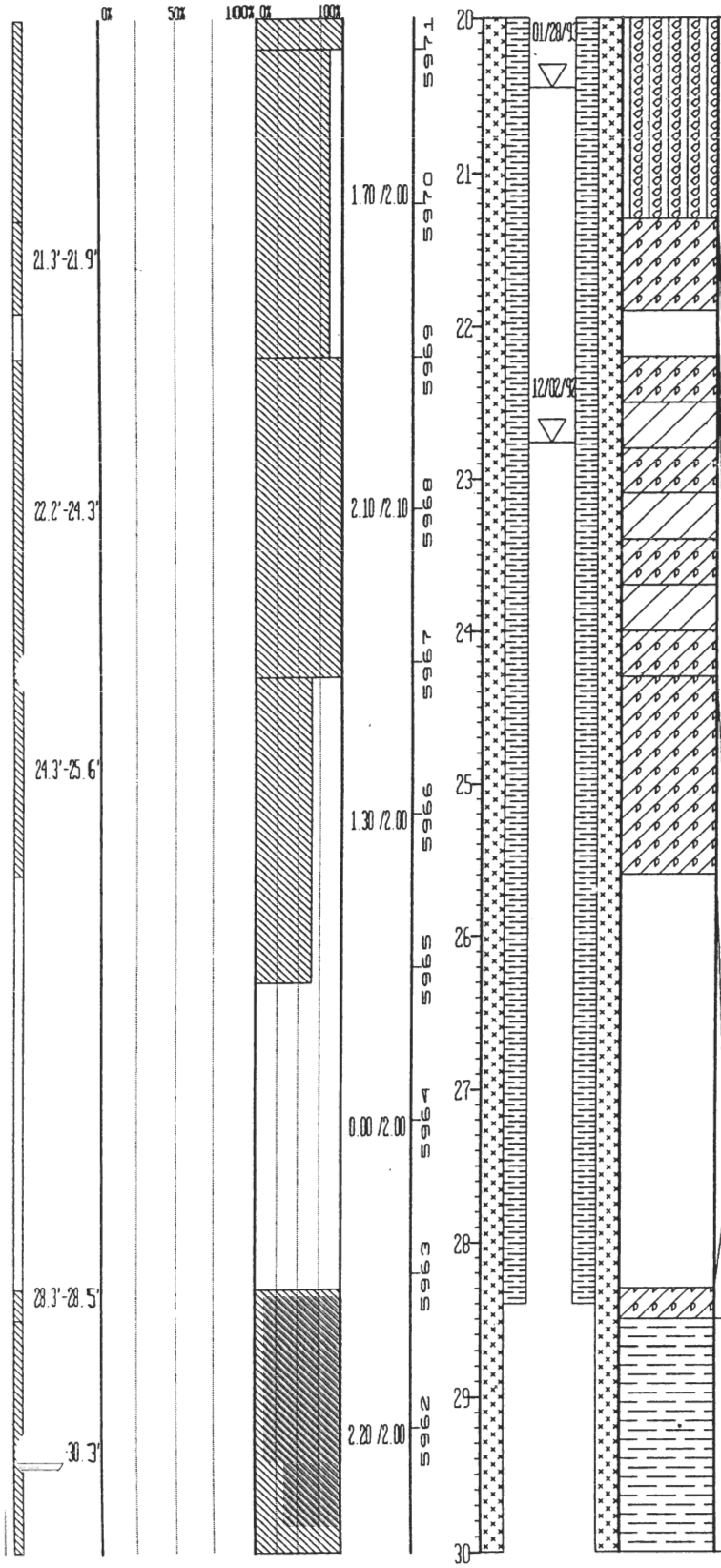
STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 30.3	GROUND ELEVATION (FT)	5991.20	PROJECT NUMBER:	989073	LOG OF BORING NUMBER:
NORTH:	752070	AREA: OU7 PRESENT LANDFILL	CASING DIAMETER (IN)	2	GEOLOGIST:	JAB/KJT	70693
EAST:	2082799	LOCATOR NUMBER: 11J	BOREHOLE DIAMETER (IN)	10.25	DATE DRILLED:	12/04/92	

REMARKS: MOBIL DRILL B-57; HSA; CEMENT GROUT 0.0'-4.2', BENTONITE SEAL 4.2'-6.5', SAND 6.5'-30.5', NO BACKFILL; NO CENTRALIZERS PLACED; BOREHOLE DIAMETER 10.25" 0'-28.5' AND 3" 28.5'-30', 2.1' SUMP 28.4'- 30.5'; DEPTH TO BEDROCK 28.5'

GEOTECHNICAL SAMPLE DEPTH	SAMPLE No.	SAMPLE GRAIN SIZE (0% 50% 100%)	PERCENT RECOVERY (0% 100%)	RECOVERY/INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
						10				No core recovery (8.8'-10.2')
10.2'-12.6'				2.00 /2.00	5981 5980 5979	11 12			SC:	Same as above
12.6'-14.3'				2.00 /2.00	5978 5977	13 14			ML:	Sandy Silt with some clay Reddish yellow (7.5 YR 6/8) Very fine to fine sand in clayey silt matrix. Low plasticity Poorly graded. Subangular to subrounded sand, composed of quartz, micas - including biotite, rock frags, trace of black stained material throughout (not identified) Moist 50% Silt, 30% sand, and 15% clay
14.3'-15.4'				1.40 /2.00	5976 5975	15 16			SC:	Gravelly Sand. Reddish yellow (7.5 YR 6/6) fine to medium gravel and very fine to coarse sand (mean=coarse) in clay and silt matrix. Well graded. Subangular to angular sand and gravel composed of rock frags and quartz. Moist 23% Gravel, 56% sand, 11% clay, and 10% silt.
										No core recovery (15.4'-16.2')
16.2'-16.5'									SC:	Same as above.
16.5'-17.6'				2.00 /2.00	5974 5973	17 18			SC	Clayey Sand with some silt Light brownish gray (2.5 Y 6/2) to reddish yellow (7.5 YR 6/8) Very fine to fine sand in silty clay matrix. Subangular to subrounded sand composed of quartz, micas, rock frags, and feldspar Moist 50% Sand, 40% clay, and 10% silt
21.3'				2.00 /2.00	5972	19 20			SM:	Silty Sand with some gravel and trace of clay Light brownish gray (2.5 Y 6/2) to reddish yellow (7.5 Y 6/8) Heterogeneous mix of gravelly clayey sand, silty sand, and clayey silty sand. Gravel concentrated between 18.0'-18.5' (damaged core) Fine to medium gravel (max=0.5" diam) and very fine to fine sand in silty clay matrix Well graded, sub-angular to subrounded gravel and sand composed of rock frags and quartz with some feldspar, micas, and clays Moist to wet Grades into underlying clay 7% Gravel, 50% Sand, 30% silt, and 13% clay

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 30.3	GROUND ELEVATION (FT)	5991.20	PROJECT NUMBER:	989073	LOG OF BORING NUMBER:
NORTH:	752070	AREA: OU7 PRESENT LANDFILL	CASING DIAMETER (IN):	2	GEOLOGIST:	JAB/KJT	70693
EAST:	2082799	LOCATOR NUMBER: 11J	BOREHOLE DIAMETER (IN):	10.25	DATE DRILLED:	12/04/92	

REMARKS: MOBIL DRILL B-57; HSA; CEMENT GROUT 0.0'-4.2', BENTONITE SEAL 4.2'-6.5', SAND 6.5'-30.5', NO BACKFILL, NO CENTRALIZERS PLACED; BOREHOLE DIAMETER 10.25" 0'-28.5' AND 3" 28.5'-30', 2.1' SUMP 28.4'- 30.5', DEPTH TO BEDROCK 28.5'



UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
SM:	Silty Sand with some gravel and trace of clay. Light brownish gray (2.5 Y 6/2) to reddish yellow (7.5 Y 6/8) Heterogeneous mix of gravelly clayey sand, silty sand, and clayey silty sand. Gravel concentrated between 18.0'-18.5' (damaged core) Fine to medium gravel (max=0.5" diam) and very fine to fine sand in silty clay matrix. Well graded, sub-angular to subrounded gravel and sand composed of rock frags and quartz with some feldspar, micas, and clays. Moist to wet. Grades into underlying clay. 7% Gravel, 50% Sand, 30% silt, and 13% clay
SM:	Same as above
SC:	Clayey Sand with some gravel Strong brown (7.5 Y 5/8) Fine gravel and fine to coarse sand in silty clay matrix. Sub-rounded sand and gravel Moist to wet 5% Gravel, 60% sand, 20% clay, and 15% silt.
	No core recovery (21.9'-22.2')
SC	Clayey Sand to Sandy Clay. Light olive brown (2.5 Y 5/3) to light brownish gray (2.5 Y 6/2) Interbedded sand and clay layers (thick) Very fine to medium sand in clay and silt matrix. Subangular to subrounded sand composed of quartz, felspar, micas, rock frags, and trace of carbonaceous material Some Fe-oxide stains within clay and sand. Wet 50% Sand, 38% clay, and 12% silt, to 72% clay, 10% silt, and 18% sand.
SC	Gravelly Silty Sand. Strong brown (7.5 Y 5/6) Coarse to fine gravel (max=1 3/4" diam) and fine to coarse sand in clayey silt matrix. Subangular gravel but angular where broken with angular to subrounded sand Well graded Gravel composed mainly of quartz, quartzite, and rock frags with some meta-morphic rocks. Sand composed of quartz, rock frags, mafic minerals, and feldspar Wet/saturated. 25% Gravel, 59% sand, 10% silt, and 6% clay
	No core recovery (25.6'-28.3')
SC:	Same as above Top of bedrock 28.5'
CLAYSTONE:	Claystone with trace of silt Grayish brown (2.5 Y 5/2) to light olive brown (2.5 Y 5/6) Clay with trace of silt (4%) Well sorted, porosity=10%, no cement, slightly friable, slightly weathered, mottled gray appearance with some ir-regular patches of Fe-oxide stains, massive, not fractured Moist 96% Clay and 4% silt

STATE PLANE COORDINATE:		TOTAL DEPTH (FT): 30.3	GROUND ELEVATION (FT)	5991.20	PROJECT NUMBER:	989073	LOG OF BORING NUMBER:
NORTH:	752070	AREA: OU7 PRESENT LANDFILL	CASING DIAMETER (IN)	2	GEOLOGIST	JAB/KJT	70693
EAST:	2082799	LOCATOR NUMBER: 11J	BOREHOLE DIAMETER (IN):	10.25	DATE DRILLED:	12/04/92	

REMARKS: MOBIL DRILL B-57; HSA; CEMENT GROUT 0.0'-4.2', BENTONITE SEAL 4.2'-6.5', SAND 6.5'-30.5', NO BACKFILL; NO CENTRALIZERS PLACED; BOREHOLE DIAMETER 10.25" 0'-28.5' AND 3" 28.5'-30', 2.1' SUMP 28.4'- 30.5'; DEPTH TO BEDROCK 28.5'

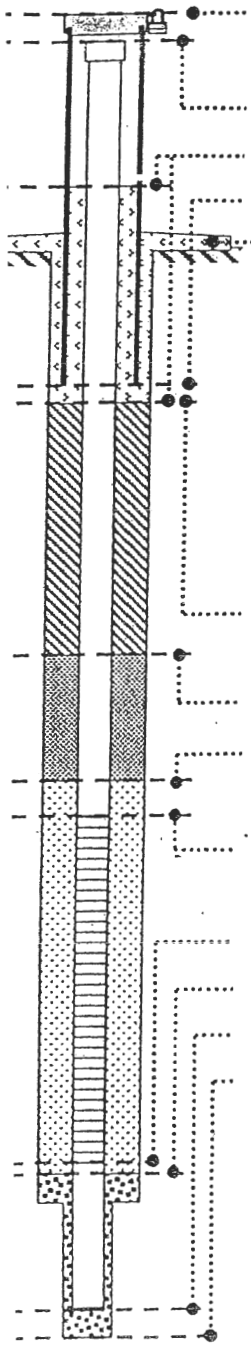
GEOTECHNICAL SAMPLE DEPTH	SAMPLE NO.	SAMPLE GRAIN SIZE	PERCENT RECOVERY	RECOVERY/ INTERVAL	DATUM (FT)	DEPTH (FT)	WELL OR PIEZOMETER CONSTRUCTION	LITHOLOGY	UNIFIED SOILS CLASSIFICATION OR ROCK TYPE	DESCRIPTION
		0% 50% 100%	0% 100%		5961	30			CLAYSTONE	Same as above. Total Depth 30.3'
					5960	31				
					5959	32				
					5958	33				
					5957	34				
					5956	35				
					5955	36				
					5954	37				
					5953	38				
					5952	39				
						40				

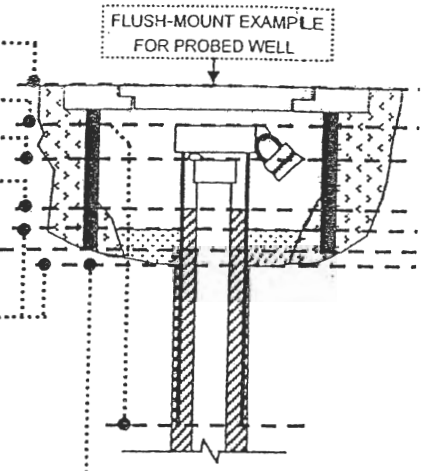
MONITORING WELL INSTALLATION REPORT: Form PRO.118

LOCATION CODE: 73005 PROJECT NAME: CY05 WELL INSTALLATION PROGRAM: PRESENT LANDFILL
SCREENED FORMATION: Bdrk. DRILLING CONTRACTOR: Layne BORING METHOD: Hollow Stem Auger
DATE DRILLED: 6/22/05 DATE COMPLETED: 6/27/05 TOTAL DEPTH: 28.0' COMPLETED DEPTH: 25.0'
ESTIMATED DEPTH TO BEDROCK: 0.0' RIG GEOLOGIST: E. WARP LOGGING GEOLOGIST: E. WARP
BOREHOLE DIAMETER IN SCREENED INTERVAL: 8" QUANTITY OF FLUIDS LOST DURING DRILLING: N/A
INITIAL WATER LEVEL (FT, DATE): Dry, 6/22/05 COMPLETED WATER LEVEL (FT, DATE): Dry, 6/27/05
DIAMETER & TYPE OF INSTALLATION (WELL/PIEZOMETER/WELL POINT/ETC.): 2" PVC WELL
TYPE OF PROTECTION (FLUSH-MOUNT VS. ABOVE GROUND, ASEPTIC, ETC.): ABOVE GROUND STEEL PROTECTIVE CASING

ALL MEASUREMENTS WILL BE MADE IN FEET FROM GROUND SURFACE

* DENOTES ITEMS THAT MAY NOT BE APPLICABLE, DEPENDING ON BORING METHOD, WELL PROTECTION & PURPOSE





PROTECTIVE CASING TOP (STICKUP OR FLUSH-MOUNT): 3.1' a.g.s.
*SECONDARY CASING TOP: N/A BOTTOM: N/A TYPE: N/A
SURFACE CASING TOP: 2.7' ags ID (IN): 2.0
SURFACE SEAL TOP: 1.35' ags BOTTOM: 0.2' bgs TYPE: CONCRETE
PROTECTIVE CASING BOTTOM, ID (IN), TYPE: 1.9', 5"x5" SQUARE STEEL
*WELL PAD DIMENSIONS, TYPE: 3'x3' square, Concrete
*ADD'L CASING FILL TOP: N/A BOTTOM: N/A TYPE: N/A
*SURFACE ISOLATION CASING TOP: N/A BOTTOM: N/A
*SURFACE ISOLATION CASING ID (IN): N/A TYPE: N/A
*OTHER (E.G., ASEPTIC) CASING TOP: N/A BOTTOM: N/A
*OTHER CASING ID (IN): N/A TYPE, PURPOSE: N/A
*CENTRALIZER(S) OD (IN): N/A NUMBER USED: N/A TYPE: N/A
*CENTRALIZER(S) DEPTH(S): N/A
*GROUT TOP: N/A MEASURED DENSITY (LBS/GAL): N/A TYPE: N/A
*GRANULAR BENTONITE TOP: N/A TYPE: N/A
*BENTONITE SEAL TOP: 0.2' TYPE: 1/4" Bentonite pellets - BARROID AND Pel-Plug } HYDRATED W/ 5 gall. of Distilled H_2O
BENTONITE SEAL OR GRANULAR BENTONITE BOTTOM (= FILTER PACK TOP): 4.0'
FILTER PACK TYPE: 16/40 Silica Sand BRAND: C.S.S.I.
SURFACE CASING BOTTOM (=SCREEN TOP): 4.6' TYPE: Sch. 40-PVC
SCREEN ID (IN): 2.0" SLOT SIZE (IN): 0.01 TYPE: Sch. 40-PVC
SCREEN BOTTOM (= SUMP, TOP): 24.65' SUMP TYPE: Threaded End Cap - Sch. 40 PVC
FILTER PACK BOTTOM (= *BACKFILL TOP): 25.0' *BACKFILL TYPE: 1/4" bentonite pellets - Pel-plug
SUMP BOTTOM (= WELL COMPLETED DEPTH): 25.0' *PILOT HOLE TOP, DIAMETER: 26.0', 2.5"
TOTAL BOREHOLE DEPTH (= *PILOT HOLE AND *BACKFILL BOTTOM): 28.0'

REMARKS: Routine well installation on 6/22/05. Top 2' of bentonite seal and protective casing installed on 6/23/05. Concrete well pad installed on 6/27/05

COMPLETED BY: Ellen S. Warp Ellen S. Warp DATE: 6/27/05
CHECKED BY: J. Boylan DATE: 6/30/05

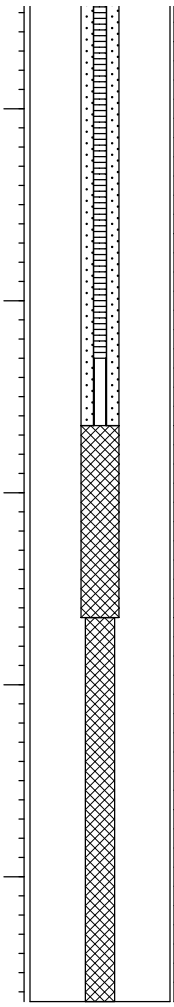
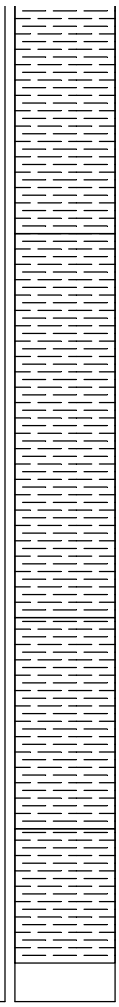
STATE PLANE COORDINATES AREA: GRND ELEV. (FT): 5937.35 CASING DIA (IN): 2
NORTH: 753006.65 TOTAL DEPTH (FT): 28.0 BH DIA. (IN): 8
EAST: 2084095.22 COMPLETION DATE: 6/22/05 GRID LOCATOR:
PROJECT: Present Landfill GEOLOGIST: E. Warp
REMARKS:

LOG OF BORING NUMBER: 73005

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5940	Protective Casing, 5 in. square, Steel; Casing, Sch 40-PVC, 2 in. ID.	3			
5939	Concrete Seal	2			
5938	Concrete Pad	1			
5937		0			SILTSTONE: Clayey Siltstone, light yellowish brown (10YR6/4). Massive texture, trace roots, dry.
					SILTSTONE: Clayey Siltstone with trace to some sand in pockets (rip-up?), brownish yellow (10YR6/6) with some light gray (10YR7/1) mottling. Weak to moderate pervasive iron oxidation with some un-oxidized mottling. Massive texture. Weak to moderately friable, trace roots. Slightly moist. Trace to some, very fine grained, sand.
5936		1			CLAYSTONE: Silty Claystone, light brownish gray (10YR6/2). Decreased iron oxidation to trace. Strongly friable, crumbly, trace roots, slightly moist.
5935	Hydrated Bentonite Pellets	2			No recovery.
					SILTSTONE: Clayey Siltstone, light yellowish brown (10YR6/4) to light brownish gray (10YR6/2). Weak pervasive iron oxidation from 2.0' to 2.1'. Massive texture, slightly moist. Increasing clay at base of interval. Moderately friable.
5934		3			CLAYSTONE: Claystone with some silt, light brownish gray (10YR6/2). Trace weak iron oxidation, predominately along bedding planes (subhorizontal) and fracture surfaces. Trace white caliche stringers and blebs. Massive texture, moderately friable, slightly moist.
5933	Filter Pack, 16/40 Silica Sand	4			No recovery.
					CLAYSTONE: Claystone with some silt, pale brown (10YR6/3) with some gray (10YR5/1) mottling. Weak pervasive iron oxidation from

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
					4.0' to 4.4'. Gray mottling from 4.4' to 4.8', with iron oxidation on internal fracture surfaces. Massive texture. Slightly moist from 4.0' to 4.4', increase to moist from 4.4' to 4.8'. Friable.
5932	Screen, Sch 40-PVC, 2 in. ID., 0.010 in. slots	5			CLAYSTONE: Claystone with some silt, gray (10YR5/1) to grayish brown (10YR5/2). Weak iron oxidation along bedding planes. Massive texture, weak to moderately friable, slightly moist.
		6			No recovery.
5931					CLAYSTONE: Claystone with trace silt, same as interval from 4.8' to 5.9'. Slightly moist.
5930		7			CLAYSTONE: Claystone, gray (10YR6/1), predominately un-oxidized. Faint undulating bedding planes visible. Trace black organic stringers throughout. Weak to moderately friable. Slightly moist.
		8			No recovery.
5929					CLAYSTONE: Claystone, gray (10YR6/1), predominately un-oxidized. Faint undulating bedding planes visible. Trace black organic stringers throughout. Weak to moderately friable, slightly moist.
5928		9			
		10			No recovery.
5927					CLAYSTONE: Claystone, gray (10YR6/1), predominately un-oxidized. Faint undulating bedding planes visible. Trace black organic stringers throughout. Weak to moderately friable, slightly moist. Trace iron oxidation stringers from 10.3' - 10.5'.
		11			CLAYSTONE: Claystone, brown (10YR5/3), slight color change. Faint laminations (bedding planes) visible with trace to some black organic stringers on planes. Trace to some iron oxidation stringers along bedding planes and fracture surfaces. Weak to moderately friable, slightly moist.
5926					
		12			CLAYSTONE: Claystone, gray (10YR5/1 to 10YR6/1). Weak iron oxidation along bedding planes at 11.6' and from 12.2' to 13.0'. Fissile and moderately friable, slightly moist. Iron oxidation along fracture surfaces, especially from 11.6' to 11.8' and 12.2' to 13.0'.
5925					
		13			
5924					

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
		14			SILTSTONE: Clayey Siltstone to silty claystone, pale brown (10YR6/3) to light brownish gray (10YR6/2). Weak iron oxidation on sub-horizontal bedding planes (approximately 4 to 6 iron-oxidized bedding planes per foot) and fracture surfaces. Trace black organic stringers. Notable iron oxidation coating 80 deg fracture from 18.9' to 19.2'. Color of iron oxidation is strong brown (7.5YR5/6). Iron oxidation on 20 deg fracture from 19.5' to 19.6'. Moisture decreasing to trace. Occasional iron oxidation-replaced organic debris fragments. Some intervals to silty claystone, but predominately clayey siltstone.
5923					
		15			
5922					
		16			
5921					
		17			
5920					
		18			
5919					
		19			
5918					
		20			
5917					
		21			
5916					
		22			SILTSTONE: Clayey Siltstone to silty claystone, gray (10YR5/1). Notable color change. Decrease iron oxidation to trace as minor fracture coating. Massive texture, moderately friable. Increase moisture to slightly moist.
5915					

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5914		23			CLAYSTONE: Claystone with some silt, yellowish brown (10YR5/6) and gray (10YR5/1). Weak iron oxidation mottled throughout. Iron oxide coating ~80 deg fracture at 22.9'. Moderate pervasive iron oxidation from 23.7' to 23.8'. Moderately friable from 23.1' to 24.0', corresponding with increased moisture zone. Slightly moist from 22.7' to 23.1', moist from 23.1' to 24.0'.
		24			CLAYSTONE: Claystone with trace silt, gray (10YR5/1) to light brownish gray (10YR6/2). Decreased iron oxidation to trace along bedding planes and fracture surfaces. Massive textured, moderately friable. Clay-rich (no silt) from 24.0' to 24.2' and slightly darker color (dark gray: 10YR4/1). Moist, decreasing to very slightly moist from 24.2' to 26.0'. Fissile between 24.5' and 25.7'. Trace black organic material.
5913					
		25	Threaded End Cap - Sump, Sch 40-PVC		
5912			Bentonite Pellet Backfill		
		26			CLAYSTONE: Claystone, grayish brown (10YR5/2). Massive texture, weakly friable. Iron oxidation along internal fractures at 26.3' and 27.0'. Very slightly moist.
5911			Bentonite Pellet Backfill in Pilot Hole		
		27			CLAYSTONE: Claystone, dark gray (10YR4/1). Notable color change. Fissile and friable, trace moisture.
5910					
		28			No recovery.

STATE PLANE COORDINATES AREA: GRND ELEV. (FT): 5925.8 CASING DIA (IN): 2

NORTH: 752878.53 TOTAL DEPTH (FT): 27.7 BH DIA. (IN): 8

EAST: 2084050.53 COMPLETION DATE: 6/27/05 GRID LOCATOR:

PROJECT: Present Landfill GEOLOGIST: E. Warp

REMARKS:

LOG OF BORING NUMBER: 73105

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5929	Protective Casing, 5 in. square, Steel; Casing, Sch 40-PVC, 2 in. ID.	3			
5928		2			
5927		1			
5926	Concrete Seal; Concrete Pad	0			GP: Gravel (fill), pea gravel (1/4" diameter, subrounded to subangular), composed of granite and quartzite. Poorly graded, dry.
5925		1			CL: Clay with trace sand and gravel, grayish brown (10YR5/2) to gray (10YR5/1). Re-worked claystone. Thin black organic stringers common, moist.
5924		2			SC/CL: Gravelly, Sandy Clay to clayey, gravelly sand, strong brown (7.5YR5/6). Imported fill (Qalrf). 60% clay, medium plasticity, 30% sand (medium grained to coarse grained, subrounded to subangular), 10% gravel (1/4" diameter, subrounded to subangular), very moist.
5923	Hydrated Bentonite Pellets	3			No recovery.
5922		4			SC/CL: Gravelly, Sandy Clay to clayey, gravelly sand, strong brown (7.5YR4/6). Imported fill (Qalrf). Very similar to interval from 0.4' to 0.8'. 65% clay, medium plasticity, 20 - 25% sand (medium grained to coarse grained, subangular to subrounded), 10 - 15% gravel (1/8" - 1/4" diameter, subrounded, predominately granite and quartzite), saturated, but not flowing.
					No recovery.
					SC/CL: Gravelly, Sandy Clay to clayey, gravelly sand, strong brown (7.5YR4/6). Imported fill (Qalrf). Very similar to interval from 2.0' to

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5921	Filter Pack, 16/40 Silica Sand	5			2.9'. 60% clay, medium plasticity, 25% sand (medium grained to coarse grained, subangular to subrounded), 15% gravel (1/4" - 1/2" diameter, subangular, composed of granite, quartzite, and schist), saturated.
5920	Screen, Sch 40-PVC, 2 in. ID., 0.010 in. slots	6			No recovery.
5919		7			GP: Gravel with trace sandy clay, strong brown (7.5YR4/6) clay. Appears to be pea-gravel (possible slough). Gravel (1/4" - 3/4" diameter, subrounded to subangular), poorly graded. Moisture decreases from saturated to moist.
5918		8			GC/CL: Gravelly, Sandy Clay and shattered quartzite cobble mixture. 45% gravelly, sandy clay, light brown (7.5YR6/4) with 55% shattered cobbles (1/2" to 1-1/2" diameter, angular), moist.
5917		9			No recovery.
5916		10			GC/CL: Sandy Clay/Gravel mixture, strong brown (7.5YR5/6) clay. 60 - 70% gravel and cobbles, 20 - 30% clay (medium plasticity), 5 - 10% sand (coarse grained, subangular). Shattered quartzite cobbles from 8.4' to 8.6' (2" diameter) and from 9.2' to 9.5' (2" - 3" diameter). Moist.
5915		11			No recovery.
5914		12			GC/CL: Sandy Clay/Gravel mixture, strong brown (7.5YR5/6). 50% clay (medium plasticity), 30% gravel (1/8" - 3/4" diameter, subangular), ~20% sand (coarse grained), moist. Quartzite cobbles (1" - 2" diameter) at 11.2' and 11.7'.
5913		13			No recovery.
					GC/CL: Sandy Clay/Gravel mixture, same as interval from 10.0' to 11.9'.
					CL: Silty Clay, gray (10YR6/1). Re-worked silty claystone. Poor recovery due to clogged split spoon sampler producing "ribbons" of claystone. Probable cobble lodged in sampler. Moist.
					No recovery.

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5912					
		14			CLAYSTONE: TOP OF BEDROCK. Silty Claystone (weathered bedrock), grayish brown (10YR5/2) with some yellowish brown (10YR5/6) mottling. Massive texture, firm and cohesive. Weak to moderately friable. Weak iron oxidation mottled throughout. Trace black organic material. Moist. Bedrock contact estimated at 12.5'. Estimated by drilling conditions and changes in penetration.
5911		15			No recovery.
5910		16			CLAYSTONE: Silty Claystone, iron oxidized, yellowish brown (10YR5/4), grading to gray (10YR5/1) at base of interval. Moderate pervasive iron oxidation from 16.0' to 16.3', then decreasing at base. Massive texture, weak to moderately friable. Saturated from 16.0' to 16.2', decreasing to moist from 16.2' to 16.3'.
5909		17			CLAYSTONE: Claystone with silt, iron oxidized, yellowish brown (10YR5/8). Strong pervasive iron oxidation. Firm and dense, moist. Black organic material common as stringers and along undulating bedding planes.
5908		18			CLAYSTONE: Claystone with silt, grayish brown (10YR5/2) with some yellowish brown (10YR5/6) mottling. Decreasing overall iron oxidation to weak, mottled. Firm, weakly friable, moist. Black organic stringers common. Faint bedding visible.
					No recovery.
5907		19			CLAYSTONE: Claystone with trace to some silt, gray (10YR5/1) with yellowish brown (10YR5/4) mottling. Weak iron oxidation mottled throughout. Firm/dense. Weakly friable. Black organic stringers common. Black carbonaceous material coating bedding planes at 18.9' and 19.0'. Moist.
5906					No recovery.
		20			CLAYSTONE: Claystone, light brownish gray (10YR6/2) to gray (10YR6/1). Massive texture, firm/dense. Trace overall iron oxidation. Weak iron oxidation from 21.7' to 22.0'. Trace black organic stringers. Moisture decreases to slightly moist.
5905		21			
5904		22			
					CLAYSTONE: Claystone, gray (10YR5/1) to dark gray (10YR4/1).

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5903		23			Un-oxidized bedrock. Notable color change. Massive texture, firm/dense. Trace black organic material. Moisture decreases to very slightly moist. Abrupt color change at base.
5902		24			CLAYSTONE: Claystone, dark gray (10YR4/1) to very dark gray (10YR3/1). Un-oxidized, un-weathered bedrock. Fissile/friable. Black carbonaceous material common. Decreasing moisture.
5901		25			
5900	Threaded End Cap - Sump, Sch 40-PVC	26			No recovery.
	Bentonite Pellet Backfill in Pilot Hole				CLAYSTONE: Claystone, dark gray (10YR4/1) to very dark gray (10YR3/1). Un-oxidized, un-weathered bedrock. Fissile/friable. Black carbonaceous material common. Abundant black carbonaceous material from 27.0' to 27.7'. Moisture decreases to trace. Refusal at 27.7'.
5899		27			

STATE PLANE COORDINATES AREA: GRND ELEV. (FT): 5937.12 CASING DIA (IN): 2
NORTH: 752767.53 TOTAL DEPTH (FT): 32.0 BH DIA. (IN): 8
EAST: 2084218.33 COMPLETION DATE: 6/27/05 GRID LOCATOR:
PROJECT: Present Landfill GEOLOGIST: E. Warp
REMARKS:

LOG OF BORING NUMBER: 73205

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5940	Protective Casing, 5 in. square, Steel	3			
	Casing, Sch 40-PVC, 2 in. ID.				
5939		2			
5938		1			
	Concrete Seal				
5937	Concrete Pad	0			CL: Clay with silt, trace gravel, and trace sand, brown (7.5YR4/3). Medium plasticity and firm. Trace to 3% disseminated caliche. Trace roots. Schist cobble (3/4" diameter, subangular) at 0.3'. Slightly moist to moist.
5936		1			
					No recovery.
5935	Hydrated Bentonite Chips	2			CL: Clay with silt, trace gravel, and trace sand, brown (7.5YR4/4 to 7.5YR4/2). Medium plasticity and firm. Same as interval from 0.0' to 1.5'. Slightly moist.
5934		3			GC/CL: Sandy Gravel/Clay mixture, brown (7.5YR4/4). ~75% sandy gravel and ~25% clay. Gravel (1/4" - 1" diameter, subangular to subrounded, predominately quartzite). Sand (coarse grained, subangular). Weak iron oxidation disseminated throughout clay and as coating on 1/4" gravel clasts. Trace disseminated caliche. 2" diameter quartzite cobble at 2.4'. Shattered quartzite cobble from 3.0' to 3.2'. Poor recovery due to cobbles. Slightly moist.
					No recovery.
5933	Filter Pack, 16/40 Silica Sand	4			CL: Sandy, Gravelly Clay, brown (7.5YR4/4). 5 - 10% gravel (1/4" - 1/2" diameter, subrounded to subangular, predominately quartzite). 5 - 7% sand (coarse grained, subangular). Clay has medium
	Screen, Sch 40-PVC, 2 in. ID., 0.010 in.				

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
					plasticity. Moisture increases from slightly moist to moist.
5932		5			CLAYSTONE: TOP OF BEDROCK. Claystone, grayish brown (10YR5/2) to gray (10YR5/1). Firm/dense. Black organic stringers common on undulating bedding planes. 1/4" caliche lense at base of interval. Sharp basal contact, color change. Moist.
5931		6			CLAYSTONE: Claystone, iron-oxidized/weathered, yellowish brown (10YR4/6). Moderate to strong pervasive iron oxidation. Moderately friable. 1/4" caliche lense at top of interval and as blebs throughout. Moist.
					CLAYSTONE: Silty Claystone, gray (10YR6/1). Dinstinct color change. Massive texture. Caliche mottled throughout. Friable. Moisture decreases to very slightly moist.
5930		7			No recovery.
					CLAYSTONE: Claystone, iron oxidized/weathered, yellowish brown (10YR5/6 to 10YR5/4). Weak pervasive iron oxidation. Weak to moderately friable. Trace white caliche stringers. Thin caliche lense at 6.8'. Slightly moist.
5929		8			CLAYSTONE: Claystone, grayish brown (10YR5/2). Decreased iron oxidation to trace as stringers. Moderately friable. Massive texture. Slightly moist.
					No recovery.
5928		9			CLAYSTONE: Silty Claystone, iron oxidized, yellowish brown (10YR5/4). Weak to moderate pervasive iron oxidation. Massive texture. Weak to moderately friable. Black manganese oxide (possible organics) bleb at 8.2'. Slightly moist.
5927		10			CLAYSTONE: Claystone, gray (10YR5/1). Decreased iron oxidation to trace. Massive texture, firm yet weakly friable. Trace black organic stringers throughout. Black organic lense (1/8" thick) at 11.2'. Trace iron oxidation stringers from 11.2' to 12.0'. Moisture decreases to very slightly moist. Hard, cryptocrystalline calcareous clast (~3/8") at 9.9'.
5926		11			
5925		12			CLAYSTONE: Claystone, gray (10YR6/1). Massive texture, dense/firm, weakly friable. Trace to some iron oxidation. Abundant black organic material from 12.8' to 13.0'. Very slightly moist.
5924		13			CLAYSTONE: Claystone with silt, gray (10YR6/1). Massive texture as above interval from 12.0' to 13.3'. Un-oxidized bedrock. Trace black organic stringers. Firm/dense. Thin caliche lense along

slots

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
					internal bedding plane at 13.7'. Very slightly moist.
5923		14			
5922		15			CLAYSTONE: Silty Claystone, gray (10YR6/1). Weak iron oxidation along horizontal bedding planes. Predominately massive texture, firm/dense. Trace black organic stringers and blebs. Weak to moderate pervasive iron oxidation from 17.3' to 17.7'. Near-vertical fracture (~80 deg) from 18.9' to 19.5' with iron oxide coating. 1/4" horizontal lense of carbonate (druse) at 19.7'. Interval slightly moist. Occasional sandy intervals at 17.1', and from 17.6' to 17.7'. Claystone interval from 18.8' to 19.1'. Rip-up clasts, iron oxide-replaced organic debris present. Sand is very fine grained to fine grained.
5921		16			
5920		17			
5919		18			
5918		19			
5917		20			
5916		21			CLAYSTONE: Claystone, grayish brown (10YR5/2). Weak iron oxidation as stringers and along bedding planes. Black organic material along bedding planes. Possible manganese oxide associated with iron oxidation along bedding and fracture surfaces. Dense/firm. Slightly moist.
5915		22			CLAYSTONE: Claystone, gray (10YR6/1 to 10YR5/1). Trace weak iron oxidation as stringers and along bedding/fracture surfaces. Iron oxidation as fracture (~50 deg) coating at 22.6'. Interval weak to moderately friable. Massive texture. Slightly moist.

Elev (Ft)	Well or Piezometer Construction and Materials	Depth (Ft)	Lithology	Unified Soils Classification or Rock Type	Lithologic Description
5914		23			CLAYSTONE: Claystone, dark gray (10YR4/1). Firm/dense. Trace iron oxidation along bedding planes/fracture surfaces. Bedding planes are faintly visible. Trace black organic material along bedding and as clasts (to 1/2" diameter). Slightly moist from 23.1' to 24.2', decreases to trace moisture from 24.2' to 30.4'. Weak pervasive iron oxidation from 29.1' to 29.3'.
5913		24			
5912		25			
5911		26			
5910		27			
5909		28			
5908		29			
5907	Threaded End Cap - Sump, Sch 40-PVC	30			
5906	Bentonite Pellet Backfill in Pilot Hole	31			CLAYSTONE: Claystone, un- (iron) oxidized/un-weathered, very dark gray (10YR3/1). Distinct color change. Firm and dense. Trace iron oxidation stringers from 31.8' to 31.9'. Sub-horizontal, undulating bedding faintly visible. Black organic material common along bedding planes and as clasts (to 1/2" diameter). Trace moisture.
		32			

Master Rocky Flats Site Ecology Reports Reference List

(Last Updated 5/1/08)
Most of these reports are available electronically in Adobe (.pdf) format.

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MEMORANDUM OF AGREEMENT FOR THE ADMINISTRATION OF A WETLAND BANK AT ROCKY FLATS

Introduction

The Rocky Flats Environmental Technology Site (RFETS) is owned by the Department of Energy (DOE). The current site mission is environmental restoration, waste management, management of special nuclear materials, and decontamination and decommissioning of facilities.

The environmental impacts associated with past, present, and future activities at the site are being investigated by DOE pursuant to the requirements of the Atomic Energy Act (AEA), the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Response actions undertaken may result in wetland impacts regulated by Section 404 of the Clean Water Act (CWA) on the RFETS. Wetland impacts resulting from CERCLA and non-CERCLA actions require mitigation.

The 6,265 acre RFETS has approximately 1100 wetlands covering approximately 191 acres that were identified and mapped in a 1994 sitewide wetland delineation performed by the U.S. Army Corps of Engineers (the Corps) Omaha District. The wetland inventory as identified by the Corps map is the basis for the RFETS wetlands map (Wetlands Map) which establishes the baseline for the wetlands inventory.

Regulatory Authority

Section 121 (e) of CERCLA establishes that a CWA Section 404 permit is not required for CERCLA response actions conducted entirely on site. However, it is EPA's responsibility to ensure that the substantive requirements of CWA Section 404 are met. CERCLA response actions must meet the substantive requirements of Section 404 of the CWA. For non-CERCLA actions on RFETS, the Corps administers the substantive and administrative requirements of CWA Section 404 including compliance with CWA Section 404(b)(1) Guidelines. By agreement between EPA and the Corps, EPA will make the determination of whether or not wetlands impacts on RFETS are related to CERCLA response actions. If impacts are not CERCLA related, the Corps has jurisdiction. For the purposes of this memorandum, the regulatory agency with jurisdiction will be considered the Lead Agency.

This Memorandum of Agreement for the Administration of a Wetland Bank at RFETS (MOA) has been designed with consideration given to the Draft Federal Guidance for the Establishment, Use, and Operation of Mitigation Banks (Guidance).

Mitigation projects will comply with the following:

1. Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230) .

2. The Memorandum of Agreement between the EPA and the Department of the Army Concerning the Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines

3. The substantive requirements of Executive Order 11988, Floodplain Management .

4. The substantive requirements of Executive Order 11990, Protection of Wetlands .

5. The substantive requirements of 10 CFR 1022, Compliance with Floodplain/Wetland Environmental Review Requirements .

Purpose

This MOA is an agreement between DOE Rocky Flats Field Office (DOE, RFFO), EPA, the Corps, and the U.S. Fish and Wildlife Service (FWS), that describes how wetland impacts and mitigation will be accounted for using a mitigation bank established and maintained by DOE, RFFO. The sole purpose of this MOA is to provide the administrative procedure for using the acreage established by a wetland bank to ensure that RFETS wetland functions and values will be maintained.

This MOA is intended to enable DOE, RFFO to track compensatory mitigation for unavoidable wetland impacts resulting from DOE activities on the RFETS. This agreement is also intended to establish a means of tracking consolidation of compensatory mitigation for impacts to small, isolated, fragmented wetlands into parcels that provide enhanced wetland functions and values. The Parties agree that compensatory mitigation projects should be located where there are appropriate physical, hydrological, chemical, and biological characteristics to establish and maintain wetland functions and values in advance of wetland disturbance.

The Parties to this agreement have established that the goal of wetland mitigation is to achieve no overall net loss of wetland functions and values. This goal will be achieved by developing sustainable, functioning wetlands that provide compensatory mitigation for authorized unavoidable wetland impacts, while allowing CERCLA/RCRA response actions and other Site activities to proceed without unreasonable delays. The Parties to this agreement recognize that "no net loss" may not be achieved. However, it remains a goal to achieve no overall net loss of wetland functions and values resulting from RFETS activities.

Bank Administration

The DOE, RFFO, EPA, the Corps, and the FWS have agreed to the terms of this MOA, thereby establishing the administrative framework for managing the wetlands bank. DOE will take all necessary steps and use its best effort to obtain timely funding to meet commitments that may arise under this MOA. The Parties agree that any obligation of funds required as a result of this MOA are subject to the availability of appropriated funds, and no provisions shall be interpreted to require obligation or payments in violation of the Anti-Deficiency Act, 31 U.S.C. Sec. 1341.

Bank Sponsor/Administrator

DOE, RFFO is the wetland bank sponsor/administrator responsible for the overall management of the wetland inventory and responsible for ensuring wetland mitigation. DOE, RFFO will track compensatory mitigation for unavoidable impacts to wetlands resulting from DOE activities occurring within the RFETS boundary or within Operable Units associated with RFETS.

DOE, RFFO shall establish and maintain an accounting system in the form of a ledger that will document and track the credits and debits of the wetland bank. This ledger will provide an up to date running total of available wetland mitigation acreage. An example ledger used to administratively record each transaction is presented in Appendix A. Auditing of the ledger may be performed by EPA, the Corps, or the FWS on an as needed basis. In addition, field inspections and verification may be undertaken by any party to this MOA at any time.

DOE, RFFO shall prepare an annual report which documents all bank transactions occurring in the preceding 12 month period. This annual report shall be submitted to EPA, the Corps, and the FWS along with a revised site wetland inventory map. The revised map will show locations of projects that resulted in credits or debits for the preceding 12 month period.

Necessary Credit/Debit Documentation

Each wetland **credit** project submittal shall address the following information as appropriate:

* Identification of the Project Manager as point of contact
* Project description, including location maps and a description of the class and approximate acreage of wetland to be developed
* Plans for the restoration, creation, enhancement, or preservation of the compensatory wetland
* Project schedule
* Long term ownership and protection of the mitigation wetland, including appropriate real estate agreements and legal instruments which prevent harmful activities that would jeopardize the continued conservation purpose of the wetland
* Opportunity for public review and participation
* Availability of the water supply
* Funds for the development, operation, maintenance, and monitoring of the project during the bank's operational life, as well as for management of the project
* Performance standard for determining success of the wetland project and a monitoring plan to ensure that the standards are being met.
* Field verification of approximate acreage and kind, when established
* Maintenance plan.
* Remedial action plan describing the procedures for identifying and implementing appropriate remedial action when the need is identified by the monitoring plan.

Each wetland **debit** project submittal shall address the following information as appropriate:

* Identification of the Project Manager as the point of contact
* Project description, including location maps and a description of the class and approximate acreage of wetland to be impacted.
* Sequencing documentation
* Reasons and plans for impacting the wetlands
* Field verification of approximate acreage and kind

* Project schedule
* Opportunity for public review and participation

Checklists of required items for each credit and/or debit wetlands project are presented in Appendix B. The Parties may enlist the participation of various local, state, or federal entities to assist in the development of individual wetland projects.

Credit/Debit Evaluation

In general, the same methodology will be used to evaluate both credits and debits. DOE shall submit credit and debit documentation to the EPA and the Corps. Individual project requirements and schedules will be established by agreement between the Lead Agency and the DOE, RFFO project manager. In general, the Lead Agency will review documents submitted by DOE within 30 days. DOE will revise and resubmit documents for review within 30 days of receipt of comments and shall request approval from the Lead Agency.

The EPA and the Corps, in consultation with the FWS, will review mitigation projects proposed by DOE for use as wetland bank credits in accordance with the provisions of this MOA. Projects proposed by DOE for use as wetland mitigation bank credits will be identified using the 1987 Corps of Engineers Wetlands Delineation Manual, the same methodology as that used in the 1994 sitewide wetland delineation. After review, the EPA and the Corps will then, if they deem appropriate, approve. If approval is not given, EPA and/or the Corps will provide detailed explanation for disapproval.

For debit projects, the Lead Agency, in consultation with the FWS, will review the documentation. The Lead Agency will then, if deemed appropriate, approve. If approval is not given, the Lead Agency will provide detailed explanation for disapproval.

The credits and debits will be based on the number of acres of wetlands and on the Cowardin class of the wetland. Compensatory wetlands of the same Cowardin class as those being impacted will be considered in-kind mitigation. Appropriate mitigation ratios will be determined on a case by case basis, using professional judgment.

The credit value will be determined based on acreage to be attained from the compensatory wetlands at the time of debiting. The maturity of the compensation wetland and its apparent ability to survive and function, based on best professional judgment, should be factors in determining the value of the credits available. The debit value will be determined based on the areal extent of the impacted wetland, after considering the condition of the impacted wetland. The Lead Agency will make the determination of the relative value of credit and debit acreage.

Timing of Debits

In general, impacts to wetlands will not occur unless there is sufficient acreage available in the wetland bank to adequately mitigate for the impacts. It may be appropriate to allow limited debiting based upon a projected wetland acreage. Once an area has been mitigated for any project, that area will not require any future mitigation for impacts from that project (e.g., impacts associated with maintenance of ditches).

Sequencing Requirements

Site wetland mitigation will consist of sequentially avoiding wetland impacts, minimizing wetland impacts, and finally providing compensatory mitigation for any remaining unavoidable impacts. This sequencing will be consistent with mitigation policies established under the Section 404(b)(1) Guidelines and described in the MOA between the EPA and the Department of the Army. Bank credits will be used to provide compensatory mitigation only after this sequencing has been followed.

Wetlands Map

A RFETS Wetland Map will be prepared that is based on the wetlands delineation undertaken by the Corps of Engineers in 1994. The RFETS Wetland Map will be updated to reflect changes that occur in wetland extent and location.

Siting of Compensatory Wetlands

Compensatory mitigation should be undertaken in areas adjacent or contiguous to the impact site when practicable and environmentally preferable. The preference for on-site mitigation, however, should not preclude the use of an off-site mitigation project when there is no practicable opportunity for on-site compensation, or when use of an off-site project is environmentally preferable to on-site compensation. Mitigation locations will be selected after consideration of the potential for the site to provide the necessary physical, chemical, hydrologic, and biological characteristics and the desired wetland functions and values. The adequacy of the water supply, and the compatibility with adjacent land uses and watershed management plans will also be considered during site selection. Impacts to ecologically significant resources (e.g., upland and wetland), cultural resources, and threatened and endangered species will be avoided to the maximum extent practicable.

Compensatory wetland sites that allow in-kind replacement of wetlands will be preferable; however, locations that best support a different type of wetland (out-of-kind) may be used as compensatory mitigation in situations determined by the Lead Agency to be environmentally preferable.

Dispute Resolution

Except as discussed below, any disputes resulting over issues related to the mitigation bank will be addressed and resolved according to the dispute resolution provisions identified in the *Federal Guidance for the Establishment, Use, and Operation of Mitigation Banks*. The Guidance referenced above contemplates only banks for Corps lead activities and projects. In activities related to CERCLA response actions, EPA is the lead agency and the parts of the Guidance referencing the Corps' role shall be interpreted to mean EPA's role.

The Parties to this agreement reserve their right to challenge any decision made by the other Parties to this agreement under all applicable laws relating to that decision.

Mitigation MOA Operational Life

This MOA will terminate upon written notification by any one of the signatories to DOE, the EPA, the Corps, and the FWS. Management and protection of the individual wetland projects undertaken will continue in compliance with the requirements of applicable laws.

MEMORANDUM OF AGREEMENT
FOR THE ADMINISTRATION OF A WETLAND BANK
AT ROCKY FLATS

James K. Hartman
Assistant Manager of Site Support and Security
DOE, RFFO Representative

Oct 25, 1995
Date

Max H. Dodson
Director, Ecosystems Protection and Remediation Division
EPA, Region VIII Representative

11/15/95
Date

Michael S. Meuleners
Colonel, District Engineer
U.S. Army Corps of Engineers Representative

2/6/96
Date

U.S. Fish and Wildlife Service Representative

3-11-96
Date

REFERENCES

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APPENDICES

CHECKLIST

for

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE WETLAND MITIGATION BANK CREDIT PROJECTS

Each compensatory wetland mitigation project submittal should address the following information as appropriate:

- Identification of Project Manager as point of contact.
- Project description, including location maps and a description of the class and approximate acreage of wetland to be developed.
- Plans for the restoration, creation, enhancement, or preservation of the compensatory wetland.
- Project schedule.
- Long term ownership and protection of the mitigation wetland, including appropriate real estate agreements and legal instruments which prevent harmful activities that would jeopardize the continued conservation purpose of the wetland.
- Opportunity for public review and participation.
- Availability of the water supply.
- Funds for the development, operation, maintenance, and monitoring of the project during the Banks operational life, as well as for management of the project.
- Performance standards for determining success of the wetland project.
- Maintenance plan.
- Field verification of approximate acreage and kind, when established.
- Monitoring plan adequate to evaluate the success of the wetland and to identify field conditions requiring remedial action.
- Remedial action plan describing the procedures for determining and implementing appropriate remedial actions when the need is identified by the monitoring plan.
- Contingency plan, including sufficient funding, to be used in the event of a project failure.

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
WETLAND MITIGATION BANK - CREDITS
EXAMPLE

Transaction #	Date	Map Location	Project Description	Acres	Credit
0001		Map 2 - A-7	Offsite wetland creation as part of Standley Lake Protection Project, completed June 25, 1995 at a cost of $XX,XXX.	8.07 PSS 3.65 PEM	8.07 PSS 3.65 PEM
0005		Map 3 - C -8	Two Ponds Wetlands Enhancement, completed September 21, 1995 at a cost of $XX,XXX	2.00 PFO	2.00 PFO

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
WETLAND MITIGATION BANK - DEBITS
EXAMPLE

Debits

Transaction #	Date	Map Location	Project Description		Mitigation Ratio	Total Debit
0002		Map 1 - F-4	RFETS Sandrock Blanket i Pond X-X, completed X, X Mitigation credit taken fro... Lake Protection Project (Map 2-A-7)		2 to 1	0.02 PSS
0003		Map 1 - C-5	Cleanout of culverts located in XXXXX, completed X, X, 1995. Mitigtaion credit taken from Standley Lake Protection Project (Map 2-A-7)	0.50 PSS 0.02 PEM	2 to 1 2 to 1	1.00 PSS 0.04 PEM
0004		Map 1 - D - 3	Cleanout of culverts located in XXXX, completed X, X, 1995. Mitigation credit taken from Standley Lake Protection Project (Map 2 - A - 7)	0.04 PSS 0.08 PEM	2 to 1 2 to 1	0.08 PSS 0.16 PEM
0006		Map 1 - D - 1	Cleanout of culverts located in XXXX, completed X, X, 1995. Mitigation credit taken from Standley Lake Protection Project (Map 2 - A - 7)	0.02	2 to 1	0.04

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
WETLAND MITIGATION BANK - DEBITS AND CREDITS COMBINED
EXAMPLE

Debits + Credits Combined

Transaction #	Date	Map Location	Project Description	T T			Total Debit	Total Credit
0001		Map 2 - A-7	Offsite wetland creation as part of Standley Lake Protection Project, completed June 25, 1995 at a cost of $XX,XXX.	C				8.07 PSS 3.85 PEM
0002		Map 1 - F-4	RFETS Sandrock Blanket Installation at Pond X-X, completed X, X, 1995. Mitigation credit taken from Standley Lake Protection Project (Map 2-A-7)	Debit	0.01 PSS	2 to 1	0.02 PSS	
0003		Map 1 - C-5	Cleanout of culverts located in XXXXX, completed X, X, 1995. Mitigation credit taken from Standley Lake Protection Project (Map 2-A-7)	Debit	0.50 PSS 0.02 PEM	2 to 1 2 to 1	1.00 PSS 0.04 PEM	
0004		Map 1 - D - 3	Cleanout of culverts located in XXXX, completed X, X, 1995. Mitigation credit taken from Standley Lake Protection Project (Map 2 - A - 7)	Debit	0.04 PSS 0.08 PEM	2 to 1 2 to 1	0.08 PSS 0.16 PEM	
0005		Map 3 - C -8	Two Ponds Wetlands Enhancement, completed September 21, 1995 at a cost of $XX,XXX	Credit	2.00 PFO			2.00 PFO

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
WETLAND MITIGATION BANK BALANCE LEDGER
EXAMPLE

		Credits (Acres)						Debits (Acres)						Balance (Acres)					
		Wetland Type						Wetland Type						Wetland Type					
Trans. No.	Date	PEM	PSS	PAB	PUB	PFO	PSB	PEM	PSS	PAB	PUB	PFO	PSB	PEM	PSS	PAB	PUB	PFO	PSB
0001		3.65	8.07											3.65	8.07				
0002									0.02					3.65	8.05				
0003								0.04	1.00					3.61	7.05				
0004								0.08	0.04					3.53	7.01				
0005						2.00								3.53	7.01			2.00	
0006												0.02		3.53	7.01			1.98	
0007									2.10					3.53	4.91			1.98	
0008								0.53						3.00	4.91			1.98	
0009																			
0010																			
0011																			
0012																			
0013																			
0014																			

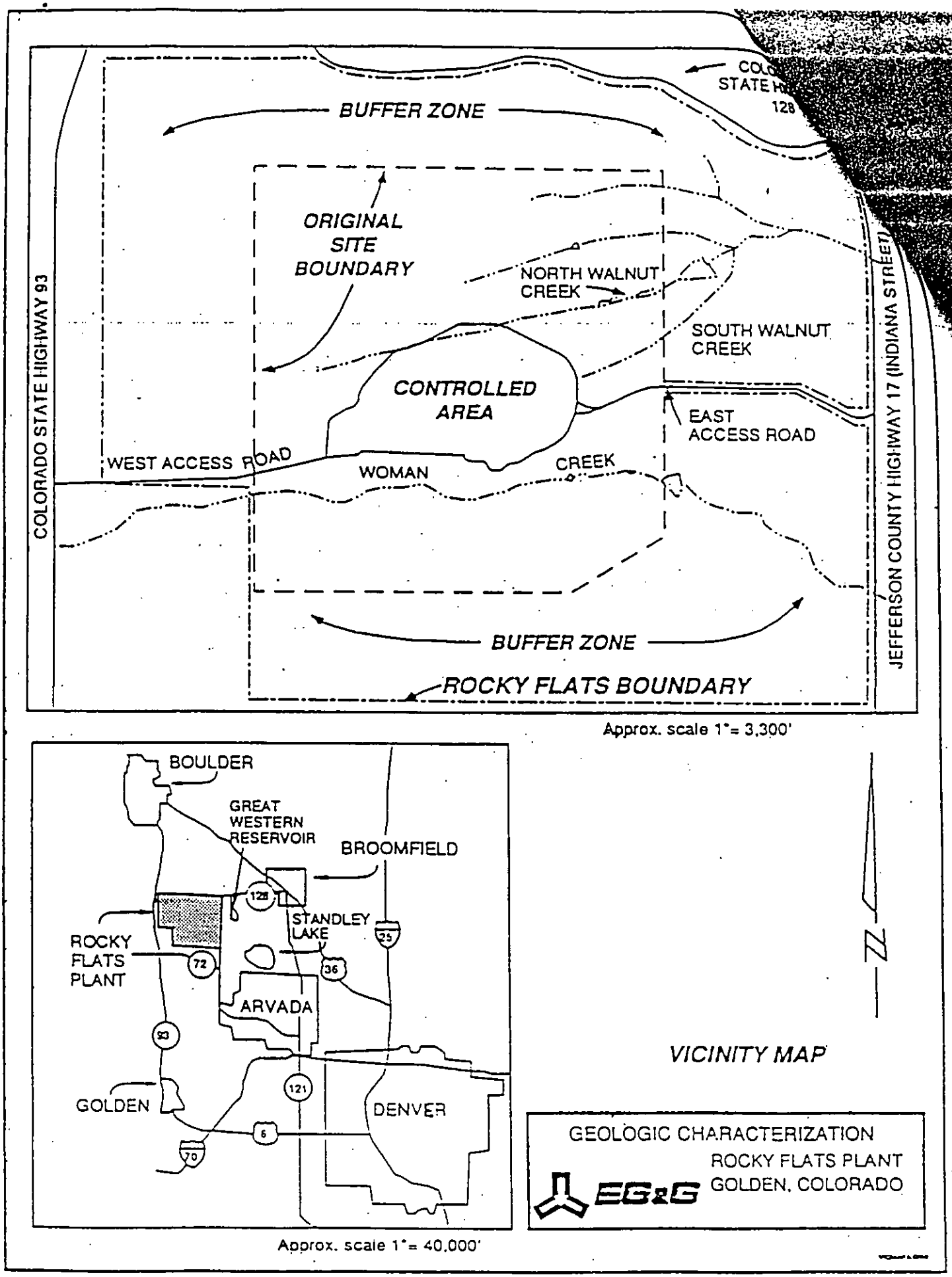
BUFFER ZONE
ORIGINAL SITE BOUNDARY
NORTH WALNUT CREEK
SOUTH WALNUT CREEK
CONTROLLED AREA
EAST ACCESS ROAD
WEST ACCESS ROAD
WOMAN
CREEK
COLORADO STATE HIGHWAY 93
JEFFERSON COUNTY HIGHWAY 17 (INDIANA STREET)
BUFFER ZONE
ROCKY FLATS BOUNDARY
Approx. scale 1"= 3,300'
BOULDER
GREAT WESTERN RESERVOIR
BROOMFIELD
STANDLEY LAKE
ROCKY FLATS PLANT
ARVADA
GOLDEN
DENVER
128
72
36
93
121
6
70
VICINITY MAP
GEOLOGIC CHARACTERIZATION
ROCKY FLATS PLANT
GOLDEN, COLORADO
EG&G
Approx. scale 1"= 40,000'

Figure 2-2

TO: All Site Personnel

FROM: KH-Ecology Group

DATE: February 19, 2004

SUBJECT: USE OF PART I OF THE PROGRAMMATIC BIOLOGICAL ASSESSMENT FOR THE RFETS

This document covers selected activities that may occur at RFETS and have potential to impact the Preble's meadow jumping mouse (a federally listed threatened species) or the current Preble's mouse protection areas. On January 30, 2004, the U.S. Fish and Wildlife Service concurred that these activities may be conducted at RFETS. Although concurrence has been received for the specific projects listed in the document, contact your Environmental Manager and the KH Ecology Group prior to commencement of projects authorized within this Part I. The K-H Ecology Group will provide additional information on the minimum best management practices required for the activity under this approval. Activities occurring in Preble's meadow jumping mouse protections areas that are not explicitly outlined in this Part I are not authorized.

For additional information please contact your Environmental Manager or the KH Ecology Group individuals indicated below:

Jody Nelson x2231
Karin Kiefer x3560
Andrew Rosenman x3687

Thank you.

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PROGRAMMATIC BIOLOGICAL ASSESSMENT FOR DEPARTMENT OF ENERGY ACTIVITIES AT THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

PART I: Activities with "No Effect", or that "May Affect, but Not Likely to Adversely Affect" threatened or endangered species.

January 2004

U.S. Department of Energy
Rocky Flats Field Office
Golden, Colorado

January 2004
Revision 10
Classification Exemption CEX-105-01

Prepared for
US Department of Energy
Rocky Flats Field Office
Golden, Colorado 80402-0464

By
Kaiser-Hill Company, LLC

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
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Cliff

IN REPLY REFER TO:
ES/CO: Rocky Flats
MS 65412 LK

JAN 30 2004

Mr. Cliff Franklin
Department of Energy
Rocky Flats Field Office
10808 Highway 93, Unit A
Golden, CO 80403-8200

Post-it™ Fax Note 7671	Date	# of pages ▶ 2
To A Rasmussen	From C Franklin	
Co./Dept.	Co.	
Phone #	Phone #	
Fax # 8482	Fax #	

Dear Mr. Franklin,

Based on the authority conferred to the U.S. Fish and Wildlife Service (Service) by the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*), we have reviewed the Rocky Flats Programmatic Biological Assessment, Part One with your letter of December 18, 2003, and its effects on the federally-listed Preble's meadow jumping mouse, *Zapus hudsonius preblei* (Preble's). The projects, as proposed, may affect wetlands or other riparian habitats.

Part One of your Programmatic Biological Assessment contains descriptions and locations for groundwater monitoring, soil sampling, surface water monitoring, Building 124 water treatment, Building 891 combined water treatment facility operations, sanitary waste water operations, sanitary waste disposal, routine infrastructure and support activities, utilities deactivation, waste storage and removal, building and structure decommissioning and demolition in the Industrial Area (IA), present landfill, recycling of concrete, IA revegetation, and routine soil remediation projects. Based upon your project descriptions and locations, the Service concurs that these projects will not affect Preble's or its habitat.

Additionally, based on the project information and locations provided on ecological monitoring, air quality monitoring, routine pond operations, routine road maintenance, weed and vegetation management, Well Abandonment and Replacement Program (WARP), removal of concrete pads from abandoned wells, subsurface soil sampling, groundwater treatment system monitoring, trash removal from the Buffer Zone, B-4 Pond building removal, C-1 Pond rip rap pile removal, Walnut Creek dirt pile removal, pipeline removal, fence and t-post removal, gravel and riprap storage area, guard rails along roads, power pole and power line removal, security force Buffer Zone activities, South Interceptor Ditch maintenance, temporary surface water flumes, and Buffer Zone concrete/incinerator removal projects, the Service concurs that these activities are not likely to adversely affect Preble's or its habitat.

Due to changes in scheduling, or in the project design, portions of several projects have already been consulted on separately. The boundary of the Preble's Protection Area was revised in December, 2003, and may now affect some of these projects. Therefore, they have been retained as part of the Programmatic Biological Assessment.

Should any of project plans change, or if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered.

Should any of your projects not begin within one year of the date of this letter, please contact the Service to discuss any changes in the projects or in site conditions. If the Service can be of further assistance, please contact Amy Thornburg at (303) 966-5777.

Sincerely,

Susan C. Linner
Colorado Field Supervisor

cc: USFWS, Rocky Mountain Arsenal, NWR (Attn: Dean Rundle)
Kaiser Hill, Rocky Flats (Attn: Andrew Rosenman)
Professional Environmental Group, Rocky Flats (Attn: Jody Nelson)

Ref: Alison/Rocky Flats/PBS Part One Concurrence/012904

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Acronyms and Abbreviations

ATV	All Terrain Vehicle
BA	Biological Assessment
BE	Biological Evaluation
BMP	Best Management Practices
BO	Biological Opinion
BZ	Buffer Zone
CDPHE	Colorado Department of Health and Environment
CDNR	Colorado Department of Natural Resources
CDOW	Colorado Division of Wildlife
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CNHP	Colorado Natural Heritage Program
D&D	Decommissioning and demolition
DOE	U.S. Department of Energy
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
GMP	Groundwater Monitoring Program
IA	Industrial Area
ITS	Interceptor Trench System
LHSU	Lower HydroStratigraphic Unit
MOA	Memorandum of Agreement
MSL	Mean Sea Level
MST	Modular Storage Tanks
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Lab
OU	Operable Unit
PBA	Programmatic Biological Assessment
PWTS	Process Waste Transfer System
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFNWR	Rocky Flats National Wildlife Refuge
RSOP	RFCA Standard Operating Protocol
SEO	State Engineer's Office
SID	South Interceptor Ditch
Site	Rocky Flats Environmental Technology Site
SPPTP	Solar Pond Plume Treatment Project
TSCA	Toxic Substances Control Act
UHSU	Upper HydroStratigraphic Unit
USCOE	U. S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

WARP	Well Abandonment and Replacement Program
WWTP	Waste Water Treatment Plant

1. Introduction

1.1 Background

Rocky Flats Environmental Technology Site (Site, RFETS) is an U.S. Department of Energy (DOE) nuclear industrial facility that has been part of the nationwide nuclear weapons complex since 1951. The Site is located in rural Jefferson County, Colorado, approximately 16 miles northwest of Denver, and 5 miles southeast of Boulder (Figure 1). The Site covers approximately 6,300 acres, of which approximately 5,900 acres forms an undeveloped Buffer Zone (BZ) around the central industrialized portion (Industrial Area; IA). The original 1951 land purchase included approximately 2,500 acres of rangeland, which was expanded by an additional 4,030 acres from private ranches between 1974-1976 (some 280 acres were later allocated to the National Renewable Energy Laboratory, NREL). The Site adjoins undeveloped rangelands that are being encroached upon by housing developments on the northeast and southeast. Public open-space lands border the Site to the north, east, and northwest. Sand and gravel mining activities, light industry, and other potential sites for industrial/commercial use are present on the western edge of the Site at a few locations. Jefferson County has zoned approximately 750 acres of the western BZ for surface mining. The Colorado Division of Mines and Geology has issued a reclamation permit for these lands.

The original mission of this DOE facility was the manufacture of nuclear weapons components. After the end of the Cold War, nuclear weapons production was stopped. In 1996**,** the U.S. Department of Energy, Rocky Flats Field Office (DOE), the Environmental Protection Agency (EPA), and the Colorado Department of Public Health and Environment (CDPHE) executed the Rocky Flats Cleanup Agreement (RFCA). RFCA is the Federal Facility Compliance Agreement and Consent Order negotiated pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), and Colorado Hazardous Waste Act (CHWA). RFCA provides the regulatory framework for attaining the goal to achieve accelerated cleanup and Site closure in a manner that is safe to workers and the public, and protective of the environment. At this time the Site is undergoing cleanup and closure. From now through late 2005, the buildings and other structures at the Site will be decommissioned and demolished, with the disturbed areas seeded with native plant species.

After Site cleanup and closure is completed, the Site will become the Rocky Flats National Wildlife Refuge (RFNWR) to be managed by the U.S. Fish and Wildlife Service (USFWS).

1.2 Purpose

The DOE developed this Programmatic Biological Assessment (PBA) as part of the Section 7 consultation requirements of the Endangered Species Act of 1973, as amended (ESA). The DOE is the action agency requesting the formal consultation with the USFWS. This document is Part I of two parts of the PBA that will address the potential for Site activities to affect threatened and endangered species that are protected under the ESA. Part I of the PBA has been prepared to examine impacts from routine, ongoing activities, and specific closure actions that will have either "no effect" or "may affect, but are not likely to adversely affect" on species under consideration in this PBA, which includes the Preble's meadow jumping mouse (Preble's mouse; *Zapus hudsonius preblei*) and its habitat (current protection areas). The current Preble's protection areas at the Site are defined as those areas delineated by the *Preble's Meadow Jumping Mouse Protection Plan* for the Site (DOE 2000; see Appendix A in Part I of the PBA for the Plan and the map). This plan was required under the Memorandum of Agreement (MOA, February 26, 1999) signed between DOE, USFWS, U.S. Environmental Protection Agency (EPA), Colorado Department of Public Health and Environment (CDPHE), and the Colorado Department of Natural Resources (CDNR). The plan was developed based on several years of Preble's mouse trapping, telemetry, and habitat characterization work at the Site. The plan has been submitted several times to the USFWS for concurrence, however, the USFWS has never concurred. Although the plan has never received formal concurrence, it has been cited and used for numerous Biological Assessments (BAs), Biological Evaluations (BEs), and Biological Opinions (BOs) for Site projects. Part II of the PBA addresses actions that "are likely to adversely affect" the species under consideration in this PBA including the Preble's mouse and its habitat (current protection areas). Part II of the PBA also addresses water depletion issues.

There will be no effect from any of the activities listed in Part I of the PBA on the species evaluated, with the exception of the Preble's mouse. Although some activities listed in Part I of the PBA may affect the Preble's mouse, it is unlikely that these activities will adversely affect it.

Unlike most other Section 7 consultations, the DOE activities covered under this PBA are aimed at removing man-made structures in and adjacent to the habitat of the Preble's mouse and re-establishing the native vegetation. This large-scale project differs from most other consultations where private and public agencies are consulting about activities that have permanent impact on the habitat of federally listed species (i.e., residential and commercial development, roads, parking lots, etc.). Instead of encroaching permanently into the Preble's mouse habitat, this project will re-establish and increase the amount of habitat at the Site while largely having only temporary impacts. Thus the long-term benefits will far outweigh the short-term impacts. Because the Site will become a national wildlife refuge these resource values will be protected for future generations.

1.3 Assumptions

This PBA addresses all the potential activities that may occur at the Site through closure that may affect threatened and endangered species, with specific emphasis on the Preble's mouse. However, the fact that a project is listed in this document does not mean that it will necessarily take place. Only projects that are conducted will be mitigated as discussed in the PBA. Mitigation will not occur for projects that are not conducted. The objective of the PBA is to identify all potential projects for the consultation process so that no delays in project schedules will occur. Where specific project plans are not available, the worst case scenarios have been assumed. The projects activities are required to meet regulatory requirements or site closure commitments.

1.4 Responsibilities

Project managers will receive a copy of the PBA and BO, and be briefed on the guidelines and requirements contained therein pertinent to their project. The project managers are responsible to ensure compliance with the requirements and guidelines outlined in the PBA and BO. Projects are responsible to follow and maintain the best management practices (BMPs).

2. Environmental Setting

2.1 Air Quality

Air quality is generally better at the Site than in the urbanized portion of the Denver Metropolitan Area; air emissions are within permitted limits for regulated air pollutants. The principal point sources of criteria pollutants at the Site have been the steam plant boilers. Minor combustion sources include smaller boilers and emergency generators. Fugitive dust is one of the more significant air pollutants at the Site; cleanup and related construction can require dust suppression to control fugitive dust.

Radiological air emissions both on- and off-Site are largely unrelated to Site operations. Most radiation is naturally occurring background radiation from sources such as radon. The annual background dose for Denver area residents is about 418 mrem (more than 1 mrem per day). Radioactive emissions from the Site are principally from contaminated soil, with an annual dose for the nearest most impacted off-Site resident of about 0.1 mrem. Facilities with potential radionuclide emissions are continuously monitored at emission points to ensure that emissions are properly controlled and comply with regulations.

2.2 Surface Water

The Site is situated within the headwaters of two regional drainage basins, Boulder Creek basin and Big Dry Creek basin. Within these basins, three intermittent systems, Walnut Creek, Woman Creek, and Rock Creek, drain the Site (Figure 2).

Walnut Creek is an east-flowing stream that drains the central portion of the Site, including most of the IA. Runoff from the developed area to the drainage occurs faster and with greater volume than under natural conditions. Within Site boundaries, Walnut Creek includes three major branches on-Site, South Walnut Creek, North Walnut Creek, and a northern tributary referred to as the "unnamed tributary." These tributaries converge in the eastern portion of the Site. The North Walnut Creek drainage includes a series of four detention ponds (A-series ponds), constructed for Site runoff control and pollution prevention programs. The South Walnut Creek runoff is controlled through a series of five in-channel detention ponds (B-series ponds).

Walnut Creek is generally dry from July through April based on natural flows, however, it does receive water from pond discharges throughout the year. Pond discharges occur on the average ten times per year and last about fourteen days per discharge.

The Woman Creek drainage is located south of the IA, and includes an area from the Boulder Diversion Canal west of the Site to Indiana Street. The three sources of flow to Woman Creek are precipitation and surface runoff, seepage from Antelope Springs and

lesser seeps, and conveyance flows as a result of water rights agreements. These flows are from Kinnear Ditch, Smart Ditch #1, and Smart Ditch #2.

Woman Creek flows through Pond C-1, and is then diverted around Pond C-2 by the Woman Creek Bypass Canal. Woman Creek flows are either diverted into the Mower Diversion Ditch or proceed in Woman Creek to Indiana Street and off-Site.

Surface water runoff from the southern slope of the IA is collected by the South Interceptor Ditch and conveyed to Pond C-2. Water impounded in Pond C-2 is held for quality analysis, and discharged into Woman Creek below the dam.

Rock Creek is located in the northern portion of the Buffer Zone. It is upstream of the IA, and it is physically separated from the IA by a northeast trending ridge. It was undisturbed by Site activities during operation of the Rocky Flats Plant. Rock Creek is now part of the Rock Creek Preserve, a part of the Site property that is co-managed by DOE and the USFWS. Rock Creek flows off-Site into Coal Creek.

2.3 Groundwater

The Site is located in a regional groundwater recharge area. Recharge occurs primarily from the infiltration of precipitation. Groundwater recharge also occurs from infiltration from stream, ditch, and pond seepage.

Shallow groundwater flow at the Site generally follows the topography of the bedrock surface. Groundwater in the ridge tops generally flows toward the east-northeast. In areas where the ridge tops are dissected by east-northeast trending stream drainages, groundwater flows to the north or south toward the bottom of the valleys. In the valley bottoms, groundwater flows to the east, generally following the course of the stream. Shallow groundwater flow is primarily lateral due to the low permeability of the underlying claystone bedrock.

Two non-hydraulically connected groundwater systems are present at Rocky Flats. The upper unit exists as an unconfined aquifer and the lower unit as a confined aquifer. Aquifer recharge occurs through direct infiltration or percolation, infiltration from surface water when the water table lies below a stream or canal, inter-aquifer leakage, and infiltration from artificial sources, such as detention ponds, surface water impoundment, sewer lines, and dry wells.

The uppermost aquifer or upper hydrostratigraphic unit (UHSU) consists of the unconfined saturated zone, in which unconsolidated and consolidated groundwater-bearing strata are in hydraulic communication. The UHSU consists of Rocky Flats Alluvium, valley-fill alluvium, colluvium, landslide deposits, weathered Arapahoe and Laramie Formation bedrock, and sandstones within the Arapahoe and upper Laramie Formations in hydraulic communication with the overlying unconsolidated surficial deposits. The UHSU exhibits a wide range of hydraulic conductivity, but generally has a

relatively low to moderate hydraulic conductivity. The lower hydrostratigraphic unit (LHSU) consists of the consolidated, unweathered bedrock zone of the Arapahoe and upper Laramie Formations. These formations have less sandstone and more claystones that create an aquitard restricting hydraulic communication with the UHSU. The lower Laramie and Fox Hills Formations comprise a third hydrostratigraphic unit.

The three hydrostratigraphic units are hydraulically separated beneath the IA. The units are thought to converge near the western edge of the Site due to monoclinal folding and erosional proximity.

2.4 Geology

The Site is located along the western margin of the Denver Basin, an asymmetric basin with a steeply east-dipping western flank and a gentle eastern flank. The elevation at the Site is about 6,000 feet above mean sea level (msl), and the upper surface of the alluvium slopes easterly one to two degrees. A monoclinal fold limb exposed west of the Site is the most significant surficial structural feature. Along the west limb of the fold, an angular unconformity exists between the Upper Cretaceous bedrock and the base of the Quaternary Rocky Flats Alluvium.

The stratigraphic sequence that underlies the Site extends from the crystalline Precambrian gneiss, schist, and granitoids at 3,000 feet below msl to the unconsolidated Quaternary deposits at surface about 6,000 feet above msl. Bedrock formations from the uppermost Cretaceous Pierre, Fox Hills, Laramie, and Arapahoe Formations are present at the surface and beneath the Site. The Quaternary Rocky Flats Alluvium and Verdos Alluvium unconformably overlie the Cretaceous Arapahoe and Laramie Formations in the central portion of the Site. The unconsolidated surficial deposits, combined with the weathered portion of subcropping bedrock formations, form the sequence of rocks which have the greatest importance regarding groundwater flow at the Site.

Several Quaternary alluvial formation pediment covers have been identified in the vicinity of the Site. The Rocky Flats Alluvium is an unconsolidated deposit derived from quartzites and granites of the Coal Creek Canyon provenance west of the Site. The deposit diminishes from west to east with a thickness ranging from about 100 feet to less than one foot. In the central portion of the Site, the deposit is about 15 to 25 feet thick. The Rocky Flats Alluvium is a heterogeneous deposit dominantly composed of angular to subrounded, poorly-sorted, coarse, bouldery-gravel with a clay and sand matrix. Clay, silt, and sand lenses as well as varying amounts of caliche are also present.

In addition to the pediment-forming alluvial deposits, younger Quaternary units consisting of colluvium, landslide alluvium, and valley fill alluvium mantle the hillslopes and valley bottoms below the pediment surface. Colluvial deposits are derived from Arapahoe and Laramie Formations and older alluvial deposits. These units consist of 3 to 16 feet of sheetwash, soil creep, and landslide materials. These deposits locally flank the

Rocky Flats Alluvium, and generally extend to lower parts of the slopes along the principal drainages.

Landslide deposits more commonly flank the Rocky Flats Alluvium. The deposits are often bounded by headwall scarps and lobate toes at the downslope margins. Seeps issuing from the base of the Rocky Flats Alluvium contribute to landslide colluvium generation. The landslide units include earth flows, slumps, and debris flows in a thickness estimated between 10 to 33 feet.

The Arapahoe Formation is composed of claystones and silty claystones with some lenticular sandstone, and is generally less than 25 feet thick at the Site. The basal Arapahoe Sandstone is of concern as a potential contamination pathway, especially where it subcrops beneath the alluvial/bedrock unconformity.

The Laramie Formation is about 600 to 800 feet thick, and is composed of a lower sandstone/claystone/coal interval and an upper, thicker claystone interval. The permeable lower sandstones and coals of the Laramie, combined with the permeable sandstones of the Fox Hills, constitute a regional aquifer system known as the Laramie-Fox Hills aquifer. This aquifer system is an important water source in the South Platte River Basin, and is the sole water supply for some residents in the surrounding area. The Fox Hills Formation is primarily a fine-grained sandstone that is about 75 to 125 feet thick with thin siltstone and claystone interbeds. The Fox Hills Formation outcrops and subcrops along a narrow, north-south trending pattern in the extreme western part of the Site. The Pierre Formation is a 7,500-foot thick, dark gray, silty bentonitic shale that acts as a lower confining layer for the Laramie-Fox Hills aquifer in the Denver Basin. This thick marine shale unit subcrops only in the extreme western part of the Site.

2.5 Soils

Soils in the western and eastern portions of the Site are distinctly different. Most soils are alluvial (stream-deposited), colluvial (gravity-deposited), or exposed bedrock material. Soil textures are predominantly loamy, with varying amounts of clay, sand, gravel, and cobbles.

The prevalent soil types on the western side of the Site are Flatirons (very cobbly to very stony sandy loams), and Nederland (very cobbly, very sandy loam). Flatirons soils exhibit low permeability, slow runoff, and slight erosion characteristics. Nederland soils are moderately permeable, and exhibit rapid runoff and severe water erosion (on steep slopes) characteristics.

Soils on the eastern side of the Site include Denver-Kutch-Midway clay loams that exhibit low permeability, rapid runoff, and low to moderate wind erosion and severe water erosion characteristics, Valmont clay loam that exhibits low permeability, slow runoff, and moderate wind erosion and low water erosion characteristics, Haverson loam that has moderately slow permeability, slow runoff, moderate wind erosion and slight

water erosion characteristics, and Nunn clay loam that has low permeability, slow to medium runoff, slight to moderate wind erosion and slight to moderate water erosion characteristics.

2.6 Ecological Resources

2.6.1 Vegetation

The uniqueness and diversity of the plant communities at Site has been documented by a number of studies (K-H 1997a, 1997b, 1998a, 1999a, 2000a, 2001a, 2002a). The topography and close proximity of the Site to the mountains has resulted in an interesting mixture of prairie and foothills plant communities at the Site. Currently 600 species of plants are reported for the Site. No threatened or endangered plant species are known to occur at the Site. Plant communities at the Site range from xeric (dry) grassland communities to more hydric (wet) communities such as wet meadows and marshes (Figure 3).

The plant communities of greatest ecological significance on Site are the xeric tallgrass prairie, the Great Plains riparian community, the tall upland shrubland community, and wetlands. The xeric tallgrass prairie occurs on the cobbly alluvium found on pediments (flat upland areas) and ridges at the Site. This prairie is distinguished by such tallgrass plant species as big bluestem (*Andropogon gerardii*), little bluestem (*Andropogon scoparius*), prairie dropseed (*Sporobolus heterolepis*), and switchgrass (*Panicum virgatum*). These species are common and abundant in the tallgrass prairies hundreds of miles to the east of the Front Range, but their presence here is rare. Big bluestem and little bluestem are the most abundant of these prairie species found at the Site with the others occurring less commonly. In addition, common montane or foothills species such as mountain muhly (*Muhlenbergia montana*), Fendler's sandwort (*Arenaria fendleri*), and Porter's aster (*Aster porteri*), also occur in the tallgrass prairie at the Site. These latter species are indicative of the unique mixing of mountain and prairie species found at the Site. The xeric tallgrass prairie was once a more common grassland along the Front Range, extending in a narrow band along the mountain front from Colorado Springs to the Wyoming border. As with many of the ecosystems along the Front Range, development, mining, overgrazing, and other human activities have destroyed the xeric tallgrass prairie. The Colorado Natural Heritage Program (CNHP) lists the xeric tallgrass prairie at the Site as the largest known remnant in Colorado and possibly North America. Because of this rarity, the CNHP has classified this plant community as very rare and susceptible to becoming endangered. The presence of breeding populations of the grasshopper sparrow, itself only known to occur in just over 100 locations in Colorado, and the presence of the State rare butterfly, the argos skipper, in the xeric tallgrass prairie on Site, are further indicators of the quality and special nature of the prairie at the Site.

The Great Plains riparian community, mapped at the Site as riparian (stream channel) woodland and shrubland, is found along streams at the Site. Examples of this community are found in the Rock Creek, Walnut Creek, Woman Creek, and Smart Ditch drainages. Plains cottonwood (*Populus deltoides*), coyote willow (*Salix exigua*), and peach leaf

willow (*Salix amygdaloides*) predominate in this community. Another unusual shrub community, dominated by leadplant (*Amorpha fruiticosa*), is also often found in association with the Great Plains riparian community at the Site. Often found in association with the riparian community is the short upland shrubland which is dominated by snowberry (*Symphoricarpos occidentalis*) and Arkansas rose (*Rosa arkansana*). These communities provide important habitat for many of the bird and mammal species found here, including the Preble's meadow jumping mouse.

The tall upland shrubland community is found on north-facing slopes primarily in the Rock Creek drainage. This community commonly occurs just above wetlands and seeps. The dominant tall shrubs are choke cherry (*Prunus virginiana*), hawthorn (*Crataegus erythropoda*), and American plum (*Prunus americana*). Other common species in the tall upland shrubland are typical of the foothills to the west of the Site. It has been identified by the CNHP as a potentially unique shrubland community, possibly not occurring anywhere else. This community is used by many animals throughout the year for cover and is used during the spring by mule deer as fawning areas. Several rare bird species also inhabit this community during the breeding season.

The mesic mixed grassland is a mixed grass prairie community common on the hillsides at the Site. This community covers the largest amount of area at the Site and is dominated by western wheatgrass (*Agropyron smithii*) and blue grama grass (*Bouteloua gracilis*), with green needle grass (*Stipa viridula*), purple three-awn (*Aristida purpurea* ssp. *robusta*), and buffalo grass (*Buchloe dactyloides*) occurring commonly.

The U.S. Army Corps of Engineers (USCOE) delineated 1,097 separate wetlands at the Site in 1994 (USCOE, 1994). These areas occupy about 190 acres along the three drainage basins within the Site. The wetlands can be segregated into stream bottom wetlands and slope wetlands.

Stream bottom wetlands (palustrine wetlands associated with stream channels) are the most common type of wetland at the Site. Stream bottom wetlands account for 73% of the total number of wetlands and 65% of the total wetlands area. Stream bottom wetlands at the Site include *Forested wetlands*, *Scrub-shrub wetlands*, and *Herbaceous emergent wetlands.*

Slope area wetlands are found where ground water is discharged along hillsides between the alluvial cap and the underlying consolidated material. Although the seeps are fed by shallow aquifers, the discharge is sufficiently persistent to support well-developed stands of wetland vegetation. Slope area wetlands include *saturated, seasonal and temporary wetlands*. Saturated wetlands are located at the point of discharge of a seep and are characterized by persistent soil saturation and a short marsh vegetation type. Seasonal wetlands that are typically located farther from the water source than saturated wetlands and are consistently saturated only during periods of high discharge and are characterized by a wet meadow vegetation type. Temporary wetlands are located at the perimeter of

saturated or seasonal wetlands and are characterized by a wet meadow community type or a mesic mixed grassland type.

Stream bottom wetlands include 800 locations covering 123 acres. The Rock Creek drainage basin includes 161 wetlands covering 25 acres, the Woman Creek drainage basin includes 339 wetlands covering 58 acres, and the Walnut Creek drainage basin includes 300 wetlands covering 40 acres.

Slope area wetlands include 297 locations covering 67 acres. The Rock Creek drainage basin includes 152 wetlands covering 32 acres, the Woman Creek drainage basin includes 102 wetlands covering 27 acres, and the Walnut Creek drainage basin includes 43 wetlands covering 8 acres.

2.6.2 Wildlife

A considerable diversity of wildlife occurs at the Site. A brief discussion follows of the various groups of wildlife found at the Site.

Birds occur in all available habitats at the Site. The most common raptors at the Site year-round are red-tailed hawks, American kestrels, great horned owls, and northern harriers. In summer, the most common additional species are Swainson's hawks, golden eagles, and turkey vultures. Other species that occasionally visit the Site include the bald eagle, peregrine falcon, ferruginous hawk, and burrowing owl. Among more than 45 species of waterfowl and shorebirds at the Site, mallards, Canada geese, and great blue herons are the most common. Other frequently observed waterfowl species include buffleheads, blue-winged teal, green-winged teal, common and hooded mergansers, ring-necked ducks, redheads, and lesser scaups. Several waterfowl and shorebirds breed at the Site. Over 95 neo-tropical migrant species have been recorded at the Site, several of which have been confirmed as breeding in a variety of habitats. Common neo-tropical migrant species observed at the Site include the Say's phoebe, eastern and western kingbirds, cliff and barn swallows, American robins, yellow warblers, common yellowthroat, grasshopper sparrows, vesper sparrows, red-winged blackbirds, and western meadowlarks.

Mule deer are common across the Site with an occasional white-tailed deer mixed in the population. Deer population numbers range between 100 and 160 on an annual basis at the Site. In recent years, elk and black bear have been observed occasionally in the BZ at the Site. The most commonly observed carnivore is the coyote. Several active coyote dens are present at the Site each year. Mid to small sized animals include desert cottontails, white-tailed and black-tailed jackrabbits, raccoons, muskrats, and black-tailed prairie dogs.

Amphibians and reptiles can be observed across the Site in the appropriate habitats for each species. Common species include the prairie rattlesnake, boreal chorus frogs, northern leopard frogs, western painted turtles, and bullfrogs. Occasionally the eastern

short-horned lizard can be observed on the xeric tallgrass prairie. Fish can be found in the intermittent streams and most ponds at the Site. Common species include fathead minnows, creek chubs, and an occasional small-mouth and large-mouth bass.

2.7 Species Considered In This Assessment

Based on a species list received from the USFWS the following species have been evaluated as part of this PBA. Species descriptions are presented in Part I, Appendix B.

Animals	**Legal Status**
American burying beetle (*Nicrophorus americanus*)*	LE
Bald eagle (*Haliaeetus leucocephalus*)	LT
Black-footed ferret (*Mustela nigripes*)	LE
Black-tailed prairie dog (*Cynomys ludovicianus*)	C
Boreal toad (*Bufo boreas boreas*)	C
Canada lynx (*Lynx canadensis*)	LT
Eskimo curlew (*Numenius borealis*)*	LE
Greenback cutthroat trout (*Oncorhynchus clarki stomias*)	LT
Least tern (*Sterna antillarum*)*	LE
Mexican spotted owl (*Strix occidentalis lucida*)	LT
Mountain plover (*Charadrius montanus*)	PT
Pallid sturgeon (*Scaphirhynchus albus*)*	LT
Pawnee montane skipper (*Hesperia leonardus montana*)	LT
Piping plover (*Charadrius melodus*)*	LT
Preble's meadow jumping mouse (*Zapus hudsonius preblei*)	LT
Whooping crane (*Grus americana*)*	LE
Plants	
Colorado butterfly plant (*Gaura neomexicana coloradensis*)	LT
Ute ladies'-tresses orchid (*Spiranthes diluvialis*)	LT
Western prairie fringed orchid (*Platanthera praeclara*)*	LT

* = Lower Platte River species
C = Candidate for listing
LT = Listed threatened
LE = Listed endangered
PT = Proposed threatened

3. No Effect Activities

This section of Part I of the PBA outlines various Site activities that will have no effect on listed species or their habitat. Additional or unforeseen future projects that are not listed in this section will be evaluated based on the following criteria to determine whether they meet the "no effect" definition. If projects meet the "no effect" criteria then no further consultation with the USFWS will be pursued. If projects do not meet the "no effect" criteria, then further evaluation will be conducted to determine whether they meet the "may affect, but not likely to adversely affect" or "adverse effect" criteria. Evaluations will include an assessment of potential direct and indirect effects, interdependent actions, cumulative effects (effects from state and private party actions), and interrelated actions. Projects described in this section, along with any indirect effects, interdependent actions, and interrelated actions, were deemed to have no effect on any listed species, specifically the Preble's mouse, for the following reasons (the flowchart in Figure 4 summarizes the following criteria and allows for easier determination of project activity effects):

- The majority of these activities are not located within the current Preble's protection area (see Section 1.2 of Part I of the PBA for the definition of the current Preble's protection areas; [Figure 5; map in Appendix A of Part I of PBA]).
- Only temporary disturbance to the Preble's habitat will result from these activities (such as trampling of vegetation). No permanent loss of habitat will occur.
- Vegetation will not be removed or damaged during these activities within the current Preble's protection areas.
- Soil disturbance is very minimal (< 0.5 sq. ft. per action) in the current Preble's protection areas.
- For projects located within the current Preble's protection areas, activities will be conducted on foot or using established roads and two-tracks.
- No heavy equipment (i.e., front end loaders, track hoes, back hoes, etc.) are necessary to conduct the activities when in the current Preble's protection area.
- The majority of the projects listed in this section of the PBA are scattered throughout the BZ and are not concentrated or contiguous at a given location. Therefore the potential for impacts are minimal because suitable habitat exists adjacent to project areas.
- Due to the fact that most of the activities listed in this section do not take place in or directly adjacent to Preble's habitat, and that the activities that may take place in Preble's habitat are very low impact (see reasons above), no cumulative, additive, direct or indirect effects, interdependent actions, or interrelated actions are expected to occur. Examples of these types of impacts to evaluate might include sedimentation and erosion potential, changes in water flows, or noise concerns. See further discussion of this issue in the Analysis of Impacts section of Part I of the PBA.

To minimize impacts to the Preble's mouse, project management will utilize and maintain the following best management practices (BMPs) except where regulatory and/or health and safety requirements take precedence:

- Identify and prioritize Preble's habitat areas that are subject to disturbance and design activities to avoid areas of high habitat value[1]. For example, large willow patches should be avoided.
- Reduce the impact footprint (i.e., no excessive walking in area beyond what is necessary to accomplish the work, minimizing laydown area and equipment storage locations).
- Conduct all activities during daylight hours, when the Preble's mouse is less active when scheduling during the hibernation season of the mouse cannot be accomplished.
- Minimize the length of time spent in sensitive areas (getting work done as quickly as possible, not reentering area once work is completed).
- Use established roads (i.e. paved, gravel, two-track, historically used routes to monitoring locations) for vehicle traffic.
- Remove trash and unnecessary equipment in project areas after work is completed.
- Revegetate disturbed Preble's habitat with native species after the activity has been completed in accordance with the Habitat Mitigation Techniques Plan (Appendix A, Part II of PBA).
- Prevent spilled fuels, lubricants or other toxic materials from entering Preble's habitat.
- Minimize project activities in wet areas and conditions to avoid damage to the habitat.
- The projects contained in this section of the PBA are not expected to result in erosion or sedimentation problems with perhaps the exception of the building and structure decommissioning and demolition in the IA and IA revegetation (areas outside of Preble's habitat). The building decommissioning and demolition in the IA and the IA revegetation activities will use appropriate erosion and sediment control BMPs.
- Inspect and clean equipment of weeds/seed to prevent spread of noxious weeds.

Project managers will receive a copy of the PBA and BO, and be briefed on the guidelines and requirements contained therein pertinent to their project. Project management is responsible to ensure compliance with the requirements and guidelines outlined in the PBA and BO. Projects are responsible to follow and maintain the best management practices (BMPs).

The following table lists the activities included in the "no effect" section of the PBA. The table summarizes the potential project impacts within the current Preble's protection

[1] For determination of impacts within current Preble's protection areas, habitat quality was defined based on the 1996 Site vegetation map. Higher quality habitat is defined as all woody vegetation classifications and short marsh, tall marsh, and wet meadow wetland types. Lower quality habitat is defined as all grassland classifications, mud flats, and other disturbed community types. Open water, riprap, concrete, roads, structures are not considered habitat for the Preble's mouse.

areas. Additional detail on each project is found following the table. Figures 6 and 7 show the locations of some of these projects. Project evaluations are based on worst case scenarios, except where specific plans or information currently exists. The activities included in this section are being consulted on because they are likely to happen. Their inclusion here, however, does not constitute the fact that they will indeed occur. Human impacts are defined as human foot traffic in an area. Vegetation/soil impacts are defined as activities that in some way disturb vegetation or soil beyond that associated with foot traffic in an area.

	Preble's Mouse Habitat Potential Impacts	
Project	**Human Impacts***	**Vegetation/Soil Impacts***
Groundwater Monitoring	Foot traffic, quarterly, approximately 45 wells, 1 to 2 hours per well.	None
Soil Sampling	Foot traffic, ½ hour per location	Typically <12 per year, <0.5 sq ft per sample
Surface Water Monitoring	Foot traffic, 12 locations, 3X/Month.	None
Building 124: Water Treatment Plant	None	None
Building 891: Combined Water Treatment Facility Operations	None	None
Sanitary Waste Water Operations	None	None
Sanitary Waste Disposal	None	None
Routine Administrative And Infrastructure Support Activities	None	None
Utilities	None	None
Waste Storage And Removal	None	None
Building And Structure Decommissioning And Demolition in IA	None	None
The Present Landfill	None	None
Recycling Of Concrete From Building Rubble	None	None
IA Revegetation Activities	None	None
Routine Soil Remediation	None	None

* Impacts are estimated and are not exact numbers.

3.1 Routine Activities

This section describes ongoing routine activities that take place at the Site that have no effect on the species under evaluation in this PBA. The majority of these activities have

been ongoing for more than a decade, and many have been ongoing since the Site was first activated more than 50 years ago.

3.1.1 Monitoring and Routine Maintenance

3.1.1.1 Groundwater Monitoring

The Groundwater Monitoring Program (GMP) consists of groundwater monitoring, compliance reporting, evaluation of groundwater exceedances of Rocky Flats Cleanup Agreement (RFCA) Action Levels, and maintenance of the Site monitoring well network. Monitoring includes groundwater sample collection, water level measurements, sample and data management, and well development and abandonment. The well development and well abandonment and removal program components of the groundwater program are addressed later in Part I of the PBA under the section dealing with "May Affect, But Unlikely To Adversely Affect" activities.

The groundwater monitoring network includes wells that are sampled for water quality and water levels. The monitoring program consists of water quality sample collection, well development, water level measurements, field parameter measurements, sample management, and data management done on a quarterly basis. At times, the program may cover special sampling, well development and water level measurements, aquifer testing, and special reporting. These latter activities, if conducted, would require an additional visit to a well occasionally and the addition of some small monitoring equipment that would be attached to the well head. The monitoring wells are scattered throughout the BZ and approximately 45 are found within the current Preble's protection areas. These activities would not disturb habitat, other than the drive to the well, which occurs along preexisting roads [i.e., two track roads, historical routes to the monitoring wells]. Piezometer wells in Preble's mouse habitat are accessed on foot, and the activity at the well is limited to taking a water level measurement. At the larger wells, samples are collected, requiring longer stays (about one to two hours) at the location. These short-duration visits (a few hours per visit) are conducted once every three months, and even where adjacent to or within Preble's mouse habitat, are nonintrusive activities. Established roads will be used for all vehicle traffic, activities will be performed during daylight hours, and no vegetation will be cut. Therefore, activities under this project will have no effect on the Preble's mouse. The USFWS concurred with this project in a previous draft of the PBA (USFWS 2000; concurrence letter in Part I, Appendix C).

3.1.1.2 Soil Sampling

Soil sampling is conducted frequently at the Site to characterize an area for potential contaminants. Most of this sampling takes place in disturbed areas where the potential for contaminants exists. In Preble's habitat, off-road sampling would be conducted on foot. Samples are typically taken with hand tools and consist of scraping the top inch or two of soil from a small area, generally less than one square foot. Hundreds of samples are taken each year across the Site with less than a dozen or so typically occurring in current Preble's protection area. Soil sampling has been conducted across the Site for the

past 50 years with no apparent effects to the Preble's mouse, Preble's habitat or other listed species under consideration. Trapping data from each of the drainages show mice continue to be captured where they have been trapped before. Telemetry data from the Site have shown the mice continue to move up and down the stream drainages with no apparent impacts. Habitat characterization data shows no effects to the vegetation resulting from any soil sampling efforts (DOE 1996, K-H 1998b, 1999b, 2000b, 2001b, 2002b). Thus no effect to the Preble's mouse is expected from this activity. Subsurface soil sampling is discussed in section 4.2.8 of Part I of the PBA.

3.1.1.3 Surface Water Monitoring

Routine activities include sampling and tracking; analytical data screening and quality determinations; and preparation, implementation, and maintenance of management controls (e.g., procedures, plans, schedules). Surface water sampling includes monthly monitoring of surface water effluent from the Site's Waste Water Treatment Plant (WWTP; one composite sample for one week per month) and predischarge sampling and analysis to ensure that Site surface water discharges meet water quality standards. Predischarge sampling consists of collecting grab samples from ponds that will be discharged, prior to the discharge, approximately every two months, or as pond levels dictate. Ponds are accessed via routinely maintained, improved gravel roads.

Other monitoring includes operation of an automated monitoring network for water sample collection; installation, testing, and operation of water quality probes; and flow monitoring at surface water sampling locations. Flow data are monitored continuously via radio telemetry and reported per the regulatory requirements of the National Pollutant Discharge Elimination System (NPDES) Permit and RFCA.

Monitoring stations measure water flow and sample surface water for water quality. The stations are visited two to three times weekly, depending on flow conditions. During high-runoff periods, the stations may be visited daily. The sample stations are accessible by existing roads, and vehicular travel is restricted to these roads. Some sample locations are located in Preble's mouse habitat, but the sampling activity is nonintrusive, consisting of a technician driving to the sample location, walking from the road to the sampler, checking equipment, exchanging full sample bottles for empty ones, and departing from the location. This activity is done during the daytime when Preble's mice are normally less active. Water samples consist of five-gallon samples collected over several days, weeks, or months. Collection of such a small volume of water produces a negligible effect on downstream flow.

Additional monitoring is done around buildings that are undergoing or scheduled for decommissioning. Small monitoring installations may be placed as close as possible to the building or building cluster prior to the start of demolition. These installations take advantage of existing drainage ditches, culverts, or other stormwater runways in areas adjacent to the buildings. The USFWS concurred with this surface water monitoring in a previous draft of the PBA (USFWS 2000; concurrence letter in Part I, Appendix C).

Installation of temporary surface water monitoring flumes is addressed later in Part I of the PBA under the section dealing with activities that may affect, but are unlikely to adversely affect the Preble's mouse.

3.1.2 Building 124: Water Treatment Plant

The Water Treatment Plant processes raw water to provide potable water to all Site facilities. The Water Treatment Plant treats an average of 300,000 gallons of raw water per day for human consumption, fire protection, and other uses. This water is purchased from the Denver Water Board, and does not come from Site surface waters. Decommissioning and demolition (D&D) of the water treatment plant will have no effect on any listed species because the plant buildings are located in the IA. Water depletion issues will be discussed in Part II of this PBA.

3.1.3 Building 891: Combined Water Treatment Facility Operations

This activity includes the Building 891 daily operations and maintenance, including sampling, operations, transportation, reporting, and water collection/transfer in support of the treatment facility and environmental restoration projects. At present, Building 891 processes and treats various Site waters. These waters are discharged into the South Interceptor Ditch after treatment. Building 891 will continue to operate in accordance with the agency agreements, with the primary goal of treating liquid wastes. Generally, wastes treated include decontamination water and incidental water from environmental restoration projects. Because this activity transfers, but does not deplete waters within the IA, no effect to listed species onsite or off-Site is expected. The USFWS concurred with this project in a previous draft of the PBA (USFWS 2000; concurrence letter in Part I, Appendix C).

D&D of Building 891 will not affect the Preble's mouse because it is not in current Preble's protection areas.

3.1.4 Sanitary Waste Water Operations

3.1.4.1 Disposition Of Incidental Waters

This activity involves coordinating the sampling and disposition of about 130 incidental waters that accumulates (e.g. water that accumulates in utility pits, valve vaults, secondary containment, and excavation pits) per year. Site Procedure 1-C91-EPR-SW.01 addresses the control and disposition of incidental water at the Site. A determination is made as to whether the water is to be discharged to the ground as clean surface water, sent to the WWTP, or transferred to another Site treatment facility. This activity is necessary to prevent water discharges that could result in non-compliance with RFCA surface water standards. Because this activity transfers but does not deplete waters within the industrialized area, no effect to listed species onsite or off-Site is expected. The

USFWS concurred with this project in a previous draft of the PBA (USFWS 2000; concurrence letter in Part I, Appendix C).

3.1.4.2 Disposition Of Internal Waste Water Streams

This activity involves the evaluation and disposition of routine and non-routine waste streams. A determination is made as to whether the water is discharged to the WWTP or transferred to another Site treatment facility. This activity is necessary to prevent discharges that could disrupt microbial treatment processes at the WWTP, with resultant potential NPDES permit violations and penalties. Because this activity transfers, but does not deplete waters within the industrialized area, no effect to listed species onsite or off-Site is expected. The USFWS concurred with this project in a previous draft of the PBA (USFWS 2000; concurrence letter in Part I, Appendix C).

3.1.5 Sanitary Waste Disposal

3.1.5.1 Routine Sanitary Waste Disposal

The Sanitary Waste Project includes day-to-day collection, transportation, and disposal of non-hazardous, non-radioactive sanitary waste. Waste from routine operations and from decommissioning and demolition activities is collected in dumpsters and rolloff containers. This waste is transported off-Site and placed in an off-Site commercial (Subtitle D) landfill. This activity has no effect on listed species. The USFWS concurred with this project in a previous draft of the PBA (USFWS 2000; concurrence letter in Part I, Appendix C).

3.1.6 Routine Administrative And Infrastructure Support Activities

Normal administrative activities will continue in buildings and facilities within the industrialized area as Site closure proceeds. These activities may require continuation of infrastructure support activities such as operation of the nitrogen plant, as well as logistical support, receiving and shipping, ambulance service, traffic management, excess property disposition, facility management, and security force operations. Consultation regarding these routine administrative and infrastructure support activities does not include issues related to water depletion related to these activities. Water use and depletions from these routine activities will be discussed in Part II of the PBA. Otherwise, because these activities are conducted within the industrialized area where no habitat for listed species exists, there will be no effect on listed species from continuation of these activities.

3.1.7 Utilities

As facilities are deactivated and closed, the need for utility services and systems will diminish. Deactivation of utility systems includes:

- Site water treatment plant: Once closed, bottled, potable water will be supplied to all remaining operational buildings or potentially by individual, portable water purification units.
- Site nitrogen plant: It will be shut down when special nuclear material needs no longer require the nitrogen.
- The steam plant boilers: The steam plant boilers have already been shut down and the Site is operating on portable skid boilers.
- The natural gas distribution system: It will be shut down as areas and facilities are closed.
- The Site electrical power distribution system: It will continue in operation through closure to support both deactivation and operational activities, but the number of substations will be reduced to one as soon as operational requirements will allow. Eventually at Site closure it will be reduced to zero.
- Waste water treatment plant: See section 3.2 of Part I of the PBA.

Upon decommissioning, subsurface utilities that are three feet or deeper below ground level may be abandoned (capped, grouted) and left in place. Deactivated underground utilities will be abandoned in place unless excavation is required to facilitate environmental remediation. The end state for utilities projects will occur at the point in time when there is no longer demand by the Site for these utility services, or at such time that the DOE relinquishes responsibility for the Site or for providing utility services. In the interim, these utilities will remain in place and active. Because these activities are located in the IA, no effect is expected to listed species. Power line removals are discussed in another section below. The USFWS concurred with this project in a previous draft of the PBA (USFWS 2000; concurrence letter in Part I, Appendix C).

3.1.8 Waste Storage And Removal

Waste storage is a routine activity at the Site that is conducted within buildings and specific storage facilities located within the IA. The waste storage activities take place in areas well removed from Preble's mouse habitat and watercourses at the Site. The present operation and eventual decommissioning of these storage facilities is expected to have no effect on the Preble's mouse or other listed species, because none of these activities will occur within or adjacent to habitat of any listed species. The waste storage and removal activities were previously concurred with by the USFWS in a earlier draft of the PBA (USFWS 2000; concurrence letter in Part I, Appendix C).

3.2 Building And Structure Decommissioning And Demolition

Building and structure D&D includes the tasks of characterization, site preparation, decontamination, dismantlement, demolition, and project management and support

services. After buildings or structures are removed, revegetation will be conducted using native plant species. These facilities are not located in current Preble's protection areas. Therefore, these D&D activities will not affect the Preble's mouse or other listed species. Water depletion issues associated with removal of these structures will be dealt with in Part II of the PBA. The following table lists the facility clusters and structure numbers along with a short general description, where applicable. The table is not intended to be an exhaustive list of every building/structure number on Site, however, none of these buildings are in Preble's habitat. Any buildings or structures found within Preble's habitat are discussed elsewhere in the PBA. Otherwise, any unlisted buildings or structures are found outside Preble's habitat. This description summarizes several sections that the USFWS had previously concurred with in a previous draft of the PBA (USFWS 2000; concurrence letter in Part I, Appendix C). The table lists the section numbers from the earlier draft PBA where a more extensive description of each facility cluster can be found. Potential indirect effects to the Preble's mouse may include increased noise, dust, erosion, or sedimentation problems. These project activities are not expected to create any erosion or sedimentation problems in the current Preble's protection areas. Best management practices will be used to suppress dust (water spray), and control erosion or sedimentation problems that could reach the Preble's mouse habitat. Excavation and post-project grading will be minimized to the extent needed to accomplish the remediation and cleanup objectives. Disturbances will be revegetated following protocols outlined in Part II of the PBA.

Facility Cluster	Section in Draft PBA	Buildings/structures to be removed
111 Facility Cluster	6.1	111, T111A, T112A, T112B, T112C, T115A, T115B, T115C, 116, T117A, T119A, T119B, T121A, unnumbered guard post, bus stop/car pool shelter. General staff administration buildings and offices.
130 Cluster	3.3	Buildings 130, 131, 132, C130, and temporary buildings T130A through T130J. Administrative offices and warehouse.
SECBZO Facility Cluster	3.1	Buildings 120, T120A, and 920, and their associated underground storage tanks—Tanks 043, 243, 247, 287, 318, and 319, as well as the aboveground replacements for Tanks 243 and 287, TK-32A and TK-1A.
INFMET Cluster	3.2	Building 180. This is the meteorological tower in the NW BZ.
903/905 Cluster	5.1	Buildings 903A, 903B, and 966,
891/900 Groundwater Treatment Cluster	5.2	Buildings 891, 900A, 900B, 900C, 900D, and 900E, and Tanks 891-T-200, T-201, T-202, T-203, T-204, T-205, T-206, and T-207.
125/441 Cluster	6.2	125, 126, 441, tanks 079 and 278. Laboratory, source storage, office buildings, liquid nitrogen storage tanks
444 Cluster	6.3	444, 427, 427A, 445, 447, 448, 449, 450, 451, 453, 454, 455, 457, T444A, and Tank 427
690T Cluster	6.4	662, storage sheds, and Tanks 036 and 037
910 Cluster	6.5	215D, 226, 227, 228A, 228B, and 910, and 3 separate tanks (B226 EDTA Tank, B227 Nitric Acid Tank, and B215D Evaporator Distillate Storage Tank)
559 Cluster	6.6	559, 560, 561, 562, 563, and 564, six tanks
707 Cluster	6.7	707, 708, 711, 711A, and 718, Tanks 206, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 284, 223, 290, 324, 325, and TK-16
750 Cluster	6.8	750, 705, 706, T706A, 707S, T707B, 709, 709A, T750A, T750B, T750C, T750D, and 763 S750, and tank 205
750 Pad Cluster	6.9	Tents 2, 3, 4, 5, 6, and 12, Buildings T750E and T750F, and one tank
750HAZ Cluster	6.10	old 551 RCRA Pad, S374, three hazardous waste storage pads
569 Cluster	6.11	569 and 570

886 Cluster	6.12	875, 886, 880, 886, T886A, 886, 888A, 888, and 828
371/374 Cluster	6.13	371, 374, 373, 374A, 377, 378, 381, T371H, T371J, T371K, 376, T376A, T371I, and 371A, and tanks 163, 164, 165, 166, 167, 168, 169, 170, 171, 224, 225, 226, 227, and 228
778 Cluster	6.14	778
779 Cluster	6.15	779, 729, 782, 727, 780, 783, 780A, and 780B; cooling towers 784, 785, 786, and 787; and tanks TK-18, TK-19, and TK-24.
771/744 Cluster	6.16	771, 774, 714, 714A, 714B, 715, 715A, 716, 717, 771C, 772, 772A, 774A, 774B, 775, 790, 770, 771B, T771A, T771B, T771C, T771D, T771E, T771F, T771G, T771H, T771J, T771K, and T771L, and tanks 173, 174, 175, 176, 179, 180, 182, 183, 184, 185, 192, 193, 194, 195, 292, and 293.
776/777 Cluster	6.17	776, 777, 701, 702, 703, 712, 712A, 713, 713A, and 781, and Tanks 199, 200, 201, 202, 203, 207, 244, and 245
881 Facility Cluster	6.18	Buildings 881, 881CT, 881F, 881G, and 881H; the 881–883 Stacks; the 881–883 Tunnel; and Tanks 002, 013, 014, 015, 016, 029, and TK-66
The 865/883 Cluster	6.19	Buildings 827, 863, 865, 865, 867, 868, 879, 883, 889, and 883CT; the Carpenter Shop; and Tanks 010, 011, 012, 024, 026, 252, 323, and TK-25A
The 991 Cluster	6.20	991, 996, 997, 998, 999, 984, 985, and 989, and five tanks
566, 800A, and SECNPZ Clusters	6.21	566, 566A, and 566B, and Tank 132, 830, T881A, T881B, T883A, T883B, T883C, T883D, 884, and 885, and the 889 Slab and 890 cooling tower, 213, 260, 372, 372A, 375, 519, 550, 557, 761, 762, 762A, 764, 765, 765A, 773, 792, 792A, 888, 901, and 992, and Tanks 153, 153, 154, 155, 162, 230, and 235.
The INFSEW Cluster	7.1	972, 973, 974, 974A, and 988 Buildings and tanks required for sanitary sewage treatment.
The 440 Cluster	7.2	439, T439A, T439D, 440, and T447A
The 664 Cluster	7.3	664, 666, 668, and T664
The 551 Cluster	7.4	551 and T551A
The 904/906 Cluster	7.5	T760A, T760B, T904A, and 906; the 904 Pad, the P904 propane tank farm; and pondcrete storage tents 7, 8, 9, 10, and 11
The Process Waste Transfer System (PWTS) Cluster	7.6	207, 528, 728, 730, 731, 732, 828, 867 and 887; 10 valve vaults; and 7 separate tanks.

The 980 Cluster	7.7	965, 968, and 980
The 207 Cluster	7.8	308A, 788, and T788A, and a clarifier tank. B788, T788A, and B308A, Tanks 023 (propane storage, west of Building 788), 136 (cement silo southwest of Building 788), 137 (cement silo west of Building 788), 138 (sludge thickener tank, also known as the 207 Clarifier, east of Building 788), and 139 (propane storage, west of Building 788). Cementation Process Building Cluster, Solar Ponds Pump House
The 964 Cluster	7.9	964 and associated storage buildings

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3.3 Specific Projects

3.3.1 The Present Landfill

Use of the Present landfill (a portion of Operable Unit 7, OU7) was discontinued in 1998. To provide soil stabilization until final closure, the landfill surface was regraded and revegetated. Maintenance may include visual inspections, repair of settlement and erosion damage, weed control, and reseeding. Required groundwater and surface water monitoring will also be conducted on associated wells. Current closure plans for the landfill entail further covering the landfill with a cobble cover or about two feet of soil and revegetating the area. Operation and maintenance of the existing OU7 seep water treatment installation consists of daily inspections, sample collection and analysis, quarterly reporting, and maintenance. The East Landfill Pond on the east end of the Present landfill will remain in place after closure. Some modification of the East Landfill Pond dam may be conducted, but the work will all be outside Preble's habitat.

Neither the Present landfill nor the East Landfill Pond are located in current Preble's protection areas. The actual physical work conducted to provide final remediation to the Present landfill will therefore have no effect on the Preble's mouse. Although some noise and potential dust from the work on the Present landfill are to be expected, no effect to the Preble's mouse is expected since Preble's mice have never been captured near the Present landfill. In 1996, trapping was conducted at the East Landfill Pond to determine whether Preble's mice occurred there (K-H 1996). Trapping was conducted in the marginal habitat near the inlet of the East Landfill Pond. Trapping was conducted for a total of 480 trapnights over 4 days from August 13-16, 1996 and no Preble's mice were captured at the pond. Additionally, telemetry data collected in the Walnut Creek drainage during 1999 showed no individuals moving in the side drainage where the East Landfill Pond is located. Potential sedimentation and erosion problems from the Present landfill project will be controlled through the use of silt fence and the fact that the East Landfill Pond would capture any sediment that might runoff from the landfill area. Therefore, the project will have no effect on the Preble's mouse.

3.3.2 Recycling Of Concrete From Building Rubble

During the demolition phase of the building decommissioning discussed above, a large volume (about 130,000 cubic yards) of concrete rubble will be generated. Concrete rubble that meets free-release criteria can be used as backfill onsite. Concrete that is found to be below the unrestricted release limits for radionuclides, and is considered to be non-hazardous, non-beryllium contaminated, and non-Toxic Substances Control Act (TSCA) regulated, can be free-released.

The rubble will be stockpiled at locations in the heavily industrialized areas of the IA where buildings or parking lots were once present. These stockpiles may cover several acres and will have dust suppression and surface water runoff controls in place to protect air and surface water quality. Soil stabilizers will be used to control suspension of dust and fine materials, and silt fencing and berms will be used to control sediment transport

and erosion. Concrete rubble may be processed into backfill material using a crusher. During crushing, a water mist may be used to control fugitive dust. Similar methods or covers may be used when rubble or recycled material is being transported.

No effect on the Preble's mouse is expected from this activity since it will occur in the IA outside of current Preble's protection area. The USFWS concurred with this project in a previous draft of the PBA (USFWS 2000). The concurrence letter is included in Part I, Appendix C.

3.3.3 IA Revegetation Activities

As buildings and structures are removed within the IA, areas will be graded and revegetated with native plant species following the IA Regrading Plan (K-H 2003a) and IA Revegetation Plan (K-H 2003b). These areas are currently upland areas of low quality (i.e. parking lots, previously disturbed areas, buildings) that are located largely outside of Preble's habitat. The portions of the IA located within current Preble's protection areas that will be removed and returned to a native state are discussed in the "may affect, but not likely to adversely affect" section of Part I of the PBA. As these areas of currently low quality value are revegetated with native species, this will create additional native upland areas that may be used by wildlife, including the Preble's mouse. The total acreage of the IA to be returned to a native state is approximately 250 to 300 acres.

Because the activities discussed in this section are outside the current Preble's protection areas, there are no direct effects to the Preble's mouse. Indirect effects, however, may include noise, dust, erosion, sedimentation from these activities. Best management practices, including redundant erosion control measures and monitoring of effectiveness of these controls, will be used to negate indirect effects. Therefore no effect is expected from these activities on the Preble's mouse.

3.3.4 Routine Soil Remediation

Remediation activities will take place at several locations in the IA where cleanup is necessary to meet RFCA agreement requirements. These activities generally involve either removal or appropriate disposal/storage of the soils or covering the areas with additional soil cover. Heavy equipment is used for these activities. Remediation activities will follow the RFCA Standard Operating Protocol (RSOP) for Asphalt and Soil Management (K-H 2001c, Part II, Appendix C). An example of such an activity, but not limited to this project, is the 903 Pad remediation. It is taking place outside current Preble's protection areas. For this project and any others outside Preble's habitat, no direct effect on the Preble's mouse is expected. Best management practices, including redundant erosion control measures where needed, and monitoring of effectiveness of these controls, will be used to negate indirect effects. Remediation projects within Preble's habitat are identified and discussed in other sections of the PBA.

4. Activities That May Affect Listed Species, But Are Not Likely To Adversely Affect

The activities listed in this section of the PBA are those that may affect listed threatened or endangered species, but are not likely to adversely affect them. Additional or unforeseen future projects that are not listed in this section will be evaluated based on the following criteria to determine whether they meet the "may affect, but not likely to adversely affect" definition. If projects do not meet the "no effect" or "may affect, but not likely to adversely affect" criteria then they automatically fall into the "adverse effect" category. Evaluations will include an assessment of potential direct and indirect effects, interdependent actions, cumulative effects (effects from state and private party actions), and interrelated actions. Projects described in this section, along with any indirect effects, interdependent actions, and interrelated actions, were deemed to "may affect, but not likely to adversely affect" any listed species (in particular the Preble's mouse) for the following reasons (the flowchart in Figure 4 summarizes the following criteria and allows for easier determination of project activity effects):

- Only temporary disturbance to the Preble's habitat will result from these activities (such as trampling of vegetation). No permanent loss of habitat will occur.
- Soil or vegetation disturbance will be limited to that created by pulling of fence posts or guard rail posts, installing temporary flumes, removing power lines, removing riprap piles, removing above ground pipelines, cutting of a few shrub stems to access a work area, or similar type small impacts.
- The majority of the activities are located near established roads, so minimal off-road vehicle use is required.
- The temporal impacts will be minor for these activities. Routine activities may be done monthly or less frequently and typically require only a few hours to complete. For the non-routine activities, the work required to complete the project are mostly one-time events and once completed will no longer require access to those areas in the future.
- For the routine activities, these have been conducted for years at the Site and have had no apparent detrimental effects on the Preble's mouse or other listed species. Trapping and telemetry data have been collected on the Preble's mouse in each of the drainages at the Site over the years and have demonstrated that Preble's mice continue to occur and be captured while the routine activities continue (K-H 1997c, 1998b, 1999b, 2000b, 2001b, 2002b; RMRS 1996). Additionally, specific project trapping and telemetry data have shown the Preble's mice continue to be captured in the vicinity of project areas during and after project activities have ceased (B-4 Dam Toe Slope Project: DOE 1996; East Trenches Treatment System: K-H 2000b).
- Excavation in the riparian shrub community will not occur except for WARP and power line removals, where previously concurred with by the USFWS.

- Heavy or motorized equipment will enter the riparian plant community or cross water courses only on established roads and dam tops, or as indicated in project descriptions and where previously concurred with by the USFWS.
- The types of equipment needed to accomplish these activities may include pickup trucks, bobcats, all terrain vehicles (ATV), backhoes, trackhoes, front end loaders, cranes, or rolloffs. The type of equipment used would be the minimum needed to conduct the work. Larger pieces of heavy equipment such as backhoes, trackhoes, front end loaders, dump trucks, etc. would be used for the specific projects listed below and would largely remain on roads and other previously disturbed areas.
- The majority of the projects listed in this section of the PBA are scattered throughout the BZ and are not concentrated or contiguous at a given location. Therefore the potential for impacts are minimal because suitable habitat exists adjacent to project areas.
- Most activities are related to removing structures from the BZ, thereby ultimately improving and/or creating additional wildlife habitat, including Preble's mouse habitat.

To minimize impacts to the Preble's mouse, project management will utilize and maintain the following BMPs except where regulatory and/or health and safety requirements take precedence.

- Identify and prioritize Preble's habitat areas that are subject to disturbance and design activities to avoid areas of high habitat value[2]. For example, large willow patches should be avoided.
- Reduce the impact footprint (i.e., no excessive walking in area beyond what is necessary to accomplish the work, minimizing laydown area and equipment storage locations).
- Conduct all activities during daylight hours, when the Preble's mouse is less active when scheduling during the hibernation season of the mouse cannot be accomplished.
- Minimize the length of time spent in sensitive areas (getting work done as quickly as possible, not reentering area once work is completed).
- Use established roads (i.e. paved, gravel, two-track, historically used routes to monitoring locations) for vehicle traffic. If an established road does not exist, use the safest and most direct route that minimizes impacts to the habitat.
- Limit equipment entrance/exit areas to the minimum necessary to accomplish the work.
- Limit vegetation disturbance through alternative actions. For example, prune trees/shrubs rather than remove trees/shrubs; cut shrub stems to allow re-growth rather than grubbing out the entire root system.

[2] For determination of impacts within current Preble's protection areas, habitat quality was defined based on the 1996 Site vegetation map. Higher quality habitat is defined as all woody vegetation classifications and short marsh, tall marsh, and wet meadow wetland types. Lower quality habitat is defined as all grassland classifications, mud flats, and other disturbed community types. Open water, riprap, concrete, roads, structures are not considered habitat for the Preble's mouse.

- No blading and grubbing of woody vegetation will occur in areas of temporary disturbance.
- Remove trash and unnecessary equipment in project areas after work is completed.
- Revegetate disturbed Preble's habitat with native species after the activity has been completed in accordance with the Habitat Mitigation Techniques Plan (Appendix A, Part II of PBA).
- Prevent spilled fuels, lubricants or other toxic materials from entering Preble's habitat.
- Minimize project activities in wet areas and conditions to avoid damage to the habitat.
- Use erosion controls (i.e., silt fence, hay bales, mulching, tackifiers, surface roughening) to control erosion and sedimentation problems. Projects will monitor erosion control effectiveness and modify control techniques as needed through project completion.
- Use the least amount of and/or smallest equipment necessary to accomplish the work.
- Do not clean equipment in Preble's habitat or in areas where runoff will enter Preble's habitat.
- Staging areas will be located either outside of Preble's habitat, or within the defined project footprint.
- Inspect and clean equipment of weeds/seed to prevent spread of noxious weeds.

Project managers will receive a copy of the PBA and BO, and be briefed on the guidelines and requirements contained therein pertinent to their project. Project management is responsible to ensure compliance with the requirements and guidelines outlined in the PBA and BO. Projects are responsible to follow and maintain the best management practices (BMPs).

The following table lists the activities included in the "may affect, but not likely to adversely affect" section of the PBA. The table summarizes the potential project impacts within the current Preble's protection areas. Additional detail on each project is found following the table. Figures 6 and 7 show the locations of some of these projects. Project evaluations are based on worst case scenarios, except where specific plans or information currently exists. The activities included in this section are being consulted on because they are likely to happen. Their inclusion here, however, does not constitute the fact that they will indeed occur. Human impacts are defined as human foot traffic in an area. Vegetation/soil impacts are defined as activities that in some way disturb vegetation or soil beyond that associated with foot traffic in an area.

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Project	Human impact*	Vegetation/soil impact*
Ecological Monitoring	Foot traffic, once a week, 1 to 2 hours each	None
Air Quality Monitoring	8 samplers in habitat Foot traffic 2X/month	Whack vegetation to 6-8" with hand-held whacker 5 feet around sampler (1X-2X/annually).
Routine Pond Operations	Foot traffic weekly.	Dam road grading, vegetation removal, dam mowing, riprap rearrangement.
Routine Road Maintenance, Road Repair, Grading, and Mowing	None	1Xgrading/year, roads no wider than current width 1 or 2Xmowing/year, no farther than 20' off road edge along firebreak roads in BZ
Weed And Vegetation Management	Foot traffic 3X/year. 3 hours per visit.	3 acres of weed control per year/Rock Creek. Pulling weeds, whacking weeds, spraying weeds with herbicide.
Well Abandonment And Replacement Program	Foot traffic during removal.	Approximately 100 wells. Removal of 6 inch pads and/or 4x4 foot pads. Entrance and exit by forklift.
Removal of Concrete Pads from Abandoned Wells	Foot traffic during removal.	Removal of 6 inch pads and/or 4x4 foot pads. Entrance and exit by forklift.
Subsurface Soil Sampling	Foot traffic.	Truck mounted geoprobe entrance to and exit from area.
Groundwater Treatment System Monitoring	Foot traffic.	Replacement of iron filings. Excavation of pipes, near roads.
Trash Removal From Buffer Zone	Foot traffic only. A few days a year.	None
B-4 Pond Building	Foot traffic. One time project.	No off road driving. Removal of 30 by 30 foot structure.
C-1 Pond Rip Rap Pile	None	Removal of 20 by 20 foot pile of riprap, located next to road. Using front end loader, or other heavy equipment. One time project.
Dirt Pile Along Walnut Creek Southwest Of Landfill	None	30 by 40 feet of gravel/dirt removal. Using heavy equipment to either remove pile or push back into borrow area.

Project	Human impact*	Vegetation/soil impact*
Pipeline Removal	Foot traffic for monitoring once to twice a year. Walking along pipeline for visual inspection	Heavy equipment to pull pipeline out of habitat, excavation of pipeline where it crosses the road. One time project. T-posts holding pipeline will be removed.
Fence and T-Post Removal	Foot traffic in areas not accessible by bobcat.	Bobcat like equipment used to pull t-posts and fence posts. Approximately 18,000 feet of fence line.
Gravel/Riprap Storage Area	None	Driving on roads and disturbed areas only. Heavy equipment o remove concrete and gravel. One time project.
Guard Rails Along Roads	None	Heavy equipment, one time project. Approximately 1,000 feet of guard rail.
Power Pole And Power Line Removal	Foot traffic	Driving bucket truck to and from pole. Cutting power pole and dragging pole out of habitat using a bobcat. Approximately 40 poles in habitat.
Security Force Buffer Zone Activities	None	Off road driving in emergencies.
South Interceptor Ditch Maintenance	Quarterly visual inspections of ditch. Foot traffic.	Dredging of ditch from established road running along ditch. As needed.
Temporary Surface Water Flume Projects	Foot traffic for monitoring once installed. 3X/month.	One vehicle to enter and exit area. Soil disturbance approximately 8 sq. feet
Buffer Zone Concrete Removal/Incinerator Project	N/A. Separate consultation.	N/A. Separate consultation.

* Impacts are estimated and are not exact numbers. N/A = Not applicable.

4.1 Environmental Baseline

In Jefferson County, the Preble's mouse has been captured or suitable habitat exists along portions of Coal Creek and Ralston Creek, in addition to that found in Rock Creek, Walnut Creek, Woman Creek, and Smart Ditch at the Site. Based on the availability of potentially suitable habitat and lack of trapping information, Preble's mice are assumed to occupy appropriate habitat throughout Jefferson County.

In Boulder County, the Preble's mouse has been captured or suitable habitat exists along portions of Coal Creek, South Boulder Creek, Saint Vrain Creek, and within the City of Boulder Open Space and Mountain Parks system. Preble's habitat also exists along South Boulder Canal, Doudy Draw, and Spring Brook. Based on the availability of potentially suitable habitat and lack of trapping information, Preble's mice are assumed to occupy appropriate habitat throughout Boulder County.

During 2002, the USFWS proposed critical habitat for the Preble's mouse (67 CFR 47154). On June 23rd of 2003, the USFWS finalized the critical habitat ruling for the Preble's mouse (68 FR 37275). The final rule excluded the Rocky Flats Environmental Technology Site from critical habitat designation because the Site will become a USFWS National Wildlife Refuge after closure.

4.2 Routine Activities

The following routine activities occur in or adjacent to current Preble's protection areas. These activities are restricted within the boundaries of the Site, and do not affect surface water volumes. Potential impacts to threatened or endangered species are discussed for each activity.

4.2.1 Ecological Monitoring

Ecological monitoring evaluates the status of wildlife and plant communities to provide information used to ensure that operations at the Site remain in compliance with state and federal statutes and regulations, and for natural resource management. The monitoring program entails numerous surveys throughout the BZ as well as the IA. Several driving surveys use existing BZ roads to access areas of interest on the Site. Many areas are inaccessible by road; in these cases, surveys are conducted on foot. Foot surveys are frequently conducted in current Preble's mouse protection areas. Additionally, aquatic sampling (largely fish trapping) is conducted periodically along streams and in ponds at the Site. These activities are not expected to adversely affect the Preble's mouse onsite, or are they expected to have effect on off-Site or downstream species. Best management practices are used to minimize disturbances to the habitat by Ecology Program activities.

As part of the Site's commitment to conserve the Preble's mouse, live trapping may be conducted annually in different drainages at the Site. This monitoring is performed under Section 10 of the sub-permit issued by the USFWS (dated 3/25/02, permit # TE051719-

0), and by permit from the Colorado Division of Wildlife (CDOW, dated 2/25/03, permit # 03-TR569). Copies of both permits are included in Part I, Appendix D.

4.2.2 Air Quality Monitoring

Air quality monitoring requires routine visits to 38 air sampling sites twice monthly, and to one meteorological tower location (two towers) on a weekly basis. Fourteen of the monitors are located on the Site's perimeter, three are off site in local communities, and 21 are located onsite around or in the IA. Each sampler is accessed via an existing road, and visits include activities such as changing filters, checking flow, and calibrating instruments. Eight of the samplers at the Site are located in current Preble's protection areas. Occasionally, if vegetation gets tall around the sampler location itself, a weed whacker is used to trim the weeds to approximately 6-8 inches in an area extending about five feet from the sampler to allow access and proper operation of the sampler. As Site closure draws closer, electrical power may be shut off to these samplers. Should that occur, small gasoline powered generators will be required to provide power to the samplers, because solar power is not sufficient to provide the power needed to operate the samplers. The generators are the typical type that can be purchased at local hardware stores and operate using lawnmower size engines. The generators would only be operating during normal daylight working hours, unless a project was working into the evening and required longer hours of monitoring. But this is an unlikely scenario. If this occurs, a temporary impact to the habitat would occur where the generator is located and additional trips to the samplers will be required to refuel the generators. A small amount of additional noise would result from the generators, however, because the samplers themselves create a loud whining noise during normal operation, no effect on the mouse from the noise is expected.

Eventually the air samplers will be removed. This will involve driving to the locations, as is done for normal monitoring, removing the samplers from the poles, and later having the power poles removed. The power pole removal activities are discussed in section 4.3.8 of Part I of the PBA.

Because no disruptive actions are taken during visits (other than minimal weed trimming around samplers as needed) and additional activities will occur largely on the roads to and from the samplers there will be no adverse effect on the Preble's mouse.

The meteorological tower, located west of the IA, is visited weekly to download data, and is calibrated over a two- to three-day period twice a year. The tower will be taken down prior to Site closure. The tower and associated structures are located on the pediment top, and not in the current Preble's protection areas, therefore no impact to the Preble's mouse or other listed species will result from this activity. Air quality monitoring activities do not affect surface waters; therefore, there will be no effect from this activity on listed lower Platte River species.

4.2.3 Routine Pond Operations

Routine pond operations encompass the transfers of treated wastewater and stormwater between interior ponds, and discharges from the terminal ponds, in the A-, B-, and C-series detention ponds. Proper management of pond operations is necessary to ensure compliance with the Clean Water Act and RFCA. Routine dam monitoring is accomplished by weekly visual inspection and reading of pond levels and piezometers, and by continuous telemetry reading. This monitoring is done from access roads or by foot where roads do not exist. Pond discharges are typically conducted when pond levels reach a certain level. This height can vary, however, based on weather forecasts and other extenuating circumstances. Ponds are usually discharged as batch releases at specified rates (typically a one foot drop in water height per day) although this could vary depending on the situation. The number of annual batch releases varies depending on climatic conditions.

Routine maintenance of dams includes minor repairs and maintenance of the A-, B-, and C-series and East Landfill Pond dams, and includes activities such as dam road grading and maintenance, vegetation removal within the riprap areas of the dams (either mechanical or herbicide), vegetation trimming and vegetation mowing. Dam maintenance, as required by the State Engineer's Office (SEO) and DOE Orders, is necessary to maintain dam safety and integrity. Failure to adequately maintain dams could result in an unscheduled release, potentially resulting in non-compliance with the RFCA, NPDES permits, or threatening the safety of downstream persons, the environment, and property. Additionally, a dam failure would potentially destroy Preble's habitat downstream. Therefore, a balance between dam safety and maintenance versus the protection of the Preble's mouse is required. Vegetation management is an integral component of the dam maintenance and safety program.

Mowing (or burning) on dams and spillways of Site water management ponds has been a routine activity since the 1970s. Federal Energy Regulatory Commission (FERC) inspectors visit the Site annually to inspect dams for safety and maintenance. These inspections are required for compliance with the Bureau of Reclamation and Colorado State Engineer safety regulations. Clearing of vegetation is necessary to prevent the vegetation from obstructing from view potential structural problems in the dam.

Vegetation management activities mentioned above have already been consulted on, and will follow the guidance provided in the BE entitled *Vegetation Management on Water Control Structures and Related Actions in Preble's Mouse Habitat* (DOE 2001; Part I, Appendix C) and USFWS concurrence letter (concurrence letter dated, November 27, 2001; Part I, Appendix C). Actions of this project will not adversely affect the Preble's mouse or its habitat.

In addition to the above concurred upon actions, actions to move or replace riprap on the dam faces may occur in order to keep the dams functional, safe, and in good operating condition. Existing riprap that has shifted over time might need to be moved, or riprap

will need to be replaced. Riprap movement would be restricted to areas where riprap already exists. Areas with existing riprap are accessible from existing roads. Vegetation on any riprap areas is sparse and the current Preble's mouse survey guidance (USFWS 1999) does not recognize riprap as preferred habitat, nor does the Site data indicate that Preble's mice use riprap as preferred habitat. Therefore, since the riprap areas are not considered Preble's habitat and the riprap areas can be accessed from existing roadways and dam crests, the riprap repair activity, although it may affect the mouse, it is not likely to adversely affect the mouse.

Additional vegetation management actions necessary for dam safety inspections are addressed in Part II of the PBA.

4.2.4 Routine Road Maintenance, Road Repair, Grading, and Mowing

Buffer Zone roads and utilities are maintained routinely to ensure that roads are safe for use, and that utilities remain in good operating condition. When dirt and gravel roads become eroded, grading restores proper drainage and reduces siltation that otherwise could reach streams and affect the aquatic ecosystem. Some BZ roads serve as fire breaks, providing barriers to interrupt the spread of grassland wildfires that occasionally occur in the BZ. These roads also serve as access routes for emergency vehicles such as fire protection equipment and Site security forces, as well as groups who perform various environmental monitoring activities (e.g., surface water, groundwater, air quality, and ecology).

Some road grading and road edge mowing occurs in and adjacent to current Preble's protection areas. This road maintenance has been conducted routinely for 25 to 50 years, depending on location. Areas where roads are adjacent to or cross Preble's mouse habitat have been maintained by annual grading for most of the last 50 years. Road grading activities will not widen the current width of the roads within Preble's habitat. Mowing along the roads within Preble's habitat will not extend beyond 20 feet from the edge of the road.

No effects from the road maintenance activities are expected to any of the species under consideration in this PBA, including the Preble's mouse, because roads are not considered suitable Preble's habitat.

4.2.5 Weed And Vegetation Management

Weed management in the Rock Creek drainage will follow the BA for natural resource management (including weed control) that was written for the Rock Creek Reserve in the north BZ at the Site in 2001 (USFWS 2001a; Part I, Appendix C). The Biological Opinion (BO; USFWS 2001b; Part I, Appendix C) for this BA stated that a maximum of three acres in the Rock Creek Reserve could be treated annually with noxious weed control/herbicides with no adverse effects to the Preble's mouse. The BO also gave approval for up to three acres of prescribed burning annually within Preble's habitat in Rock Creek.

Weed management in Preble's habitat outside of Rock Creek will consist of biological control insect releases and weed management required by the USFWS for project mitigation areas. Weed management in project mitigation areas are required to meet success criteria set by the USFWS. At this time, no other weed management activities are planned in Preble's habitat at the Site.

4.2.6 Well Abandonment And Replacement Program

The Well Abandonment and Replacement Program (WARP) ensures that wells associated with the GMP, environmental restoration, decommissioning, and other site closure projects are properly abandoned to protect groundwater quality and comply with State of Colorado Well Construction Rules (2 CCR 402-2). WARP also provides for installation of replacements for damaged GMP wells to maintain compliance with RFCA groundwater monitoring requirements.

Ultimately, WARP will accomplish the abandonment of about 700 or more permitted wells across the Site, leaving only those wells that will be retained for long-term groundwater monitoring. Well abandonments, through Site closure, located in current Preble's protection areas have been addressed and concurred with through a separate consultation with the USFWS (DOE 2002a; USFWS concurrence letters dated February 24, 2003 and April 9, 2003; Part I, Appendix C). Well abandonments in the Rock Creek drainage in current Preble's protection areas were addressed in a biological evaluation in 2002 and concurrence letter from the USFWS (DOE 2002b; USFWS concurrence letter dated September 12, 2002; Part I, Appendix C). In December of 2003, a new Preble's mouse protection area map was made effective (Appendix A of Part I of the PBA). This map increased the size of the protection areas in some spots along the drainages on Site, thereby possibly including more wells in the protection area. Removal of wells that fall in this category will follow methods outlined in the previous BEs and Bos listed above.

4.2.7 Removal of Concrete Pads from Abandoned Wells

Prior to 1998, a concrete pad with an identifying tag was placed at each abandoned borehole or well location. As part of the Site cleanup, these old concrete pads will be removed from the BZ. The concrete pads range from a circular concrete pad 6 inches in diameter, to those about 4 by 4 foot in size. The old pads will require less work than abandoning wells. The smaller pads will require little more than a sledge hammer to remove the concrete. The 4 by 4 foot concrete pads will require a forklift to be driven to the area. The forklift will lift the pad, and move it out of the area. The only vehicle that will need to approach the concrete pads will be the forklift, and it will only be driven in and out of the area one time. Well abandonments have previously been approved by the USFWS (DOE 2002a, 2002b; USFWS concurrence letters dated September 12, 2002, February 24, 2003, and April 9, 2003; Part I, Appendix C). Removal of these pads will follow the same methods outlined in the previous BE's. By using best management practices, impact to the Preble's mouse habitat will be minimized and no adverse effect will occur from the concrete pad removal activity. Additionally, the removal of the

concrete pads and re-establishment of native vegetation will increase the amount of habitat available for the Preble's mouse at the Site.

4.2.8 Subsurface Soil Sampling

Subsurface soil sampling is conducted at many locations where characterization of below ground soils is needed. Most of this occurs in the IA where sampling is needed around the buildings or for other remediation activities. Sampling is typically conducted with a geoprobe type sampler mounted on a truck or small Bobcat type piece of equipment. The geoprobe pushes (hammers) a tube into the ground to the required depth. The tube and soil core (up to 3.75 inches in diameter) is removed and the required soil taken for analysis. The hole is filled with granulated bentonite (clay). If any subsurface soil sampling has to be done in Preble's habitat, best management practices would be used to minimize any impacts. Typically only the geoprobe vehicle would be driven off-road to the sample location unless another support vehicle is needed for carrying the soil samples. So the only disturbance to the habitat would be from vehicle tracks off-road, foot traffic during sampling, and the small borehole. No adverse effect to the Preble's mouse is expected from this activity.

4.2.9 Groundwater Treatment System Monitoring

The Solar Pond, East Trenches, Mound, and 881 Hillside groundwater treatment systems are groundwater collection and treatment structures designed to capture and treat contaminated groundwater. The Solar Pond treatment system is located beneath the north access road north of the Solar Ponds location. The East Trenches treatment system runs beneath and north of the road along the south side of the B-series ponds. At both of these locations the area on the north sides of the roads is grassland that has been revegetated. The Mound treatment system is located beneath the grassland on the hillside south of the 995 complex (sewage treatment plant) and South Walnut Creek. Portions of the Solar Pond, 881 Hillside, and Mound treatment systems and all of the East Trenches treatment system are within the current Preble's protection areas. The 881 Hillside treatment system has already been decomissioned and closed out. The grasslands at the remaining three locations provides some low quality habitat (mostly revegetated) away from the streamside. The above ground portions of both systems consist of several well heads, treatment cells, and water discharge locations. Maintenance of the systems involves collection of water samples from the wells and discharge locations, and removal of the iron filings used to treat the water in the treatment cells. Iron filings are removed from the treatment cell through the use of a vacuum system or a backhoe. Maintenance may also require selective excavation of discharge piping. Excavation of discharge piping will most likely involve a backhoe or trackhoe piece of equipment to remove the discharge pipe from the previously disturbed low quality habitat. Excavations would be the minimum necessary to address piping issues. At the Solar Ponds, the pipe runs beneath a gravel road/parking area and would disturb essentially no actual habitat. For the East Trenches and Mound pipe areas (also located in previously disturbed areas) the overall disturbance would be less than 0.02 acres total. Roads access all of the wells, treatment cells and water discharge areas. Some additional area around the treatment cells is

necessary for bringing in the equipment necessary to replace the iron filing every few years. During 2003, the iron filings needed to be replaced at the East Trenches treatment system and a BE was written for consultation with the USFWS (BE dated 9/19/03, Appendix C of Part I of the PBA). The USFWS visited the site and concurred that the additional area and work required to complete the maintenance activities did not constitute an adverse affect (concurrence letter dated 10/6/03, Appendix C of Part I of the PBA). Future maintenance activities would follow the general guidelines and protocols followed for the East Trenches maintenance. If future planned activities exceed those outlined in the East Trenches BE, further consultation with the USFWS would be pursued. Current plans leave the treatment systems in place and functioning after Site closure. These monitoring and maintenance activities are expected to have no adverse effect on the Preble's mouse or other species under consideration in the PBA. When the Solar Pond and East Trenches Treatment Systems were installed the disturbances were seeded with big bluestem, little bluestem, western wheatgrass, side-oats grama, blue grama, buffalo grass, and blue flax.

As part of the IA Regrading Plan an additional groundwater treatment system may be installed between Buildings 371 and 771. No specific details are currently available on this proposed treatment system, however, the project would be completely outside current Preble's protection areas and would therefore have no effect on the Preble's mouse. Best management practices would be used to minimize and erosion or sedimentation problems in the streams.

Operation and maintenance of the Interceptor Trench System (ITS) was done by collecting ITS water (about 2,000,000–4,000,000 gallons per year) from the Solar Ponds Plume, storing water in the Modular Storage Tanks (MST), and transferring water to Building 374 for treatment through evaporation. These operations were stopped when the Solar Ponds treatment system was installed in 1999. The MST were removed in FY2003, however, they were not located within the current Preble's protection areas. Therefore the MST removal had no effect on the Preble's mouse or its habitat. The USFWS concurred with this project in a previous draft of the PBA (USFWS 2000). Potential water depletions resulting from operation of the Solar Pond Plume Treatment Project (SPPTP) are discussed in Part II of the PBA.

4.2.10 Trash Removal From Buffer Zone

Trash removal is an ongoing process in the BZ and the IA. High winds blow trash onto the Site from surrounding areas as well as from the IA. Trash usually gets trapped in fences or shrubs and trees in low areas of the drainages. Because the trash that blows in is usually light, it is usually removed by hand, then collected in vehicles parked on established roads before it is removed from Site. If it becomes necessary to drive a vehicle off an established road for trash removal purposes, only one vehicle is driven off the road, and the same tracks are used to enter and exit an area. Using best management practices, no effects are expected to any species under consideration in Part I of the PBA.

4.3 Specific Projects

4.3.1 B-4 Pond Building

A small building that holds a gauging station for monitoring water flows is located on the east edge of the B-4 pond dam. The building stands next to an established road on top of the B-4 dam and is located over the concrete spillway. It is however, located in current Preble's protection area. This structure may be removed. Removal should not require off-road driving since access can be made from the road crossing the dam. The total size of the building and surrounding area is about 30 feet by 30 feet. Best management practices will be used to minimize impacts to the current Preble's protection area. Any soil disturbance will be revegetated with native species.

4.3.2 C-1 Pond Rip Rap Pile

A pile of unused riprap is located to the northeast of the C-1 pond. The area is an old disturbed parking area previously used for riprap storage for projects along Woman Creek. The riprap is located adjacent to an established road and is surrounded by non-native vegetation (smooth brome). The area of the riprap pile is about 20 feet by 20 feet in size. If the riprap pile is removed, heavy equipment will be used to load the rock and transport it away. The equipment would remain on the previously disturbed area around the riprap pile. The ground will then be revegetated using native plant species. Best management practices would be used to prevent erosion and sedimentation problems.

4.3.3 Dirt Pile Along Walnut Creek Southwest Of Landfill

In the late 1970's to the early 1980's a borrow area was used west of the IA along Walnut Creek. A large gravel/dirt pile (about 30 feet by 40 feet) remains along Walnut Creek at that area within the current Preble's protection area. As part of the Site cleanup, the pile may be removed or pushed back into the borrow area. If done, the area will be revegetated with native species. The upper western reach of Walnut Creek is separated from the downstream reaches where the nearest populations of Preble's mice are known to occur near the A-series ponds by physical barriers including a parking lot, the north access road, a highly channelized ditch, and the stream going through several hundred feet of underground culvert. Therefore no adverse effect is expected to the Preble's mouse. Best management practices will be used to minimize impacts to the habitat and prevent erosion.

4.3.4 Pipeline Removal

Several aboveground pipelines are located in the BZ and used to pump water between ponds during normal pond operations. One of the pipelines runs from the East Landfill Pond near the Current Landfill to the A-1 pond. This line has been used to pump water from the East Landfill Pond to the A-1 pond. The southern portion of the pipeline runs partially through the current Preble's protection area. Two or three similar pipelines connect the A-series and B-series ponds. Until the pipelines are removed, they will

require occasional monitoring and maintenance. This will include visually inspecting the line on the grassland. However, no vehicles will be used off established roads. Prior to Site closure the pipelines will probably be removed.

The pipelines are buried underground only where they cross under roads in upland areas outside of Preble's habitat. Aside from using heavy equipment on the road to dig up the pipelines at these locations, no excavation will be required for removal of the rest of the pipeline. The pipeline sections will be separated or cut, pulled out of the area, and removed from the Site. T-posts used to hold the pipes in place on the hillside will also be removed. Only the minimum number of vehicles necessary to safely remove the pipeline will be driven off-roads to access the pipelines and remove them. Best management practices will be used to minimize impacts to the current Preble's protection area. Although the pipeline removals may affect the Preble's mouse, they should not adversely affect the Preble's mouse or its habitat.

4.3.5 Fence and T-Post Removal

Old interior fences and t-posts are located throughout the BZ. Fences include old wooden posts with barbed wire as well as newer steel t-post fences with barbed wire. Most fences and t-posts within the current boundary fence may be removed. Some of the areas where t-posts and fencing is to be removed occur in current Preble's protection areas. Approximately 18,000 linear feet of fenceline may be removed within current Preble's protection areas. Bobcat-like equipment or small backhoes may be used to pull out the posts from the ground. At some locations where this equipment cannot access the fences, hand removal may be required for safety purposes. Any barbed-wire may be wound up in coils. Both the posts and wire will be moved to an established road where they will be loaded onto vehicles or into a roll-off for removal. Only the minimum number of vehicles necessary to conduct the work safely will be driven off established roads. Best management practices will be used to minimize potential impacts to the current Preble's protection areas. Although the activity may affect the Preble's' mouse, it is not likely to adversely affect it.

4.3.6 Gravel/Riprap Storage Area

An area north of Walnut Creek and just east of the Shooting Range access road, has been used as a storage area for gravel, dirt, and riprap for many years. The area was originally used for onsite concrete mixing. The current piles of gravel and riprap are located in this disturbed area adjacent to an existing road, and will require heavy equipment for removal. The piles of material and the area is not suitable Preble's mouse habitat. However, it is located within the current Preble's protection area. Once the material is removed it, will be revegetated with native plant species. The area is flanked on the south and east by native coyote willow thickets. The shrubs will not be disturbed, nor will vehicles drive off the established roads. Best management practices will be used to minimize impacts to the current Preble's protection area. Vehicles and heavy equipment will remain on established roads and disturbed areas. No adverse effect to the Preble's mouse is expected.

4.3.7 Guard Rails Along Roads

Guard rails along the Site roads may be removed. Approximately 1,000 feet of the rails occurs current Preble's protection areas. Most of the area surrounding the guard rails is not high quality Preble's mouse habitat since it is usually a road on one side and gravel for a short distance or a road shoulder on the other side. Removal of the guard rails will most likely be accomplished at the same time as the removal of the roads. Disturbed areas will be reseeded with a native plant species. Best management practices will be used to minimize disturbances in the habitat. This activity will not adversely affect listed species.

4.3.8 Power Pole And Power Line Removal

As electrical service needs diminish at the Site, the need for electrical power lines and power poles to various locations is eliminated. Removal of power lines and power poles began in 2002. Power lines cross through current Preble's protection areas at several locations across the Site. Removal of the power lines within current Preble's protection areas involves driving bucket trucks to the base of the poles, lowering power lines to the ground, removing associated hardware from the poles, cutting the poles, and removing all the materials to be disposed of. Power line and power pole removals at the Site have been previously evaluated and approved by the USFWS. In 2002, two power line removals were approved (DOE 2002c, USFWS concurrence letter dated October 1, 2002; Part I, Appendix C). In 2003, an amendment to the 2002 biological evaluation was done to remove three more power lines in the BZ (DOE 2003). Future power line and power pole removal activities will follow the specifications outlined in the biological evaluations and concurrence letters previously used to conduct these activities at the Site. Although this activity may affect the mouse, it is unlikely that is will cause any adverse effect. No effect is expected on any of the other species listed for consideration under this PBA.

4.3.9 Security Force Buffer Zone Activities

The Site Security Force is responsible for protecting national security interests at the Site. This often involves patrolling various areas throughout the Site, including areas in the BZ. Depending on the current alert status, the amount of time spent patrolling the BZ varies. Generally the Security Force stays on the BZ roads. There have been instances where they have driven in current Preble's protection areas. Generally it is only noticed as a set of tire tracks going off-road. Until Site security requirements diminish and the need for the Security Force is gone, there may be situations where off-road driving will be required as a result of security responsibilities and emergency situations. Occasionally the Security Force holds training sessions, involving local law enforcement agencies, in the BZ. Training exercises are not allowed in current Preble's protection areas. Education of security force personnel will be conducted to inform staff of the importance of staying on established Buffer Zone roads because of the Preble's mouse. If accidental

damage to Preble's habitat result from emergency activities it would be mitigated by reseeding the areas with native plant species and using best management practices.

4.3.10 South Interceptor Ditch Maintenance

The South Interceptor Ditch (SID) prevents water coming off the pediment to the south of IA from going into the Woman Creek drainage. The water runs in the SID and into the C-2 pond. Routine monitoring of the SID for structural integrity is required. An established road runs on one or both sides of the SID banks. Monitoring entails driving on the ditch roads and inspecting the riprap and other ditch structures. Maintenance may include dredging portions of the ditch to allow free water flow or addition of riprap to areas within the ditch needing repair. These activities would be conducted from the established road that runs adjacent to the SID. Portions of the SID are located within the current Preble's protection areas. The SID is located on the hillside north of Woman Creek.

On October 1, 2002, the USFWS released a final rule (FR 67:61531) that provides private landowners an exemption to conduct ditch maintenance activities on their properties in Preble's habitat. These exemptions were provided to allow landowners to maintain water conveyance ditches so they function properly and continue to provide habitat for the Preble's mouse when in Preble's mouse habitat areas. The final rule allows for "normal and customary ditch maintenance activities that result in the annual loss of no more than ¼ mile of riparian shrub habitat within any one linear mile of ditch within any calendar year." The Site will follow the guidelines and direction allowed for ditch maintenance provided in the final rule for ditch maintenance activities for the SID.

It is unlikely that activities for maintenance of the SID will have an adverse effect on the Preble's mouse or other species under consideration in the PBA.

4.3.11 Temporary Surface Water Flume Projects

Surface water flumes are used at the Site to monitor water flows and to obtain automated grab samples for contaminant analyses as required by regulatory requirements or closure activities. Occasionally these are large concrete structures, but more often they are temporary fiberglass or metal flumes. Replacement of the concrete structures requires the use of heavy equipment and can take several weeks to complete the construction activities. The permanent flume replacements are discussed in Part II of the PBA.

Currently there are no temporary flume installations planned; however, the flumes are typically installed as part of the surface water monitoring required for specific projects. Typical size of the flumes are 5-8 feet in length and sit in the stream bottom. The temporary flumes are installed with hand tools; and this involves setting and leveling the flume in the center of the stream, anchoring the flume in the stream bottom, and setting up side walls made of plywood and plastic vinyl. Habitat disturbance needed to install these flumes is restricted to the stream bottom and two small linear trenches, dug with a shovel or pick, for the wing walls. Soil disturbance (from shovel or pick) is

approximately 8 square feet. Occasionally a few shrubs are trimmed to allow installation. The temporary flumes are installed in one or two days and only require a vehicle to drive the equipment to the stream edge once. Disturbed areas are reseeded with native plant species and future monitoring is conducted on foot, unless the flume happens to be located along the edge of an established road or two-track.

During 2002, a biological evaluation was prepared and submitted to the USFWS for concurrence regarding a temporary flume installation in Woman Creek (K-H 2002c). The USFWS gave approval for the project in a concurrence letter (USFWS concurrence letter dated October 16, 2002; Part I, Appendix C). Future temporary surface water flume installations would be conducted in similar fashion as the 2002 installation. Best management practices would be used to minimize disturbance and impacts to the current Preble's protection areas. Currently no plans exist to install any of these flumes within current Preble's protection areas between now and closure, but the evaluation was made to include the worst case scenarios.

4.3.12 Buffer Zone Concrete Removal/Incinerator Project

Several areas below the pediment top to the south of the 130 trailer complex were used to dump cement earlier during the Site's history. Removal of the cement flows was begun in April 2003. A part of the lower cement flow was located in the current Preble's protection area. A separate BE was written to cover this project and a concurrence letter approving work within the current Preble's protection areas was received from the USFWS on April 28, 2002. Copies of both of these documents are found in Part I, Appendix C. Project changes and issues that have emerged after the initial BE and concurrence letter are being consulted on with the USFWS outside of the PBA.

East of the 903 Pad along the edge of the pediment another area of past concrete dumping exists. This area however, is outside current Preble's protection area and will have no effect on the Preble's mouse. For all cement removal projects, best management practices will be used to minimize disturbances to the current Preble's protection areas.

5. Activities Not Covered By The PBA

5.1 Site Easement Issues

Numerous easements exist at the Site for utilities such as power lines, gas lines, and telephone lines. Also water conveyance ditches for water rights owned by non-DOE parties cross the Site at various locations (McKay Ditch, Mower Ditch, Smart Ditch – D-Series Pond water rights). Mineral rights and mining operations are also present at the Site at some locations. Currently no planned activities at the Site related to these easements are scheduled. The responsibility for USFWS consultation for potential impacts to listed species resulting from normal operations, maintenance, and new construction activities related to these easements at the Site, are ultimately the responsibility of the easement parties and would be dealt with through separate consultation with the easement parties, DOE, and the USFWS. Some specific easement activities are discussed below.

5.1.1 McKay Ditch Bypass Monitoring And Maintenance

Maintenance and monitoring activities on the McKay Ditch and bypass are conducted regularly to make sure the ditch continues to function as a water conveyance structure across the Site. Monitoring consists typically of driving (where roads or two-tracks exist) or walking along the ditch. Maintenance typically involves checking and setting valve settings when the City of Broomfield has water flowing in the ditch. Typical flow periods are early to mid-summer. Checking and setting of valve settings is done on foot by walking from the nearest road to the control structures. No effect is expected to the Preble's mouse or the other species under consideration in this PBA. However, if the City of Broomfield intends to do work beyond this described or that has the potential to adversely affect the Preble's mouse or its habitat, the responsibility for consultation will fall to the City of Broomfield and DOE and is not considered under this PBA.

5.1.2 Smart Ditch Bypass Monitoring And Maintenance

The Smart Ditch bypass is a small concrete and wooden structure that diverts water from Smart Ditch to the D-Series ponds and other off-Site ponds used for downstream irrigation or other uses. Maintenance and monitoring activities would involve replacing or adjusting the wooden boards used to direct water flow. The area is accessed on foot. The water flows in this drainage come primarily from Rocky Flats Lake, southwest of the Site, and the water rights are owned by private parties. No effect to Preble's habitat or the listed species under consideration is expected from this activity. Any activities beyond these stated here that have the potential to adversely affect the Preble's mouse or its habitat, are not considered under this PBA and will require additional consultation with the USFWS by the appropriate parties.

5.1.3 Mower Ditch Bypass

The Mower Ditch Bypass runs to the north of Woman Creek below the C-2 Pond. The Mower Ditch was used to divert water from Woman Creek to Mower Reservoir east of Indiana Street. The bypass is located within the current Preble's protection area. Occasional maintenance or monitoring is necessary for the proper operation of the bypass structure. These activities can be largely conducted on foot. Any activities beyond these stated here that have the potential to adversely affect the Preble's mouse or its habitat, are not considered under this PBA and will require additional consultation with the USFWS by the appropriate parties.

6. Cumulative Effects

The Endangered Species Consultation Handbook (USFWS 1998) defines cumulative effects as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR §402.02). A description of the surrounding lands and activities conducted on those lands is presented below.

The Site is surrounded by private, city, county, state, and federal lands. A variety of land use activities occur on these lands. The land to the south of the Site is privately owned rangeland. It is currently used for grazing cattle. However, there are plans to develop portions of these properties as residential subdivision and business developments. The State of Colorado School Board land in Section 16 is also primarily rangeland, grazed by cattle throughout different times of the year. Gravel mining has occurred on this property in the past, however, none has taken place in recent years. The lands between Highway 93 and the mountain front to the west are largely City of Boulder, Boulder County, and Jefferson County open space properties used for some grazing and recreation activities. No development is planned for these areas. Between the Site and Highway 93 there is a narrow strip of private property that the current landowner has attempted to develop in the past, with no success. If development would occur, it would most likely be some type of small business (either office space or perhaps light industry). On the western edge of the Site, within Site boundaries, two gravel mine operations are currently active. Current plans, dependent on permitting, would mine much of the western portions of the BZ at the Site.

The northwest corner of the Site is bounded by the NREL. Research on renewable wind energy is conducted at the facility. Most activities involve the installation and removal of large wind generators. To the north, the Site is bordered by City of Boulder and Boulder County open space property. On the east, most of the land is City of Broomfield and City of Westminster open space property. A small amount of development (housing and office space) has occurred along Highway 128 east of Indiana Street. Along the eastern edge of the Site, there is a measure included in the Rocky Flats Wildlife Act that would allow a 300 foot corridor for development of the C-470 highway.

Because most of the surrounding land use is either rangeland or open space, no cumulative effects are expected to the Preble's mouse from these lands. These lands actually provide additional buffer areas around the Site as habitat. Where riparian habitat exits on some of these properties, steps (e.g. the use of fencing to keep cattle away from the streams) have been taken to preserve and enhance these corridors as wildlife habitat. Development activities planned for private property around the Site edges would be away from drainages at the Site and would have minimal or no effect on the mouse habitat at the Site.

The gravel mining operations on the western edge of the Site pose a potential undefined threat to the Preble's mouse habitat at the Site. It is currently unknown as to how or whether the mining operations might impact hydrologic conditions at the Site. Groundwater flows from the west provide water to the many seeps or stream flows that sustain Preble's habitat at the Site, particularly in the Rock Creek drainage. Because the drainages on Site lie largely at the headwaters of their respective watersheds, mining could potentially alter the groundwater water and surficial water flows on the Site. Currently, however, no data are available to make definitive statements about what may or may not happen. In addition, the mine operator continues to renew mining permits in order to expand mining operations. Concerns about the Preble's mouse habitat could be raised during the permitting process.

The proposed C-470 highway would potentially cut off the eastern most edges of the Preble's habitat at the Site in both the Walnut Creek and Woman Creek drainages. However, the habitat at these locations is of much lower quality than that found further west in either drainage. No mice have been captured within the area that would potentially become the highway. Currently, there are no specific plans to develop the C-470 highway along the eastern edge of the Site. As plans for the highway are developed in the future concerns about the Preble's mouse habitat could be raised during the planning process.

Numerous easements exist at the Site for utilities such as power lines, gas lines, and telephone lines. Also water conveyance ditches for water rights owned by non-DOE parties cross the Site at various locations (McKay Ditch, Mower Ditch, Smart Ditch – D-Series Pond water rights). Mineral rights and mining operations are also present at the Site at some locations as mentioned above. Currently no planned activities at the Site related to the these easements are scheduled. The responsibility for USFWS consultation for potential impacts to listed species resulting from normal operations, maintenance, and new construction activities related to these easements at the Site are the responsibility of the easement parties and would be dealt with through separate consultation with the USFWS.

Activities in areas surrounding the Rocky Flats Environmental Site will have no effect on DOE activities related to the cleanup of the Site.

7. Analysis Of Impacts

7.1 Definitions

The following definitions, cited from the Endangered Species Consultation Handbook (USFWS 1998), were used in categorizing the effects from actions discussed in Part I of the PBA on the selected threatened or endangered species considered in Part I of the PBA:

- "*No effect*" — the appropriate conclusion when the action agency determines its proposed action will not affect a listed species or designated critical habitat.

- "*May affect*" — the appropriate conclusion when a proposed action may pose any effects on listed species or designated critical habitat. When the Federal agency proposing the action determines that a "may affect" situation exists, then they must either initiate formal consultation or seek written concurrence from the Services that the action "is not likely to adversely affect".

- "*Is not likely to adversely affect*" — the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial.

- "*Is likely to adversely affect*" — the appropriate finding in a biological assessment (or conclusion during informal consultation) if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial (see definition of "is not likely to adversely affect"). In the event the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action "is likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made. An "is likely to adversely affect" determination requires the initiation of formal section 7 consultation.

- "*jeopardize the continued existence of*" — to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

7.2 Findings

The activities listed in Part I of the PBA will not affect water depletions within the greater Platte River basin. Therefore, no effects on the lower Platte River species are likely to occur from these on-Site actions. Lower Platte River species considered in this evaluation include the piping plover, the least tern, the whooping crane, the pallid sturgeon, the Eskimo curlew, the American burying beetle and the western prairie fringed orchid. Additionally, no effect from water depletions related to the Preble's mouse at the Site are likely, related to Site closure activities.

The bald eagle is a casual user of the Site. Site wildlife surveys have noted approximately one observation per year for the past six years. Bald eagle nesting has never been observed on Site. Therefore, DOE actions described in Part I of this PBA will have no effect on the bald eagle. Black-footed ferrets, boreal toads, Canada lynx, greenback cutthroat trout, Mexican spotted owls, mountain plovers, and Pawnee montane skippers do not occur at or near the Site. Ten years of ecological monitoring have never documented these species at the Site (DOE 1992, 1993, 1995; K-H, 1997c, 1998b, 1999b, 2000b, 2001b, 2002b; RMRS 1996). Therefore, the DOE actions described in Part I of this PBA will have no effect on these species. The black-tailed prairie dog occurs at the Site, but is a candidate species which is non-statutory and therefore is not considered in this PBA.

Ute ladies'-tresses, and Colorado butterfly plant, both listed species, though they occur in the Site's vicinity, have not been documented on the Site, nor in off-Site areas that might be affected by these actions (ESCO 1993, 1994). DOE activities described in Part I of this PBA will have no effect on these species.

7.2.1 Preble's Mouse Findings

The Preble's mouse occurs at the Site, and has been documented and studied extensively in each of the main drainages at Rocky Flats. Studies at the Site have focused on trapping and tagging Preble's mice, and tracking their movements through the use of telemetry. In addition, habitat characterization has been done to quantify habitat parameters at the Site. The data from these studies have yielded information on Preble's mouse habitat, areas of occupation, home ranges, and mouse movement at the Site. Using this information, Site ecologists developed a Preble's mouse protection plan (DOE 2000) that includes a Preble's mouse protection area map and a means of evaluating Site activities for potential impacts to the mouse. Appendix A to this section of the PBA outlines the methods that were used to delineate areas as Preble's mouse protection areas. These actions have been taken proactively by DOE to protect the Preble's mouse and its habitat at the Site. During 2002, the USFWS proposed critical habitat for the Preble's mouse (67 FR 47154). On June 23rd of 2003, the USFWS finalized the critical habitat ruling for the Preble's mouse (68 FR 37275). The final rule excluded Rocky Flats Environmental Technology Site from critical habitat designation. Therefore, project disturbances described in this PBA are based on the current protection areas mapped in Figure 5. Because the Preble's

mouse occurs at the Site, the major focus of Part I of the PBA has been on potential impacts to the Preble's mouse.

The majority of the projects listed in Part I of the PBA are scattered throughout the BZ and are not concentrated at a given location. The projects in Part I of the PBA fall under the criteria outlined at the beginning of the "no effect" and "may affect, but not likely to adversely affect" sections. These criteria include no permanent loss of habitat and limit soil and vegetation disturbances to that created by pulling of fence posts or guard rail posts, removing power lines, removing riprap piles, above ground pipelines, cutting of a few shrub stems to access a work area, or similar type small impacts. Therefore no adverse direct, potential additive, cumulative, direct, indirect, interrelated, and interdependent effects are expected to the Preble's mouse or its habitat from any of these projects.

Additionally, the final 4(d) rule for the Preble's mouse (67 FR 61531-61537) set forth a precedence that in principle if suitable habitat exists adjacent to a temporary project disturbance (i.e. ditch maintenance as addressed in the 4(d) rule), the action would "result in only minimal take of Preble's and is consistent with the protection and enhancement of Preble's habitat." Previous projects conducted in Preble's habitat at the Site during the active season of the mouse have shown the mice can co-exist near active project areas with little apparent impacts (DOE 1996, K-H 2000b). At both the B-4 dam toe slope sand/rock blanket project (DOE 1996) and the East Trenches treatment system project (K-H 2000b), trapping and/or telemetry studies during the project timeframes demonstrated that the Preble's mice continued to exist adjacent to the ongoing projects. For both of these projects heavy equipment, vegetation removal, soil disturbance, and excavation, were being conducted in current Preble's protection areas. At the East Trenches treatment system project, several hundred feet of Preble's habitat was disturbed along the entire B-series of ponds (B-1 to B-4). The USFWS concurred that the East Trenches treatment system project would not have an adverse effect on the Preble's mouse (USFWS concurrence letter dated January 22, 1999; Part I, Appendix C). In neither case, however, did the Preble's mice leave the stream reach where the project activities were taking place. Rather they continued to be captured in the traps and based on telemetry data continued to use the habitat adjacent to the project areas during the duration of the projects. Often the Preble's mice were found just across the silt fence from where project activities were taking place. The conclusions of these studies were that the mice would not be extirpated from areas where projects occurred provided that suitable Preble's habitat was available adjacent to the project areas.

Further evidence of the resilience of the Preble's mouse to disturbance was observed during the summer of 2002 in the Rock Creek drainage at the Site where a wildfire in February 2002 burned about 27 acres. Almost 2200 linear feet of the grassland and riparian vegetation on the north side of Rock Creek was burned along the stream edge. Of this, an additional 280 feet of habitat was burned completely across the stream where the fire crossed the stream and burned to the pediment top on the opposite side of the valley. Small mammal trapping was conducted in June 2002 and a set of 50 traps was

located in and adjacent to the burn area. Twenty-five traps were located on the north side of the fire (with nearly all the traps located in burned areas) and 25 traps located on the south side of Rock Creek in unburned habitat. Two Preble's' mice, an adult male and adult female, were captured about two meters from the edge of the burned area on the north side of the stream on different days. Additionally, while running the trap line one morning, an individual Preble's mouse was observed hopping along in the burn area. So a natural disturbance, much larger than any of the planned cleanup activities in Part I of the PBA did not extirpate the Preble's mouse from these areas since they stayed in the habitat adjacent to the wildfire and even ventured into the burn area.

Based on the potential impacts of the various DOE projects listed in Part I of the PBA (with regard to the current Preble's protection areas), the individual activities and their potential additive, cumulative, direct, indirect, interrelated, and interdependent effects are unlikely to adversely affect the Preble's mouse. Neither are they expected to jeopardize the existence of the Preble's mouse at the Site.

The following table summarizes the findings of Part I of the PBA.

Fauna	**Legal Status**	**No Effect**	**May Affect, No Adverse Effects**	**Adverse Effects**
American burying beetle*	LE	X		
Bald eagle	LT	X		
Black-footed ferret	LE	X		
Black-tailed prairie dog	C	X		
Boreal toad	C	X		
Canada lynx	LT	X		
Eskimo curlew*	LE	X		
Greenback cutthroat trout	LT	X		
Least tern *	LE	X		
Mexican spotted owl	LT	X		
Mountain plover	PT	X		
Pallid sturgeon*	LT	X		
Pawnee montane skipper	LT	X		
Piping plover*	LT	X		
Preble's meadow jumping mouse	LT	X	X	
Whooping crane*	LE	X		
Flora				
Colorado butterfly plant	LT	X		
Ute ladies'-tresses	LT	X		
Western prairie fringed orchid*	LT	X		

* = Lower Platte River species
C = Candidate for listing LE = Listed endangered
LT = Listed threatened PT = Proposed threatened

Should any of the Site activities listed in Part I of the PBA change in scope, function, or process from what is presented in this document, further consultation (informal or formal) with the USFWS will be pursued.

8. Summary

This PBA is prepared by DOE to address the potential for Site activities to affect listed threatened and endangered species that are protected under the ESA. Part I of the PBA has been prepared to examine impacts from routine, ongoing activities, and specific closure actions on threatened and endangered species in the vicinity of the Site and in the lower Platte River drainage. The activities and actions addressed in Part I are those that will have either "no effect" or "may affect, but are not likely to adversely affect" species under consideration in this PBA or the Preble's mouse or its habitat. Part II of the PBA addresses actions that are "likely to adversely affect" the species under consideration in this PBA or the Preble's mouse or its habitat. It includes the discussion of water depletion issues.

The species evaluated in the PBA include the American burying beetle*, Bald eagle, Black-footed ferret, Black-tailed prairie dog, Boreal toad, Canada lynx, Eskimo curlew*, Greenback cutthroat trout, Least tern *, Mexican spotted owl, Mountain plover, Pallid sturgeon*, Pawnee montane skipper, Piping plover*, Preble's meadow jumping mouse, Whooping crane*, Colorado butterfly plant, Ute ladies'-tresses, and Western prairie fringed orchid*. Species noted with an (*) are South Platte River species.

There will be no effect from any of the activities listed in Part I of the PBA on the species evaluated, with the exception of the Preble's mouse. Although some activities listed in Part I of the PBA may affect the mouse, it is unlikely that the activities will adversely affect it.

As Site closure proceeds, the activities listed in Part I of the PBA should be able to continue without delays from ESA issues. Should any of the Site activities listed in Part I of the PBA change in scope, function, or process from what is presented in this document, further consultation (informal or formal) with the USFWS will be pursued.

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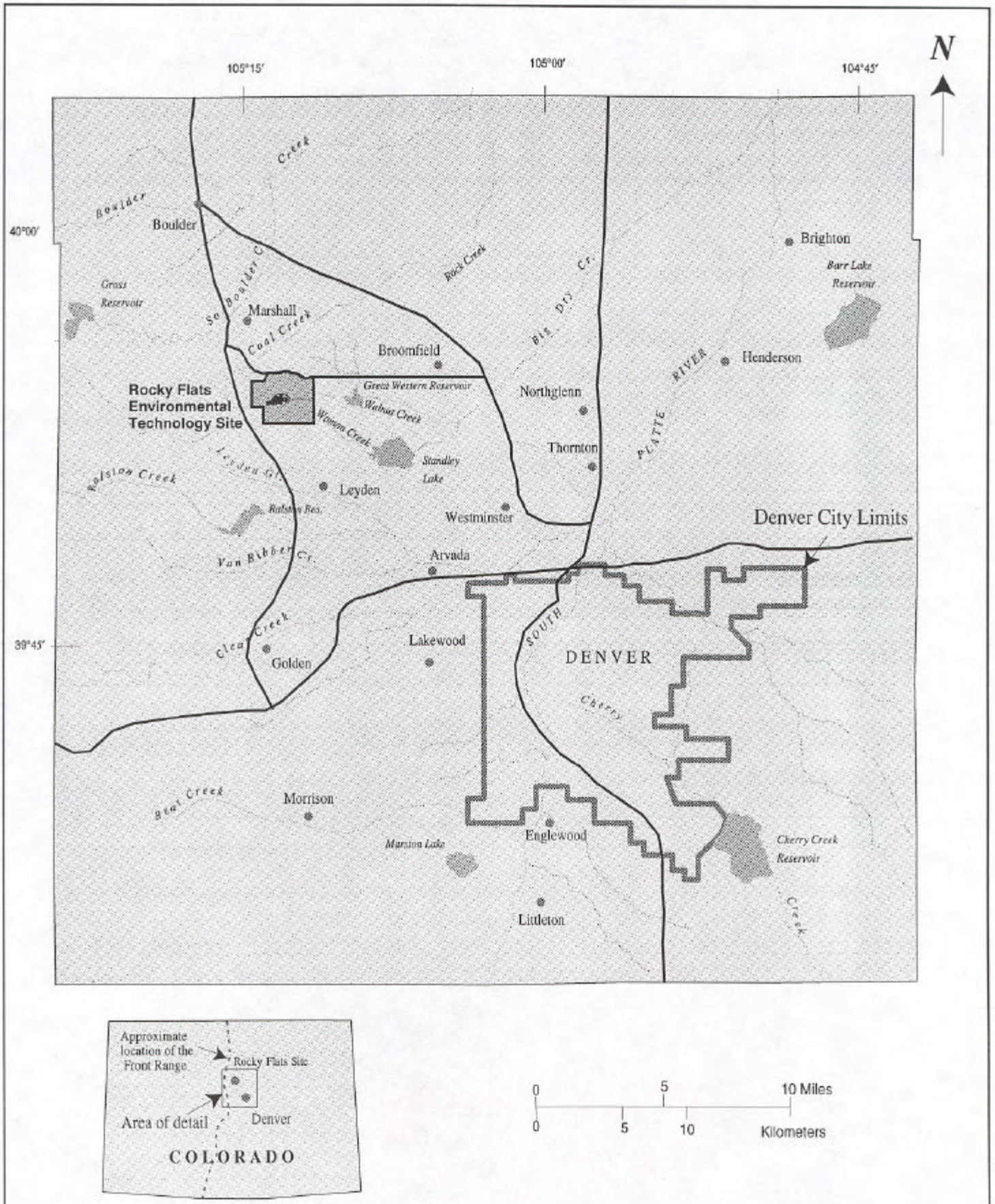

Figure 1

LOCATION OF THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

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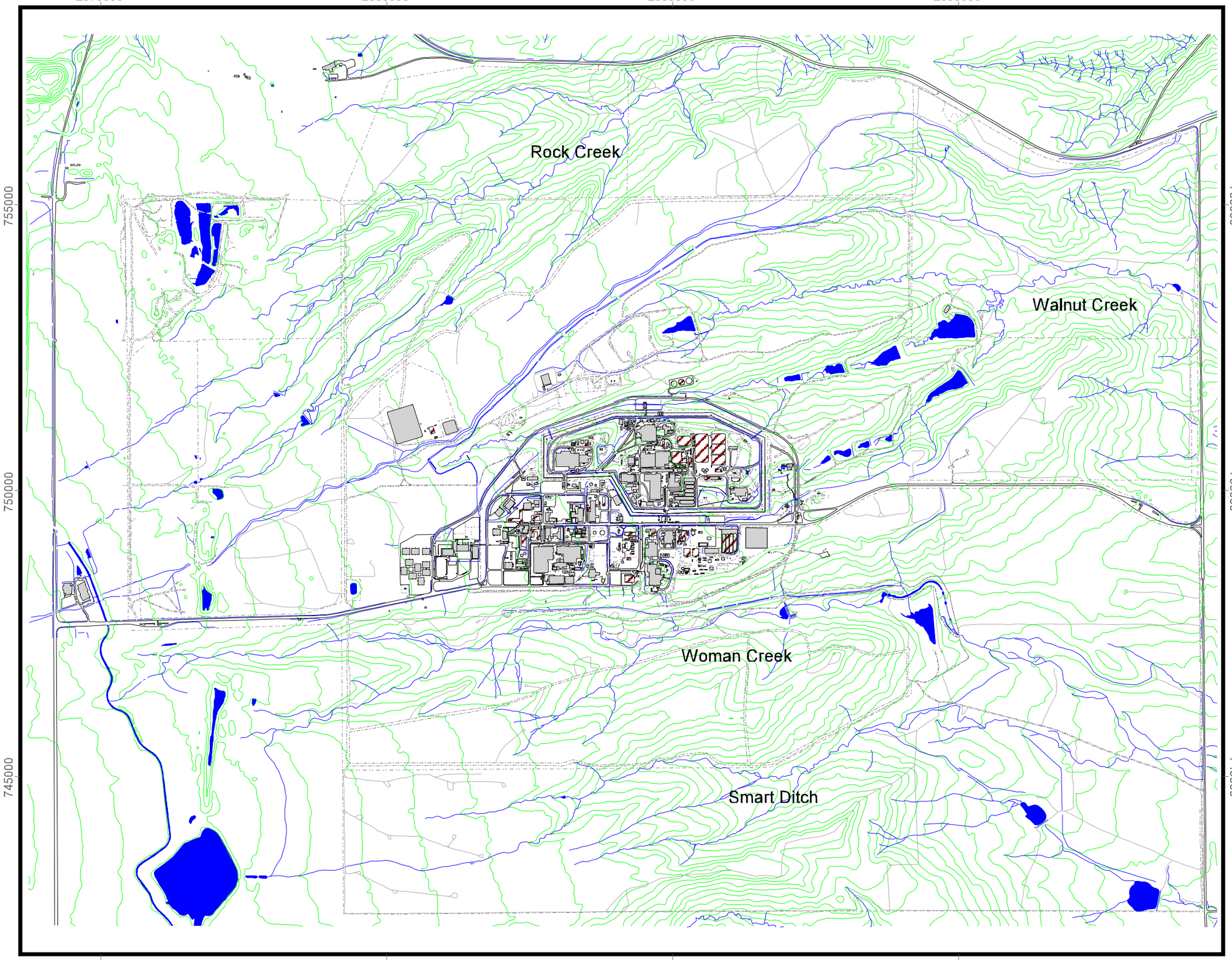
Rocky Flats Environmental Technology Site

Figure 2



Standard Features

- Buildings
- Demolished Buildings
- Lakes & ponds
- Streams & ditches
- Fences
- Paved roads
- Dirt roads
- Contours (20 ft. intervals)

DATA SOURCE BASE FEATURES:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs, 1/95.

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: LABAT LABAT-ANDERSON INCORPORATED

For: Kaiser-Hill Company, LLC

RFETS GIS Dept. 303-966-7707

MAP ID:

March 10, 2003

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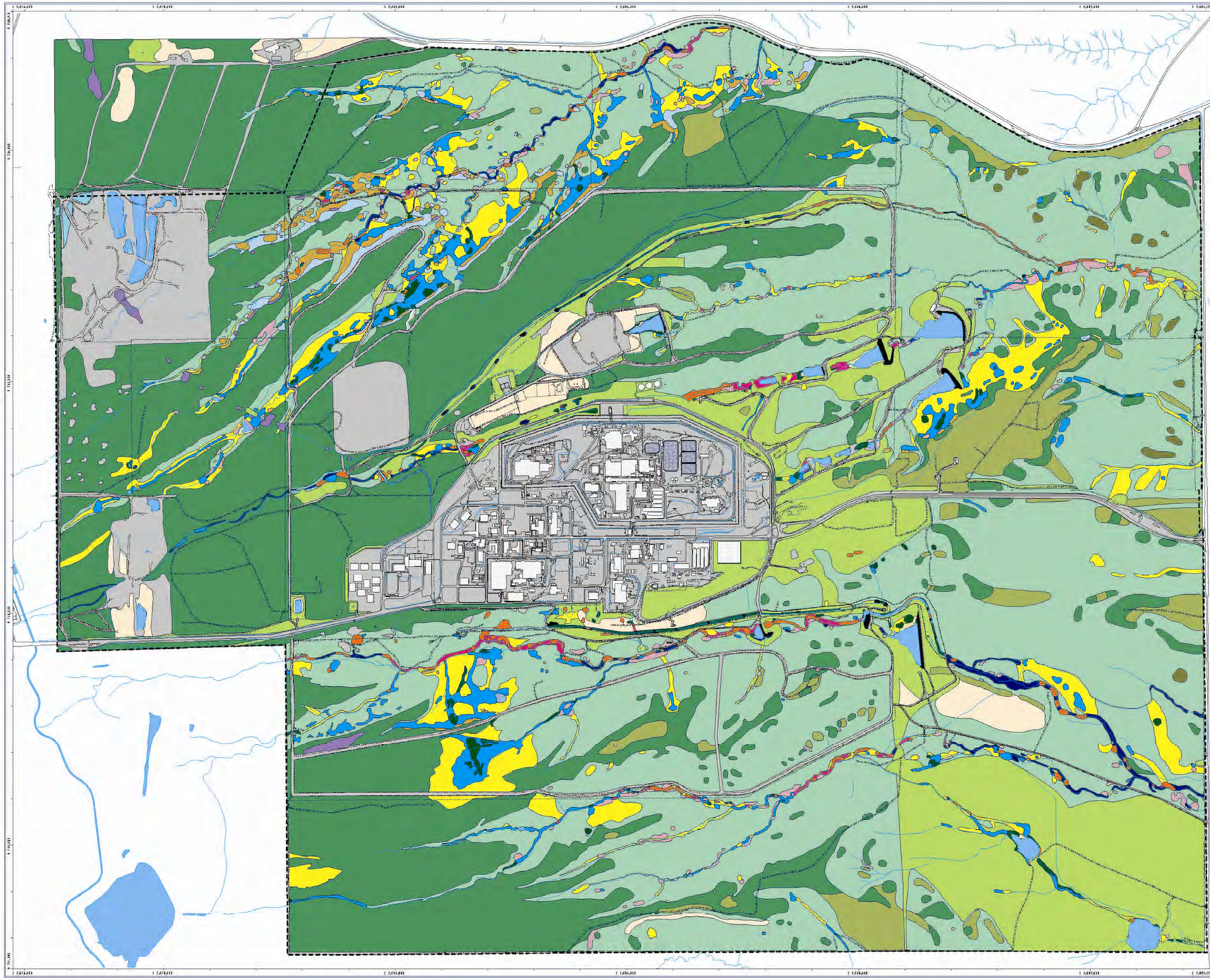

Rocky Flats Environmental Technology Site Vegetation Map

Figure 3

LEGEND

- Riparian Woodland
- Leadplant Riparian Shrubland
- Wet Meadow/Marsh Ecotone
- Short Upland Shrubland
- Willow Riparian Shrubland
- Annual Grass/Forb Community
- Xeric Tallgrass Prairie
- Ponderosa Woodland
- Reclaimed Mixed Grassland
- Mesic Mixed Grassland
- Savannah Shrubland
- Tall Upland Shrubland
- Short Marsh
- Xeric Needle and Thread Grass Prairie
- Short Grassland
- Disturbed and Developed Areas
- Open Water
- Riprap, Rock, and Gravel Piles
- Mudflats
- Tree Plantings
- Tall Marsh

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Rocky Flats boundary
- Paved roads
- Dirt roads

DATA SOURCE:
Vegetation map data provided by
FTI Environmental Services
Golden, Colorado.
Buildings, fences, hydrographic roads and other
structures from 1994 aerial frame data
captured by EG&G RSL, Las Vegas
Digitized from the orthophotographs 1996

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Scale = 1 : 7200
1 inch represents 600 feet

300 0 300 600 900

State Plane Coordinate Projection
Colorado Central Zone
Datum NAD27

U.S. Department of Energy

Rocky Flats Environmental Technology Site

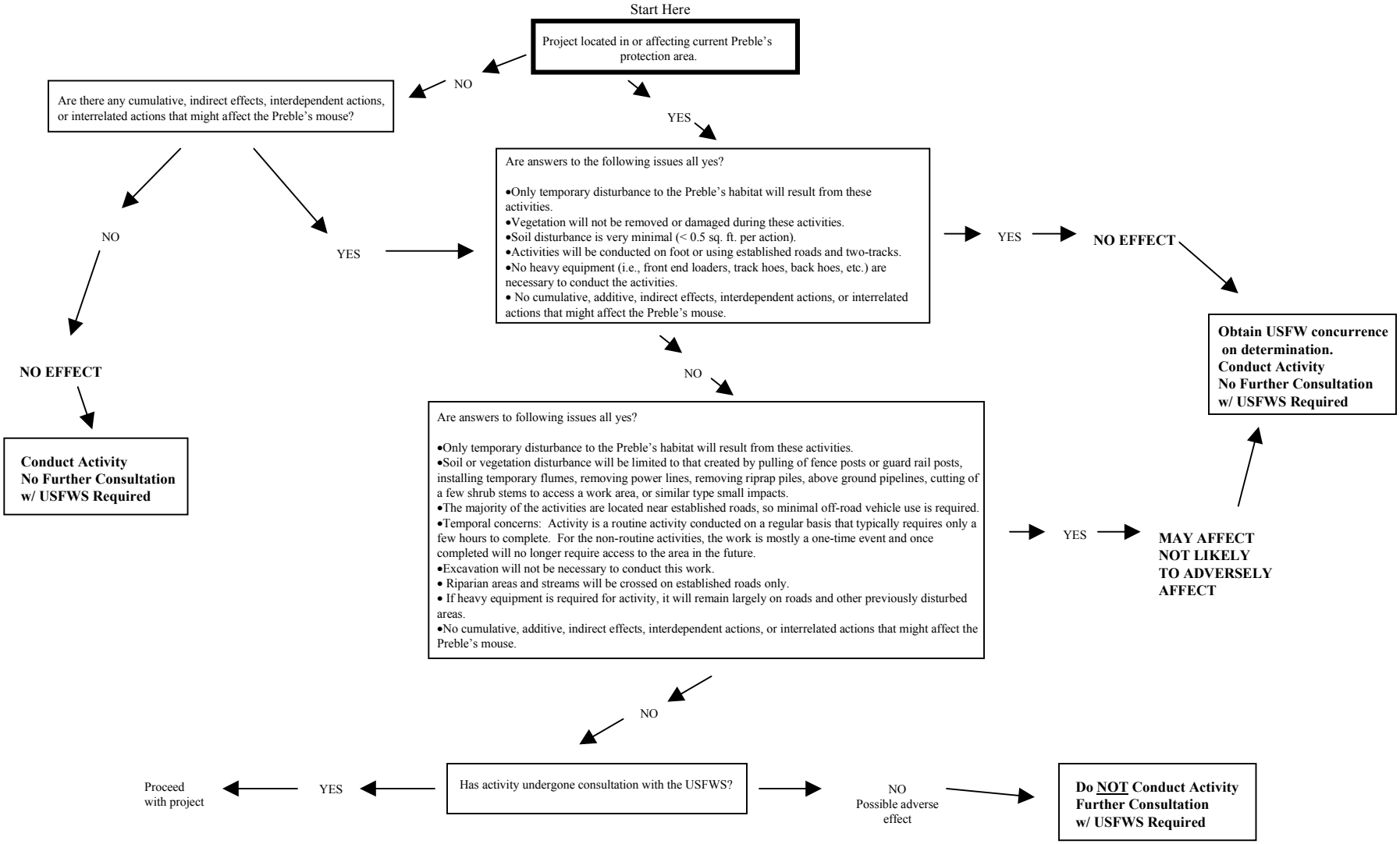
Prepared by:

RMRS Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID 98-0208

August 14, 1998

Figure 4. Project Activity Preble's Mouse Impact Determination Flowchart



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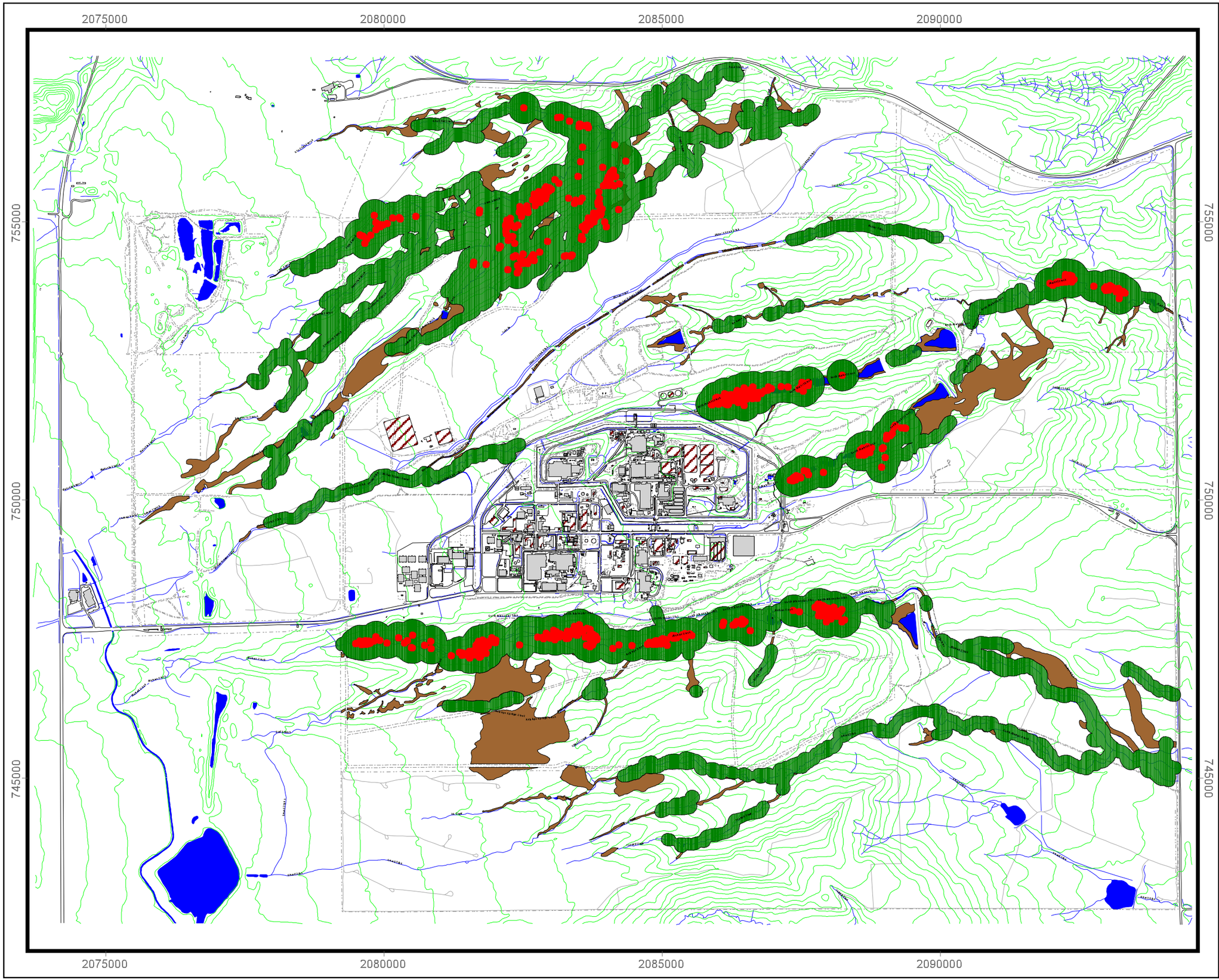

Preble's Meadow Jumping Mouse Current Protection Areas at RFETS December 2003

Figure 5

Legend

- Current Preble's Protection Areas
- Contiguous Wetlands
- Preble's mouse telemetry points

Standard Features

- Buildings
- Demolished Buildings
- Lakes & ponds
- Streams & ditches
- Fences
- Paved roads
- Dirt roads
- Contours (20 ft. intervals)

DATA SOURCE BASE FEATURES:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs, 1/95.

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: Professional Environmental Group, L.L.C.

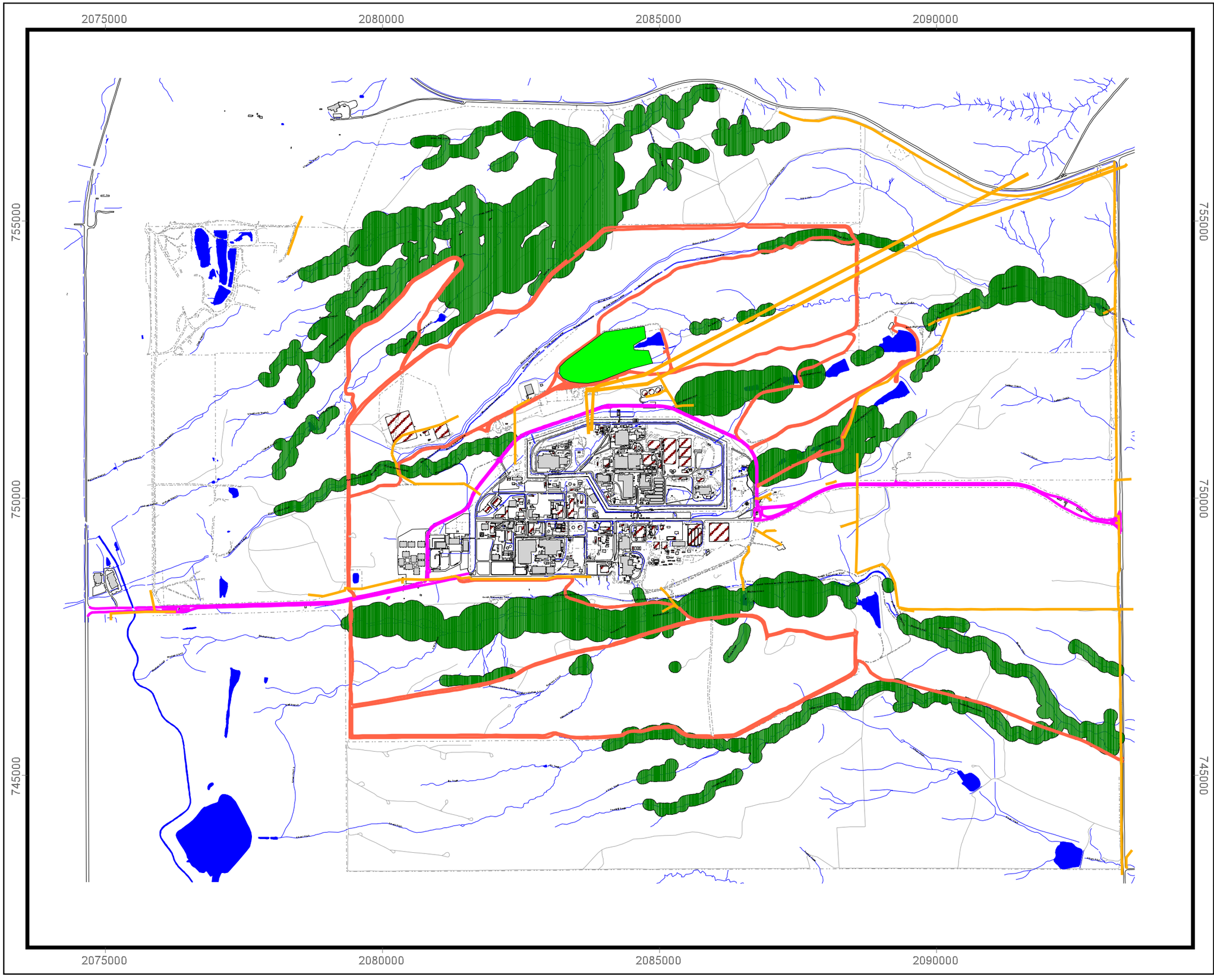
For: Kaiser-Hill Company, LLC

RFETS GIS Dept.
303-966-7707

MAP ID: 04-0006

December 16, 2003

Q:\Projects\FY2004\04-0006\PMJM\ebut.aprt\December 2003 PMJM Protection Area Map



Programmatic Biological Assessment
Part I Projects - 1

Figure 6

Legend

- Present Landfill Area
- Roadside Grading and Roadside Mowing Locations
- Roadside Mowing Only
- Powerline Removals

Standard Features

- Buildings
- Demolished Buildings
- Lakes & ponds
- Streams & ditches
- Fences
- Paved roads
- Dirt roads
- Contours (20 ft. intervals)

DATA SOURCE BASE FEATURES:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: Professional Environmental Group, L.L.C.

For: Kaiser-Hill Company, LLC

RFETS GIS Dept.
303-966-7707

MAP ID: 04-0014

January 22, 2004

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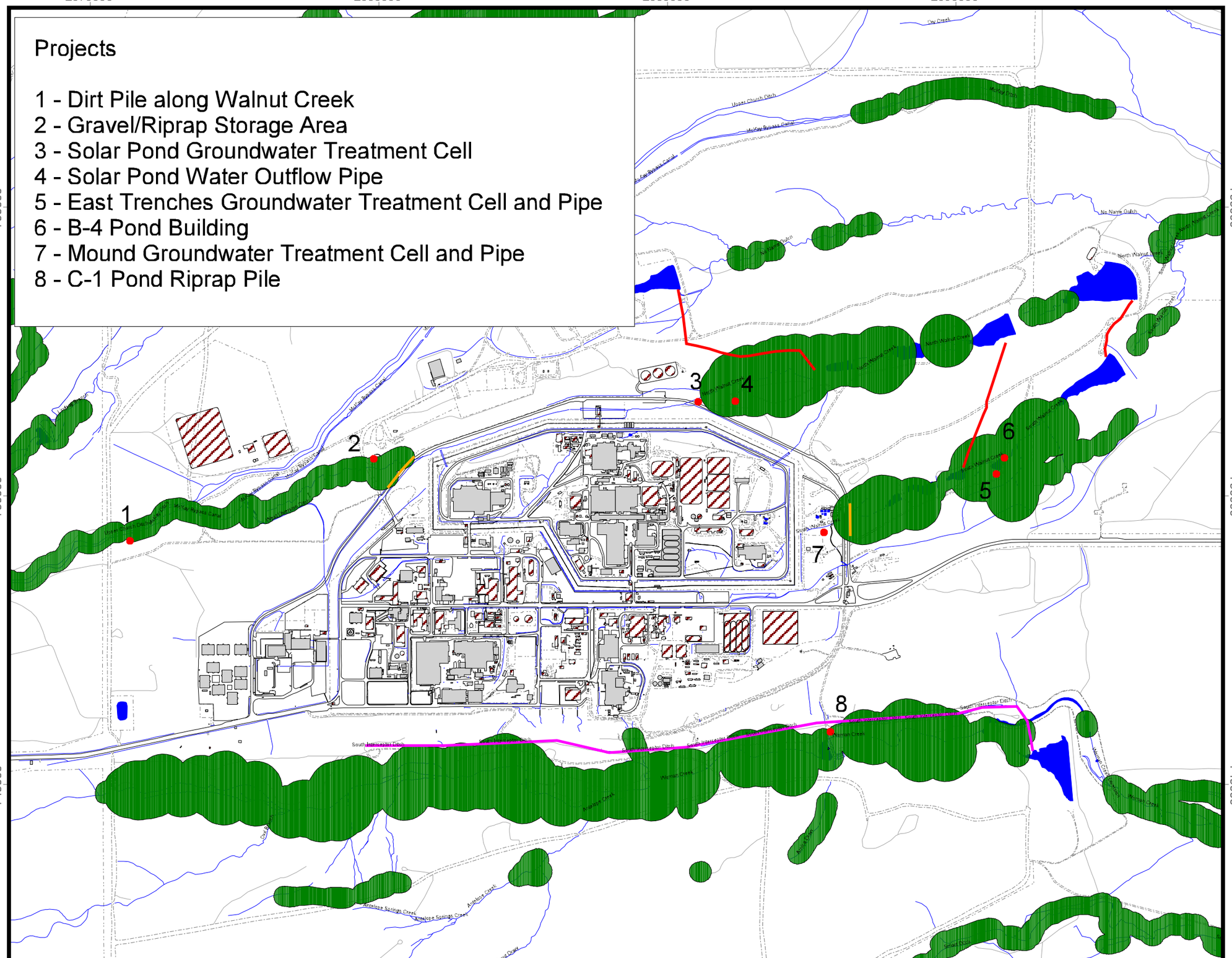
Programmatic Biological Assessment
Part I Projects - 2

Figure 7



Legend

- Above Ground Pipelines
- South Interceptor Ditch
- Guardrails
- Project Locations

Standard Features

- Buildings
- Demolished Buildings
- Lakes & ponds
- Streams & ditches
- Fences
- Paved roads
- Dirt roads
- Contours (20 ft. intervals)

DATA SOURCE BASE FEATURES:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: Professional Environmental Group, L.L.C.

For: Kaiser-Hill Company, LLC

RFETS GIS Dept.
303-966-7707

MAP ID: 04-0014

January 22, 20

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