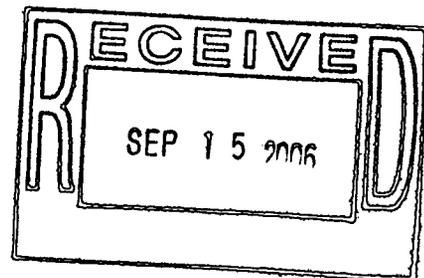


**KAISER HILL COMPANY**

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

**DRAFT**



Project No. 57378.6040  
September 2005

 **EarthTech**  
A Tyco International Ltd. Company

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IA-A-002845

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**DRAFT**  
**LANDFILL MONITORING AND MAINTENANCE PLAN**  
**ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE**  
**ORIGINAL LANDFILL**

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Project No. 57378.6040

September 2005

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## LIST OF ACRONYMS AND ABBREVIATIONS

|             |   |
|-------------|---|
| CERCLA      | Comprehensive Environmental Response, Compensation, and Liability Act |
| DQO         | data quality objective  |
| EPA         | Environmental Protection Agency                                       |
| H           | horizontal  |
| IDW         | investigation-derived waste   |
| IM/IRA      | Interim Measure/Interim Remedial Action                               |
| IMP         | Integrated Monitoring Plan  |
| Kaiser-Hill | Kaiser-Hill Company L.L.C.  |
| LHSU        | lower hydrostratigraphic unit   |
| ml          | milliliter  |
| mph         | miles per hour  |
| OLF         | Original Landfill   |
| QA          | quality assurance   |
| QC          | quality control   |
| RCRA        | Resource Conservation and Recovery Act                                |
| RFCA        | Rocky Flats Cleanup Agreement   |
| RFETS       | Rocky Flats Environmental Technology Site                             |
| RL          | reporting limit   |
| SOP         | Standard Operating Procedure  |
| UHSU        | upper hydrostratigraphic unit   |
| V           | vertical  |
| VOC         | volatile organic compound   |

## 1.0 INTRODUCTION

### 1.4 PURPOSE

This Monitoring and Maintenance Plan (Plan) has been prepared for the Original Landfill (Individual Hazardous Substance Site 115) 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).

Under the Final Interim Measure/Interim Remedial Action for the Original Landfill (IM/IRA) (Kaiser-Hill Company L.L.C. [Kaiser-Hill] 2005), 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.

### 1.5 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).

### 1.6 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 (Rockwell 1988). The landfill was not

designed or operated as an engineered landfill. Aerial photographs indicate that the landfill was operated as an area fill (EG&G 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 (Kaiser-Hill 2005). Additional information can be found in the IM/IRA for the Original Landfill (Kaiser-Hill 2005).

## 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
- 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.

### 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) annually and 100 mph every three to four years. Mean annual precipitation is approximately 15.5 inches, with approximately one-half of that amount occurring as snow.

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## 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 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 (Kaiser-Hill 2005).

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 reduce the overall slopes. This included regrading the waste and placement of gradefill material. The regrade surface within the limit of waste received a final cover unlike outside the limit of waste. The areas outside the limit of waste are included under the Final Cover monitoring program. 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 landfill (Figure 2-1). 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 calculations use a 100-year, 24-hour storm event, but also check the capacity of this design 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.

### 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 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), FY2004 (Rocky Flats 2004). 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.

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### 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 corrective actions can be taken in a timely manner.

#### 3.1 INSPECTION PROCEDURES

In accordance with the IM/IRA (Kaiser-Hill 2005), site inspections of the area will be conducted on a quarterly basis following construction of the final cover, with the following exceptions:

- The site shall be inspected after a storm event of one inch or more of rain in a 24-hour period,
- The site shall be inspected 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).

Quarterly inspections will continue for five years and will be evaluated at the first Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) review.

Site inspections will be performed using a prescribed form containing a checklist of items that would document evaluation of site conditions. The inspection form is included in Appendix A. 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 Rocky Flats Cleanup Agreement (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

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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. 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. Nevertheless, differential settlement may occur.

### **3.2.1 Monitoring Locations and Procedures**

Subsidence/consolidation at the Original Landfill will be monitored by visually inspecting the entire surface of the landfill cover for cracks, depressions, and sinkholes on a quarterly basis. 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 traversed. 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.

### **3.2.2 Corrective Action Activities**

If differential settlement or localized subsidence appears to be substantial and likely to influence the integrity of the existing soil cover and surface water drainage over the Original Landfill, appropriate corrective actions will be taken to mitigate these concerns. Corrective actions will include, but not be limited to, regrading the affected area to eliminate ponding and/or correct the slope of the surface. A corrective action plan will be prepared, and the RFCA parties will be consulted prior to any corrective action.

## **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 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 with buttress fill has been designed and constructed with applicable safety factors to guard against slope failure. Nevertheless, slope stability will be monitored.

### **3.3.1 Monitoring Locations and Procedures**

Slope stability at the Original Landfill will be monitored by visually inspecting the cover, the perimeter channel sideslopes, and the buttress fill sideslope slope for signs of cracks, evidence of block failure, seeps, and evidence of rotational failure. Visual inspection will involve traversing the slope to gain a perspective of the entire slope.

### **3.3.2 Corrective Action Activities**

Based on the site monitoring data, corrective actions will be taken to address any potential slope stability failure at the site. The corrective 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. A corrective action plan will be prepared, and the RFCA parties will be consulted prior to any corrective action.

## **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.

### **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 on a quarterly basis; and
- Visually inspecting the soil cover for signs of burrowing animals on a quarterly basis.

Visual inspection will involve traversing the slope to gain a perspective of the entire area.

### 3.4.2 Corrective Action Activities

If monitoring indicates significant loss of soil over time, corrective actions will be taken to address the affected areas. Corrective action will include, but not be limited to additional soil placement and regrading the affected areas to maintain the minimum soil cover thickness of 2 feet. The regraded areas will be vegetated to prevent further erosion. Erosion control measures may be implemented to prevent further erosion of cover soils, (e.g., erosion control mat, revegetation), if necessary. A corrective action plan will be prepared, and the RFCA parties will be consulted prior to any corrective action.

### 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. Vegetation inspections will ensure that vegetation is established properly.

#### 3.5.1 Monitoring Locations and Procedures

The 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. 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, corrective 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, corrective action will also be necessary.

### 3.5.2 Corrective Action Activities

If visual inspections show poor vegetation cover, the following corrective actions may be implemented:

- Spot herbicide applications,
- Reseeding,
- Reapplication of temporary erosion controls,
- Removal of deep-rooting trees and repair of the area, and
- Planting willows in wet (seep) areas.

A corrective action plan will be prepared, and the RFCA parties will be consulted prior to any corrective action.

### 3.6 STORMWATER MANAGEMENT STRUCTURES

Stormwater management inspections will be required on a quarterly basis 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<sup>®</sup>),
- West perimeter channel,
- East perimeter channel,
- West perimeter channel outfall,
- East perimeter channel outfall,
- Permanent erosion mat-lined upper buttress fill sideslope,

- Vegetation/temporary erosion mat-lined upper buttress fill sideslope, and
- Temporary, naturally degradable, straw wattles between the diversion berms for additional erosion control.

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, breaches in the diversion berms, subsidence, burrowing animals, and blockage. Signs of potential problems include, but are not limited to, ponding water, gulying, 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 shall 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 monitored during the inspection. The temporary check dams 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 Corrective Action Activities

If the inspections indicate that the existing stormwater management structures are not adequately controlling surface water run-on and runoff, appropriate corrective 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. 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. A corrective action plan will be prepared, and the RFCA parties will be consulted prior to any corrective action.

### **3.7 OTHER**

In addition to the inspection and monitoring activities discussed above, the site inspection will include assessment of other items that may need attention, such as the condition of established monitoring points, the French drain outfall east of the Original Landfill that drains to the south interceptor ditch, and site security.

#### **3.7.1 Conditions 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.

#### **3.7.2 Site Conditions**

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

#### **3.7.3 Reporting and Record Keeping**

Inspection reports 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 Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment.

## 4.0 GROUNDWATER MONITORING PLAN

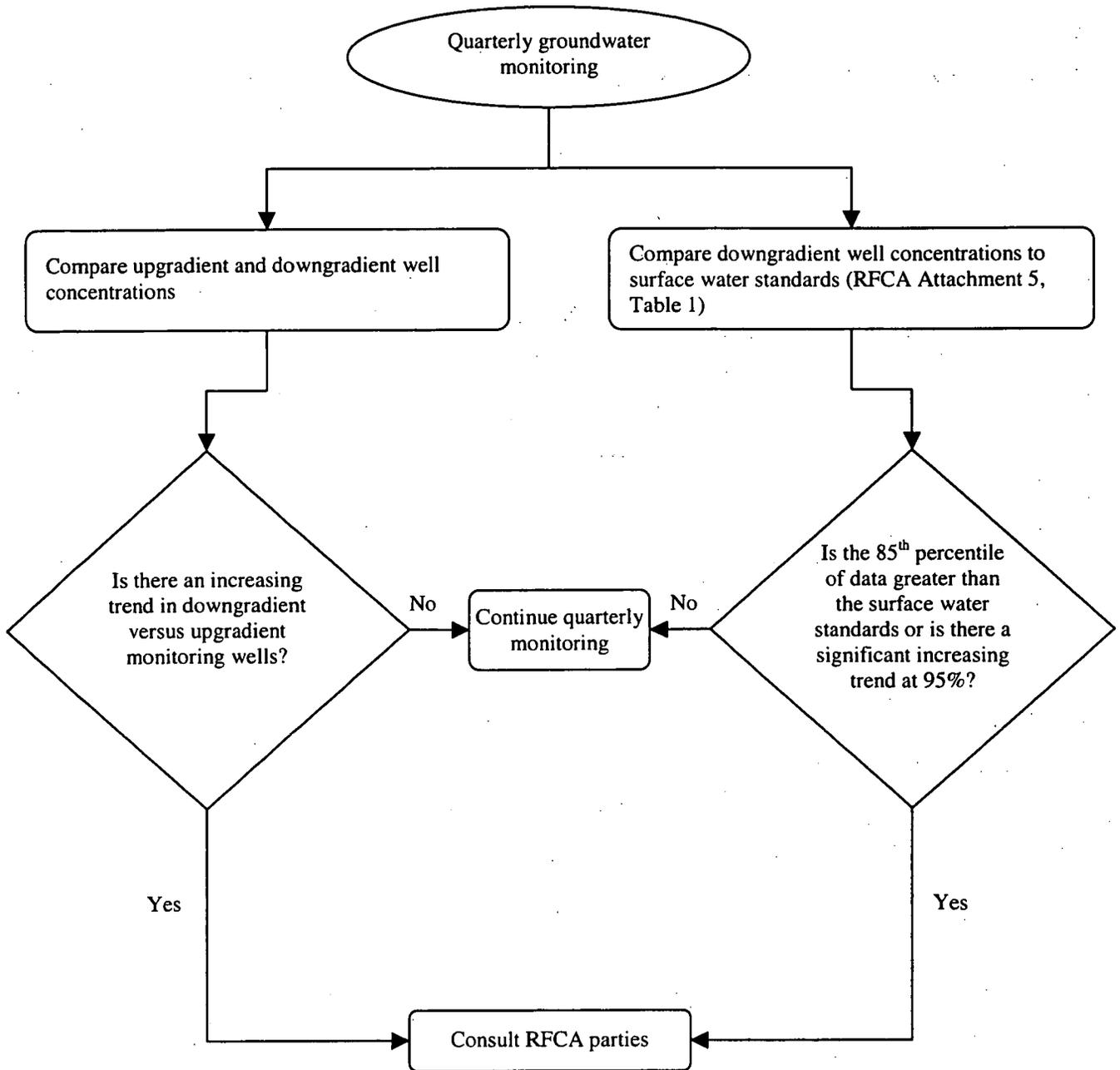
This section presents the groundwater monitoring plan for the Original Landfill during the post-closure period. The plan establishes consistent monitoring locations and frequencies for the monitoring period.

### 4.1 PURPOSE AND REQUIREMENTS

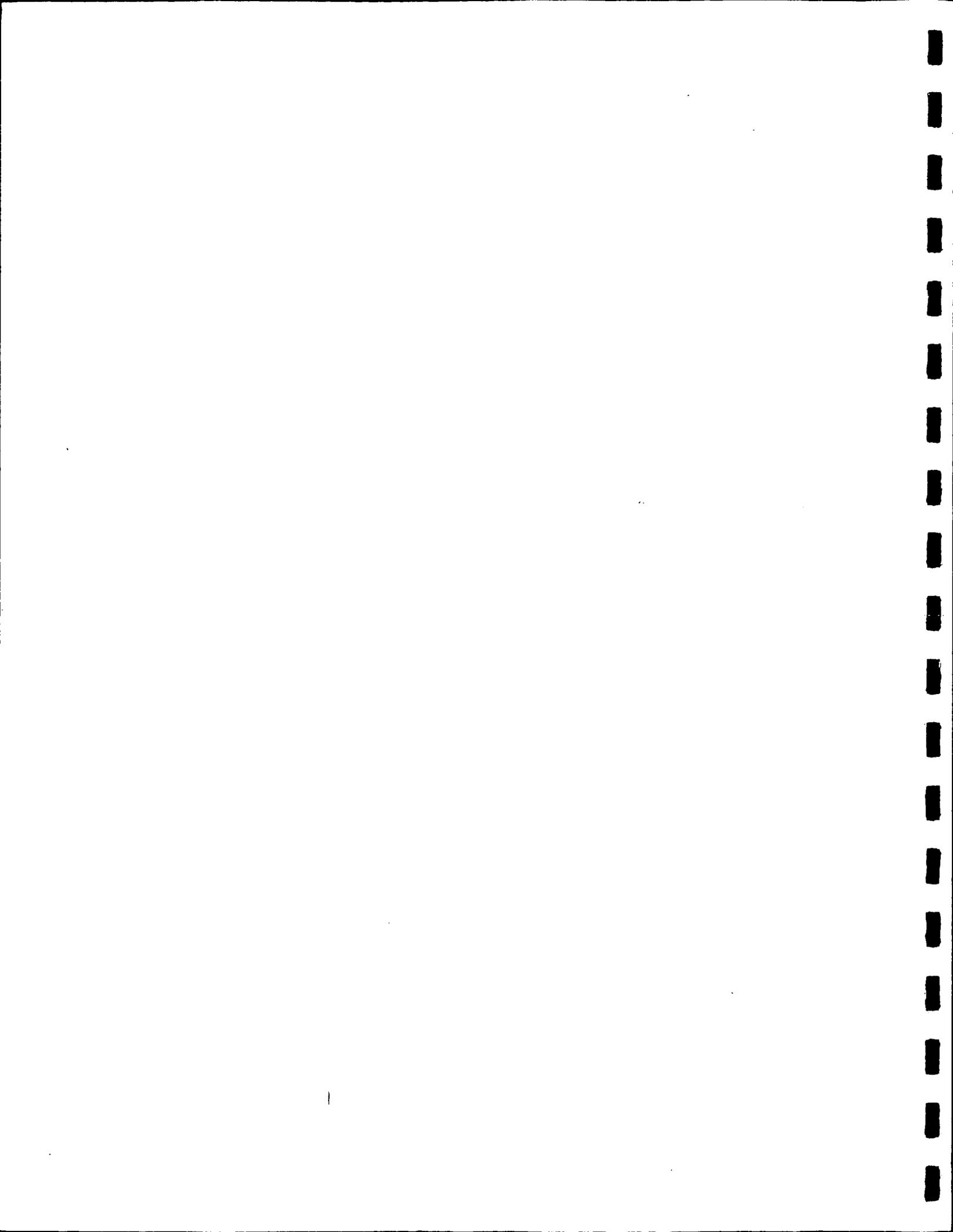
The Original Landfill groundwater monitoring plan has been implemented to determine groundwater quality impacts of the landfill (IM/IRA [Kaiser-Hill 2005]). The groundwater monitoring system was implemented under the IMP (Rocky Flats 2004) in accordance with 6 Code of Colorado Regulations 1007-3, 265.90[d]. The groundwater monitoring 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 3.3.10.7 of the IMP. The following flowchart will be used to guide the decision statement:



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### 4.3 WELL LOCATIONS

Well locations have been chosen in compliance with the IMP (Rocky Flats 2004) and include a total of four RCRA groundwater monitoring wells (Figure 4-1). Of these, one is upgradient, and three are downgradient of the Original Landfill.

Upgradient monitoring wells include well P416589. Downgradient monitoring wells include wells 60493, 7086, and 62793. 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, which were established in the IM/IRA (Kaiser-Hill 2005):

- SW-846 Method 8260B – Volatile Organic Compounds (VOCs)
- SW-846 Method 8270C – Semi-Volatile Organic Compounds
- SW-846 Method 8081A/8141A – Organochlorine and Organophosphorous Pesticides
- SW-846 Method 6010B – Metals (including uranium)
- SW-846 Method 7470A – Mercury

### 4.5 SAMPLING PROCEDURES SUMMARY

Groundwater sampling will be conducted in accordance with RFETS Standard Operating Procedure (SOP) RMRS/OPS-PRO.113 (see Appendix C). 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. Since 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.

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The four RCRA monitoring wells will be included during water level measurements. Refer to SOP PRO-0105-WLM for groundwater-level measurement procedures.

#### **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 SOP RMRS/OPS-PRO.113. During purging operations, field parameters will be recorded in accordance with SOP RMRS/OPS-PRO.118. Sampling procedures, including identification and handling, will be conducted in accordance with RMRS/OPS-PRO.069.

#### **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 are outlined in SOP RMRS/OPS-PRO.113.

#### **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). Further details on the decontamination process are given in SOP PRO-1455-FDO and SOP RMRS/OPS-PRO.112.

#### **4.5.5 Investigation-Derived Waste**

IDW that will accumulate during groundwater monitoring includes decontamination and purge water. Both will be drummed and transported off-site for disposal. See the IDW SOP for further details.

#### 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 are to 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.

Prior to implementing procedures, the laboratory will perform an initial demonstration of proficiency as specified in the method. Once the procedure is properly understood by the analyst and acceptable quality control data (precision and accuracy) are achieved, the method is placed in the laboratory for use.

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 Reports 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 closure, 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.

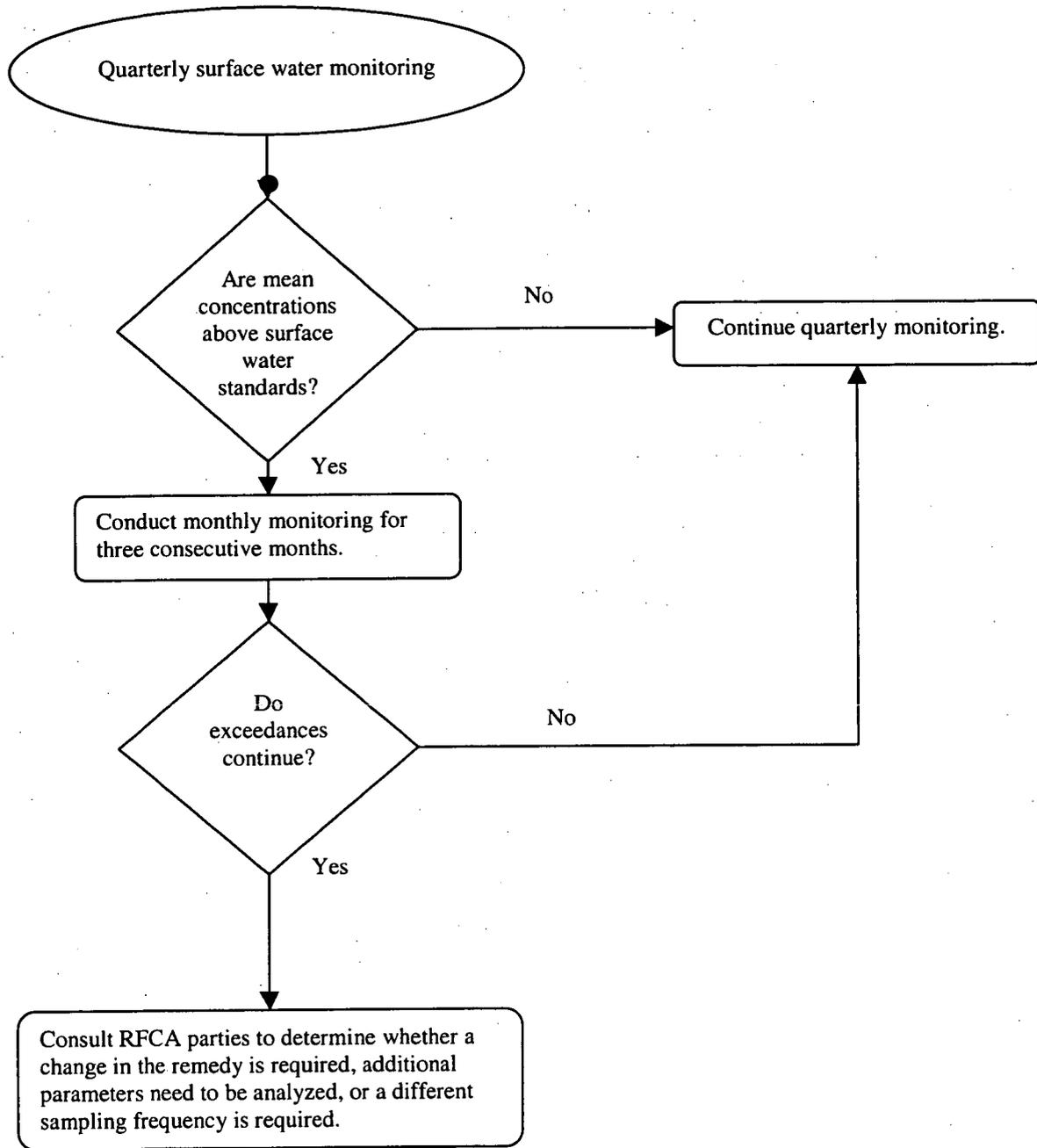
### 5.1 PURPOSE AND REQUIREMENTS

The Original Landfill surface water monitoring plan has been implemented to determine surface water quality impacts of the landfill (IM/IRA [Kaiser-Hill 2004]). 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 an effluent limit 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 (Rocky Flats 2004). The following flowchart will be used to guide the decision statement.



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### 5.3 SAMPLE LOCATIONS

Sampling will be conducted at the two locations shown on Figure 4-1, POM5 and POM6. Surface water flow will be manually measured (calibrated bucket and stop watch).

### 5.4 SURFACE WATER SAMPLE PARAMETERS

Surface water samples will be submitted for laboratory analysis for the following EPA-approved methods, which were established in the IM/IRA:

- SW-846 Method 8260B – VOCs
- SW-846 Method 6010B – Metals (including uranium)
- SW-846 Method 7470A – Mercury

### 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. Details are explained further in the SOPs in Appendix C.

#### Sampling Procedures

Surface water at the two locations will be sampled by directly placing a collection device or using a pond sampler device. The same collection suite, depending on effluent exceedances, will be taken at each sample location. 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).

Pond 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 similar to those for groundwater sampling provided in Section 4.6.

**5.7 REPORTING AND SCHEDULING**

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

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## 6.0 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 corrective action activities will be detailed in the report. If conditions appear that are of concern and require 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;
- Quarterly inspection forms;
- Notations of problems, corrective action(s) taken, and maintenance or repairs as a result of the quarterly inspection;
- Any deviations from the 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.

## 7.0 REFERENCES

- Earth Tech, Inc. 2005. *Final Design Analysis, Accelerated Action Design for the Original Landfill*. May.
- EG&G. 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.
- Kaiser-Hill Company, L.L.C. 2005. *Final Interim Measure/Interim Remedial Action for the Original Landfill*. March.
- Rockwell. 1988. *Remedial Investigation and Feasibility Study Plans for Low Priority Sites, Volume 1 – Site Descriptions, Groupings and Prioritization*. June.
- Rocky Flats. 2004. *RFETS Integrated Monitoring Plan FY2004, Revision 2, Background Document*. March.

**TABLE**

**TABLE 4-1**  
**GROUNDWATER MONITORING WELLS**  
**ORIGINAL LANDFILL**  
 Page 1 of 1

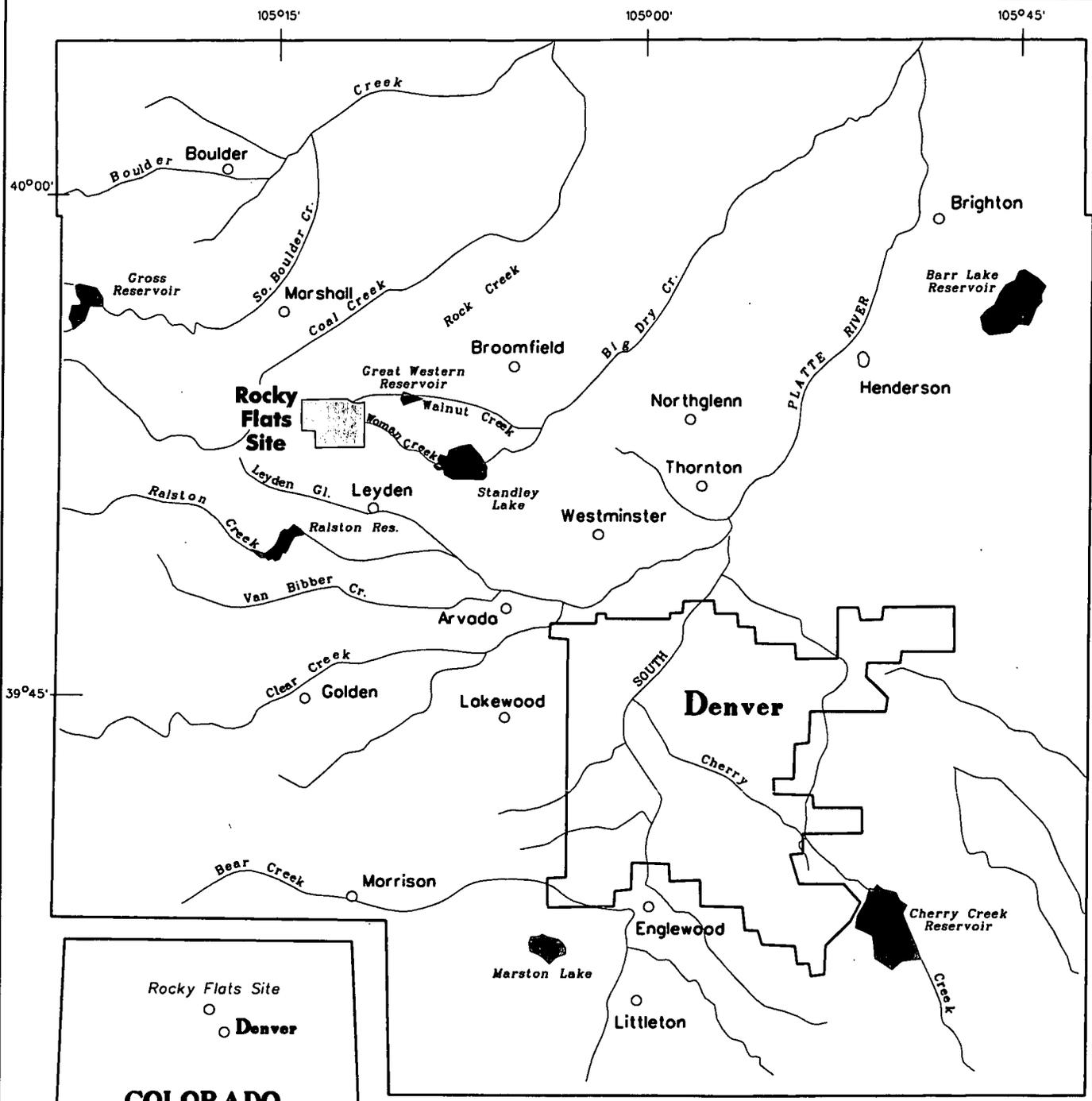
| Well ID | Type         | Installation Date | Screen Length (feet) | Borehole Depth (feet bgs) | Well Diameter (inches) | Depth to Top of Screen (feet bgs) | Depth to Bedrock (feet bgs) |
|---------|--------------|-------------------|----------------------|---------------------------|------------------------|-----------------------------------|-----------------------------|
| P416589 | Upgradient   | 9/14/89           | 4                    | 36.50                     | 2                      | 27.05                             | 30.50                       |
| 80005   | Downgradient | 8/9/05            | 15                   | 21.00                     | 2                      | 5.80                              | 16.8                        |
| 80105   | Downgradient | 8/8/05            | 15                   | 20.15                     | 2                      | 4.95                              | 17.0                        |
| 80205   | Downgradient | 8/10/05           | 15                   | 20.00                     | 2                      | 4.75                              | 8.40                        |

Note:

bgs = below ground surface

**FIGURES**

CAD FILE: GROUP\CAD\ROCKY\_FLATS\NEWDESIGN\_2004\PLFM\LOCATION.DGN DATE: 12/8/2004



LOCATION MAP

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
GOLDEN, COLORADO



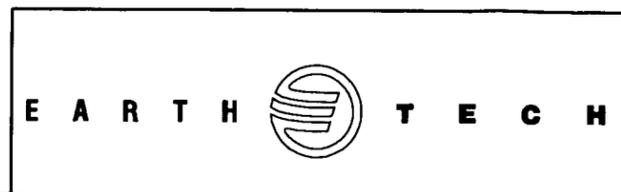
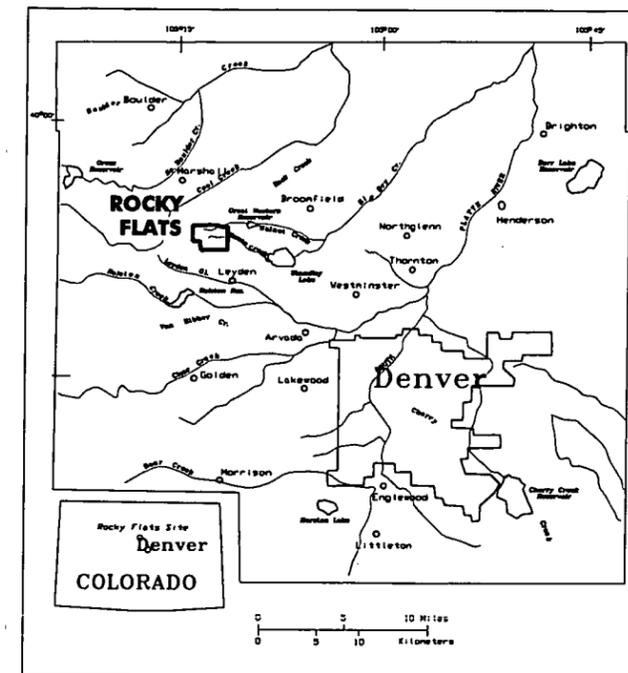
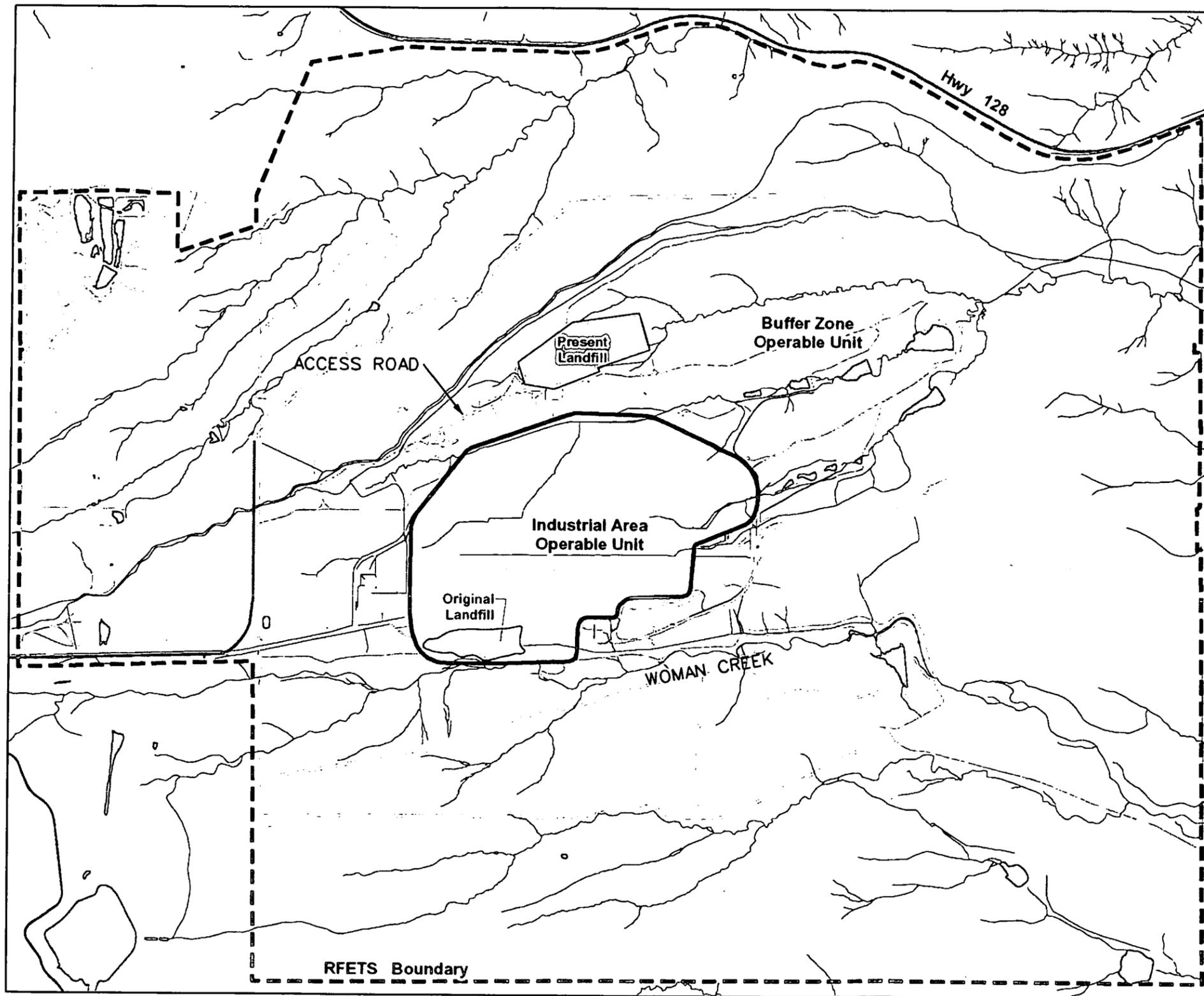


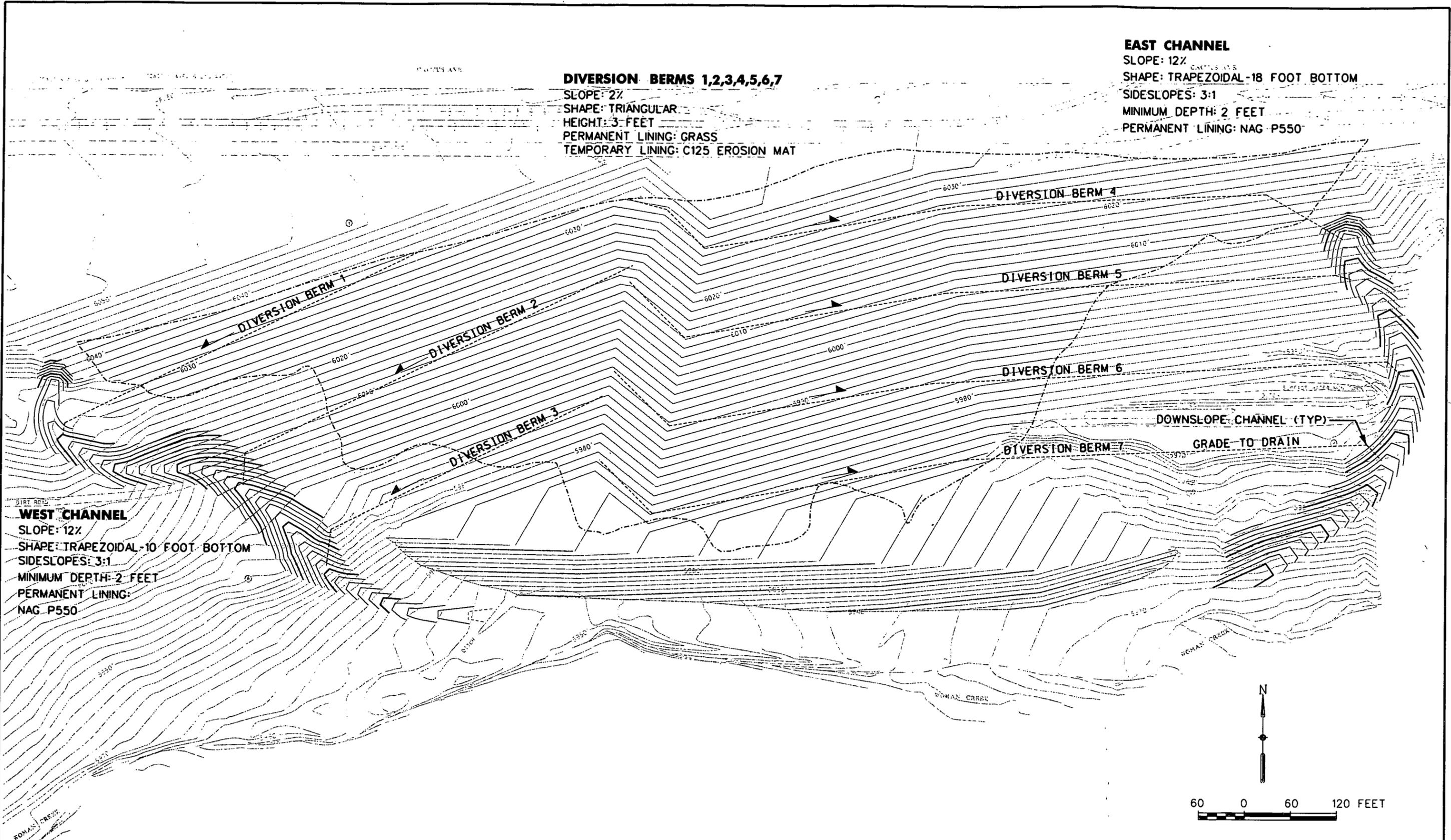
FIGURE 1-2  
 OLF SITE MAP  
 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
 GOLDEN, COLORADO

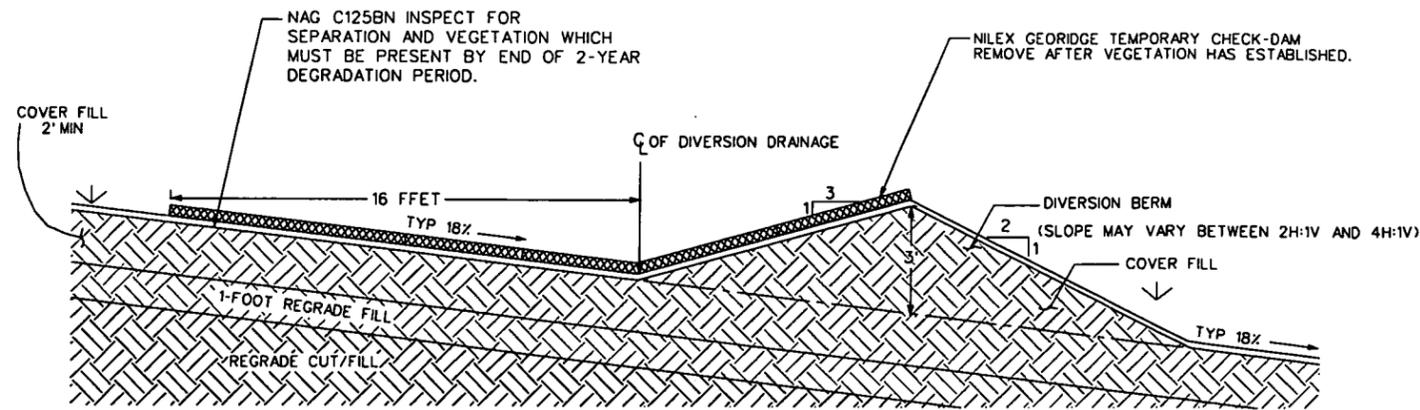
36

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

**EAST CHANNEL**  
 SLOPE: 12%  
 SHAPE: TRAPEZOIDAL - 18 FOOT BOTTOM  
 SIDESLOPES: 3:1  
 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



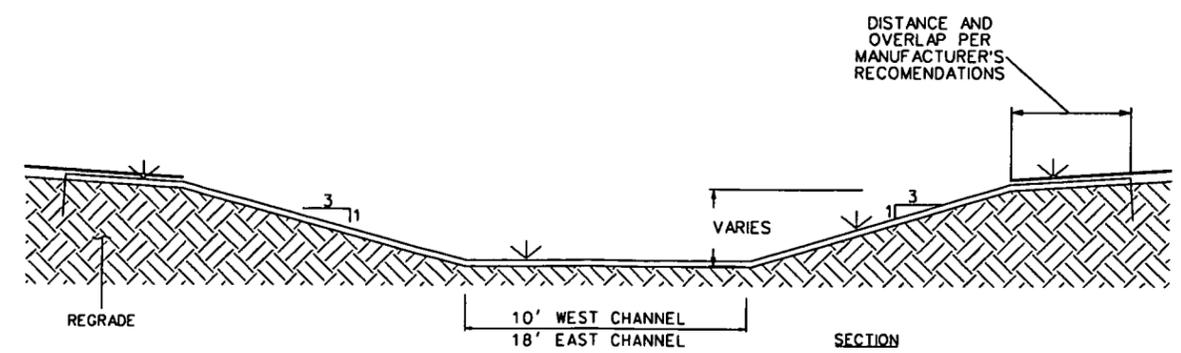


SECTION

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

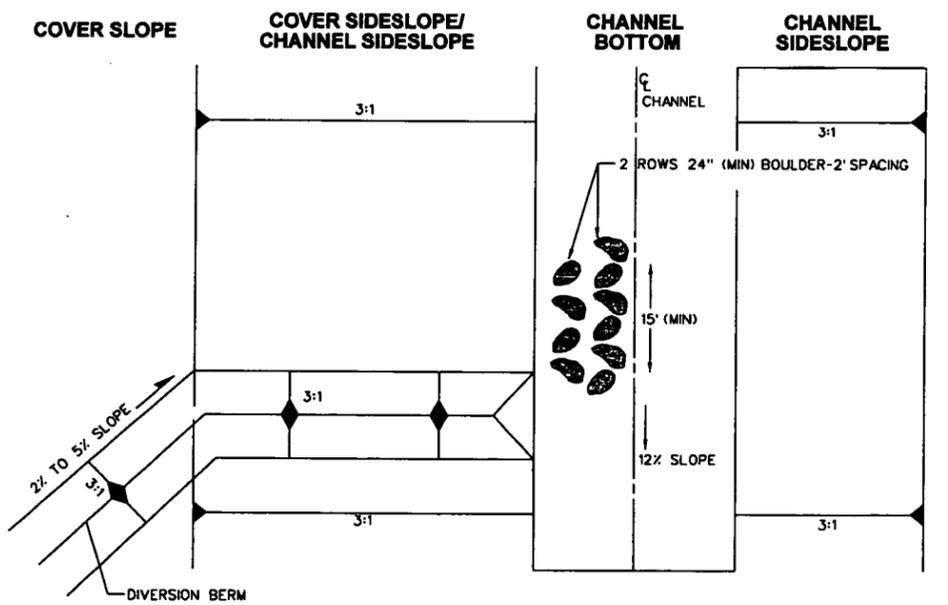


SECTION

NOTE: NAG P550

**PERMANENT/GRASS-LINED CHANNEL DETAIL (SECTION)**

NTS

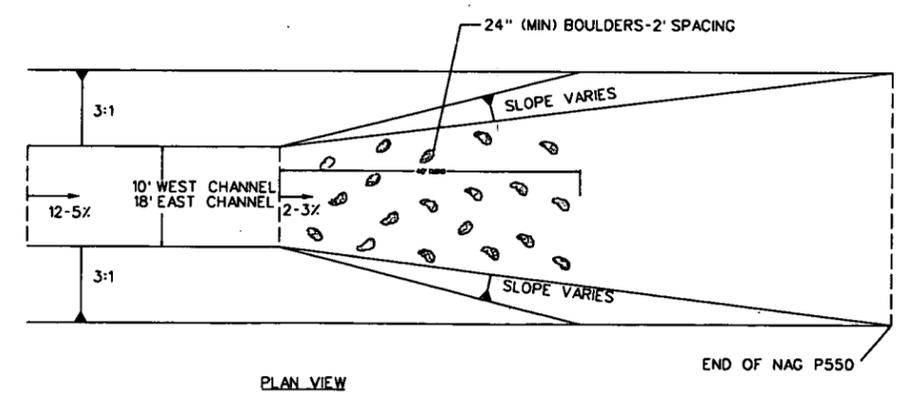


PLAN VIEW

NOTE: NAG P550 OR EQUIVALENT 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



PLAN VIEW

**END CHANNEL (PLAN VIEW)**

NTS

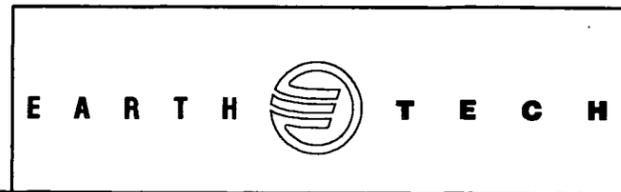
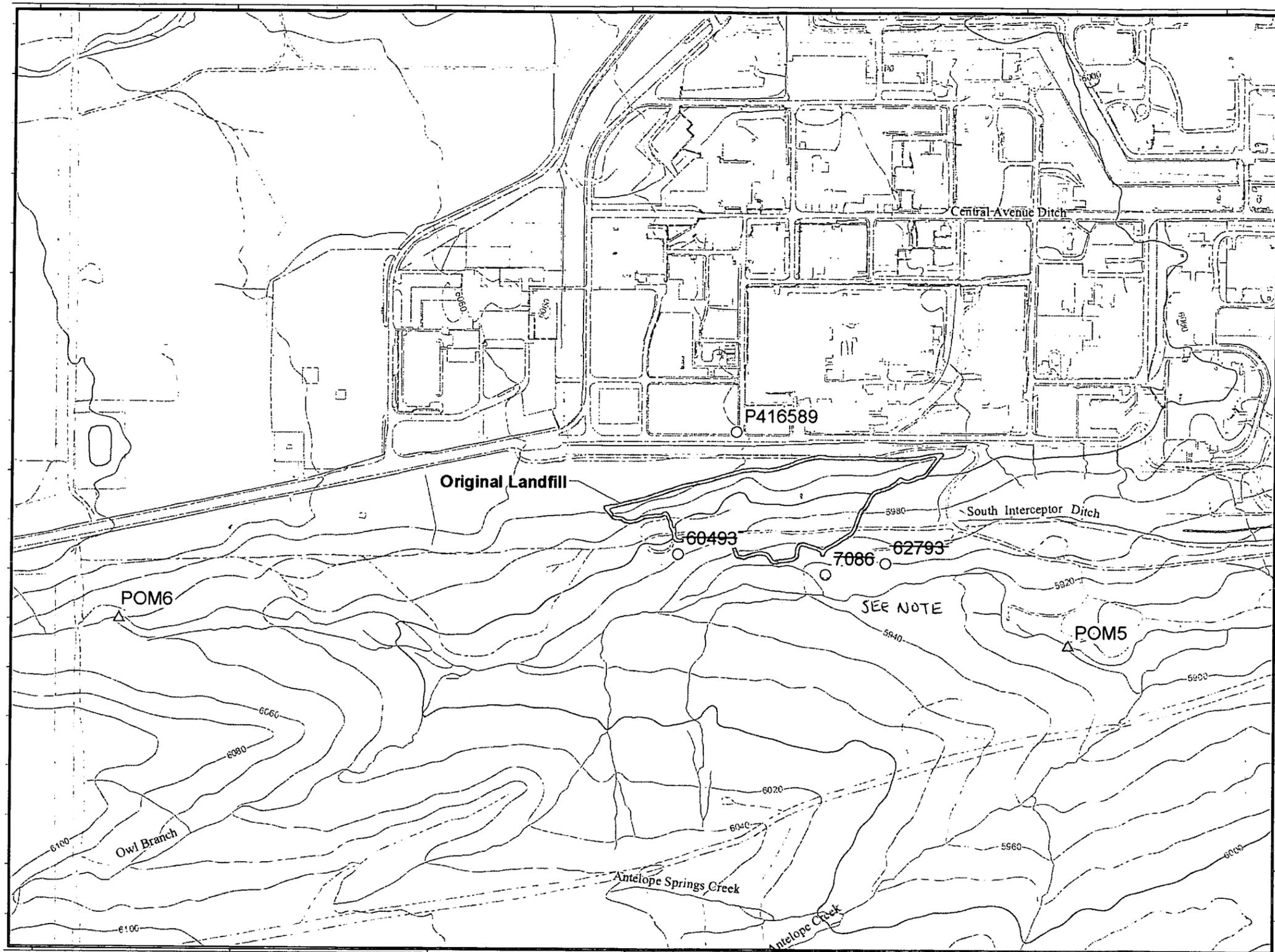


FIGURE 3-1  
**OLF STORMWATER MANAGEMENT  
 STRUCTURE DETAILS**  
 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
 GOLDEN, COLORADO



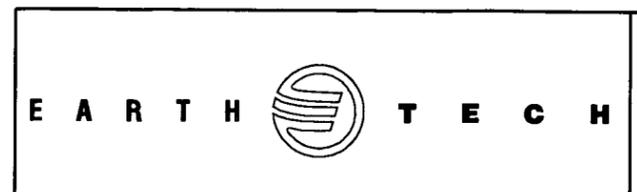
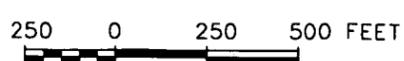
**Legend**

- Groundwater monitoring well
- △ Surface water monitoring location
- Waste material boundary

**Standard Map Features**

- Lake or pond
- Stream, ditch, or other drainage feature
- Paved road
- Dirt road
- Trail
- - - Fence
- Topographic contour (20 foot)

NOTE: MAP TO BE UPDATED TO SHOW ACTUAL DOWNGRADE MONITORING WELLS 80005, 80105, 80205.



**FIGURE 4-1**  
**OLF GROUNDWATER AND**  
**SURFACE WATER MONITORING**  
 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
 GOLDEN, COLORADO

**APPENDIX A**

**ORIGINAL LANDFILL - MONITORING AND MAINTENANCE PROGRAM  
INSPECTION FORM**

# ORIGINAL LANDFILL – MONITORING AND MAINTENANCE PROGRAM INSPECTION FORM

INSPECTOR: \_\_\_\_\_ DATE: \_\_\_\_\_

INSPECTOR'S QUALIFICATIONS: \_\_\_\_\_

## SUBSIDENCE / CONSOLIDATION

| REGION           | EVIDENCE OF CRACKS, DEPRESSIONS, OR SINKHOLES? |
|------------------|--|
| COVER – WEST     |  |
| COVER – EAST     |  |
| BUTTRESS FILL    |  |
| DIVERSION BERM 1 |  |
| DIVERSION BERM 2 |  |
| DIVERSION BERM 3 |  |
| DIVERSION BERM 4 |  |
| DIVERSION BERM 5 |  |
| DIVERSION BERM 6 |  |
| DIVERSION BERM 7 |  |

MAINTENANCE REQUIRED

\_\_\_\_\_

\_\_\_\_\_

## SLOPE STABILITY

| REGION                               | EVIDENCE OF SEEPS, CRACKS, BLOCK FAILURE, OR<br>ROTATIONAL FAILURE? |
|--------------------------------------|---|
| COVER - WEST                         |   |
| COVER - EAST                         |   |
| BUTTRESS FILL SIDESLOPE              |   |
| WEST PERIMETER CHANNEL<br>SIDESLOPES |   |
| EAST PERIMETER CHANNEL<br>SIDESLOPES |   |
| COVER SEEPS (IF PRESENT)             |   |

MAINTENANCE REQUIRED

\_\_\_\_\_

\_\_\_\_\_

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**SOIL COVER**

| REGION / LOCATION       | EVIDENCE OF SOIL DEPOSITION OR EROSION? | EVIDENCE OF RILLS/GULLIES? | EVIDENCE OF BURROWING ANIMALS? |
|-------------------------|---|----------------------------|--------------------------------|
| COVER - WEST            |   |                            |                                |
| COVER - EAST            |   |                            |                                |
| BUTTRESS FILL           |   |                            |                                |
| BUTTRESS FILL SIDESLOPE |   |                            |                                |

MAINTENANCE REQUIRED

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**VEGETATION**

| REGION                        | CONDITION OF GRASS | UNWANTED VEGETATION PRESENT**? | PERCENTAGE OF GRASS VERSUS BARE GROUND? | PERCENTAGE OF UNWANTED VEGETATION? |
|-------------------------------|--------------------|--------------------------------|---|------------------------------------|
| COVER- WEST                   |                    |                                |   |                                    |
| COVER - EAST                  |                    |                                |   |                                    |
| DIVERSION BERM 1              |                    |                                |   |                                    |
| DIVERSION BERM 2              |                    |                                |   |                                    |
| DIVERSION BERM 3              |                    |                                |   |                                    |
| DIVERSION BERM 4              |                    |                                |   |                                    |
| DIVERSION BERM 5              |                    |                                |   |                                    |
| DIVERSION BERM 6              |                    |                                |   |                                    |
| DIVERSION BERM 7              |                    |                                |   |                                    |
| WEST PERIMETER CHANNEL        |                    |                                |   |                                    |
| EAST PERIMETER CHANNEL        |                    |                                |   |                                    |
| UPPER BUTTRESS FILL SIDESLOPE |                    |                                |   |                                    |
| LOWER BUTTRESS FILL SIDESLOPE |                    |                                |   |                                    |

\* Unwanted vegetation includes weeds and deep-rooting trees.

MAINTENANCE REQUIRED

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## STORMWATER MANAGEMENT STRUCTURES

### CHANNELS / LINING

CHECK EACH STRUCTURE FOR EXCESSIVE EROSION, SETTLEMENT, BANK FAILURE, BREACHING, SUBSIDENCE, BURROWING ANIMALS, BLOCKAGE, PONDING WATER, SEDIMENT BUILD-UP, GULLYING, DEPRESSIONS, LINING DAMAGE, DISPLACEMENT, UNDERMINING, SCOUR, DETERIORATION, HOLES, RIPS, SEPARATION.

| STRUCTURE              | CONDITION |
|------------------------|-----------|
| DIVERSION BERM 1       |           |
| DIVERSION BERM 2       |           |
| DIVERSION BERM 3       |           |
| DIVERSION BERM 4       |           |
| DIVERSION BERM 5       |           |
| DIVERSION BERM 6       |           |
| DIVERSION BERM 7       |           |
| CHECK DAMS             |           |
| WEST PERIMETER CHANNEL |           |
| EAST PERIMETER CHANNEL |           |

**OUTFALLS**

CHECK EACH STRUCTURE FOR EXCESSIVE EROSION AND SEDIMENT DEPTH. IF SEDIMENT DEPTH IS COMPROMISING THE DESIGN CHARACTERISTICS, REMOVE SEDIMENT. CHECK ROCK OUTFALLS FOR ROCK INTEGRITY AND SEDIMENT BUILD-UP.

| 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)     |                            |

MAINTENANCE REQUIRED

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**EROSION CONTROL**

| AREA                               | ADVERSELY AFFECTING OLF? |
|------------------------------------|--------------------------|
| NORTH OF THE ORIGINAL LANDFILL     |                          |
| WEST OF THE WEST PERIMETER CHANNEL |                          |
| EAST OF THE EAST PERIMETER CHANNEL |                          |
| NORTH OF WOMAN CREEK               |                          |

MAINTENANCE REQUIRED

---



---

**ACTION ITEMS**

| DEFICIENCY | DATE NOTED | ACTION | DATE COMPLETED | COMMENTS |
|------------|------------|--------|----------------|----------|
|            |            |        |                |          |
|            |            |        |                |          |
|            |            |        |                |          |

SIGNATURE: \_\_\_\_\_ DATE: \_\_\_\_\_

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**APPENDIX B**

**GROUNDWATER WELL BORING LOGS / CONSTRUCTION SUMMARIES**

STATE PLANE COORDINATE: TOTAL DEPTH (FT): 36.5  
 NORTH: 74211 AREA: PLANT  
 EAST: 20815-6 LOCATOR NUMBER: 18  
 REMARKS: Hollow Stem Auger, Weston Log.

GROUND ELEVATION (FT): 6041.20  
 CASING DIAMETER (IN): 2-3/8 O.D.  
 BOREHOLE DIAMETER (IN): 7.25

OLD WELL NUMBER: P260-89  
 GEOLOGIST: SPC  
 DATE DRILLED: 09/14/89

LOG OF BORING NUMBER:  
**P416589**

SAMPLE NUMBER

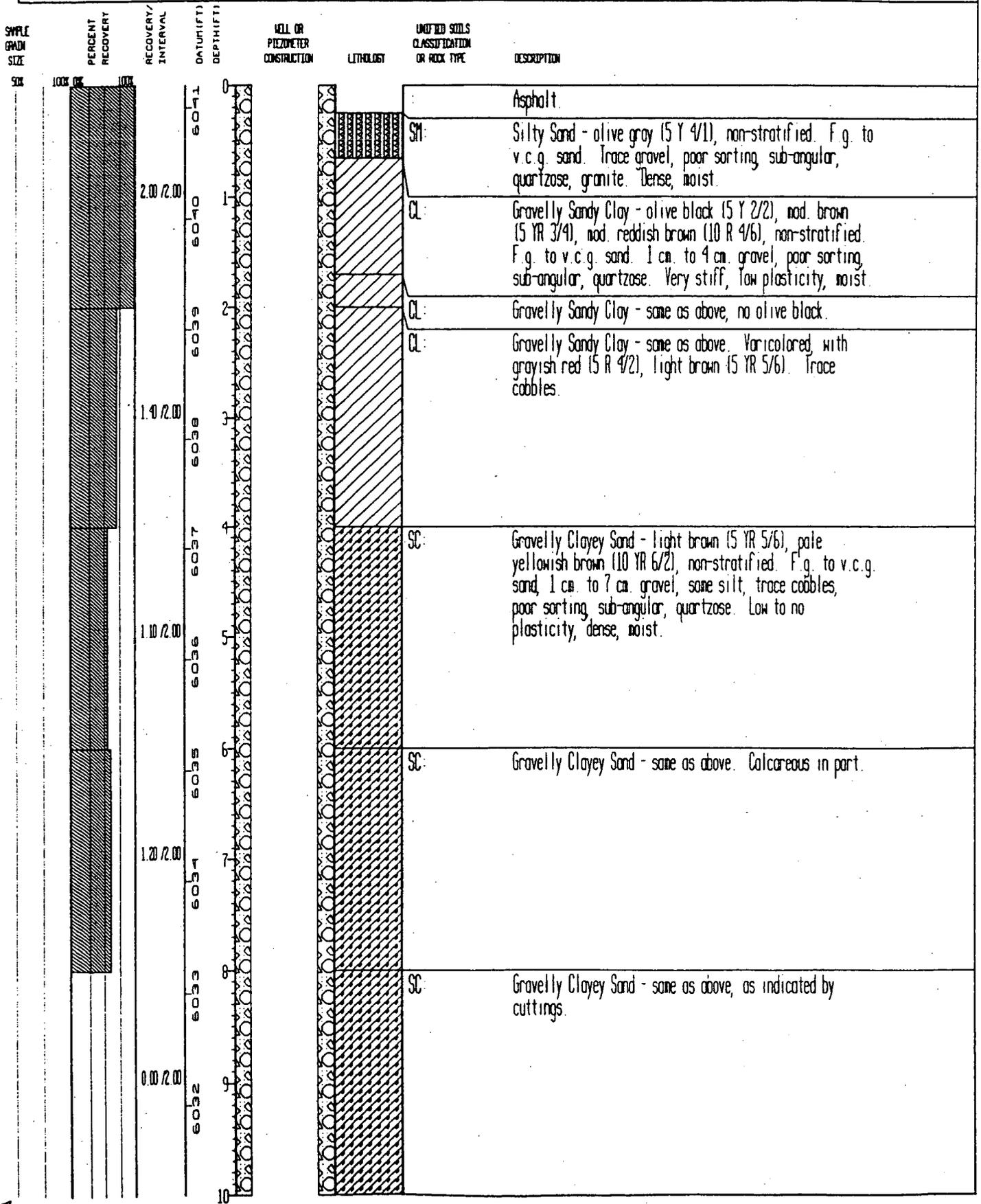
891002  
891003

891004

891005

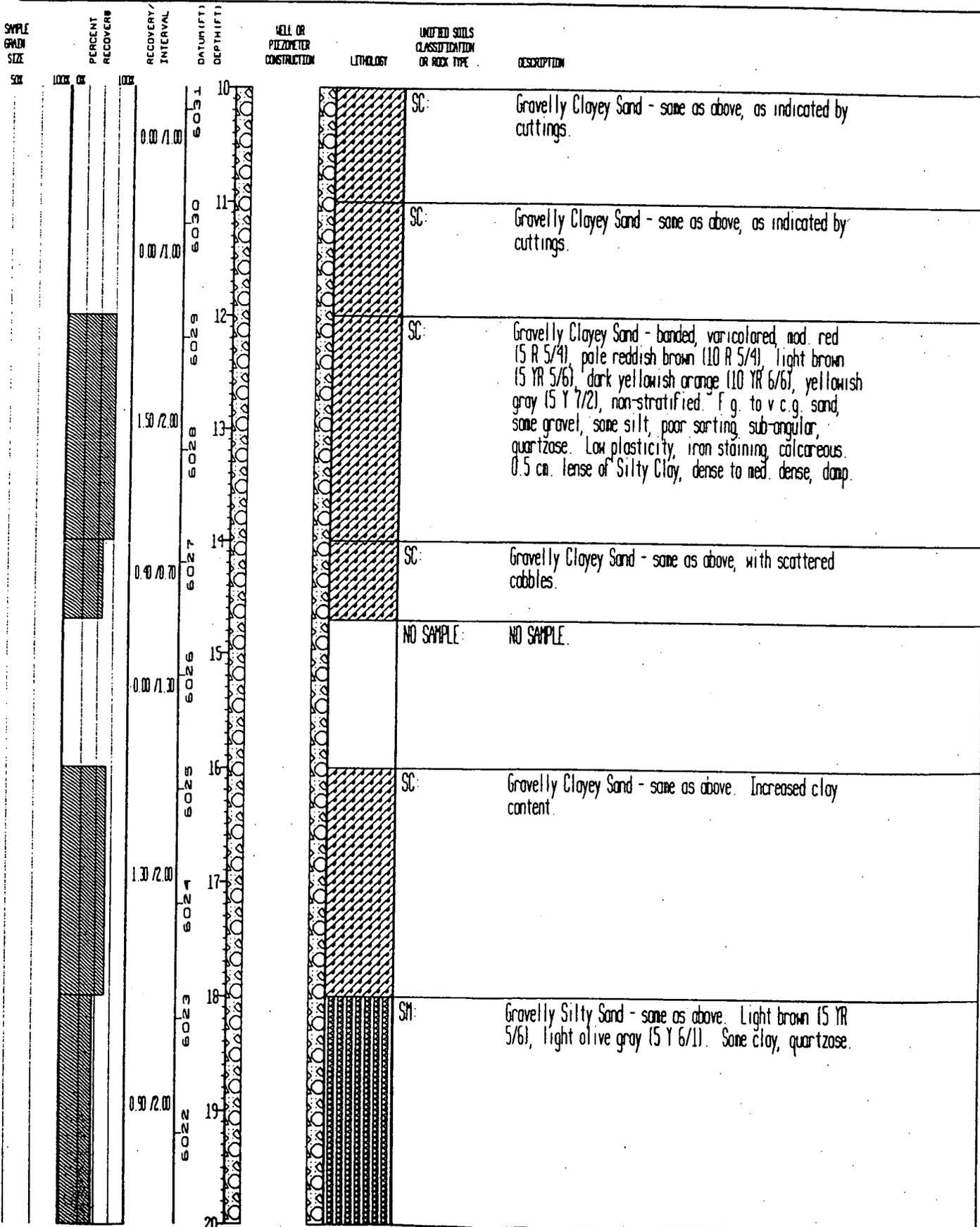
891007

891008



STATE PLANE COORDINATE: NORTH: 748211 EAST: 2081546  
 TOTAL DEPTH (FT): 36.5 AREA: PLANT LOCATOR NUMBER: 18  
 GROUND ELEVATION (FT): 6041.20 CASTING DIAMETER (IN): 2-3/8 O.D. BOREHOLE DIAMETER (IN): 7.25  
 OLD WELL NUMBER: P260-89 GEOLOGIST: SPC DATE DRILLED: 09/14/89  
 LOG OF BORING NUMBER: P416589  
 REMARKS: Hollow Stem Auger, Weston Log.

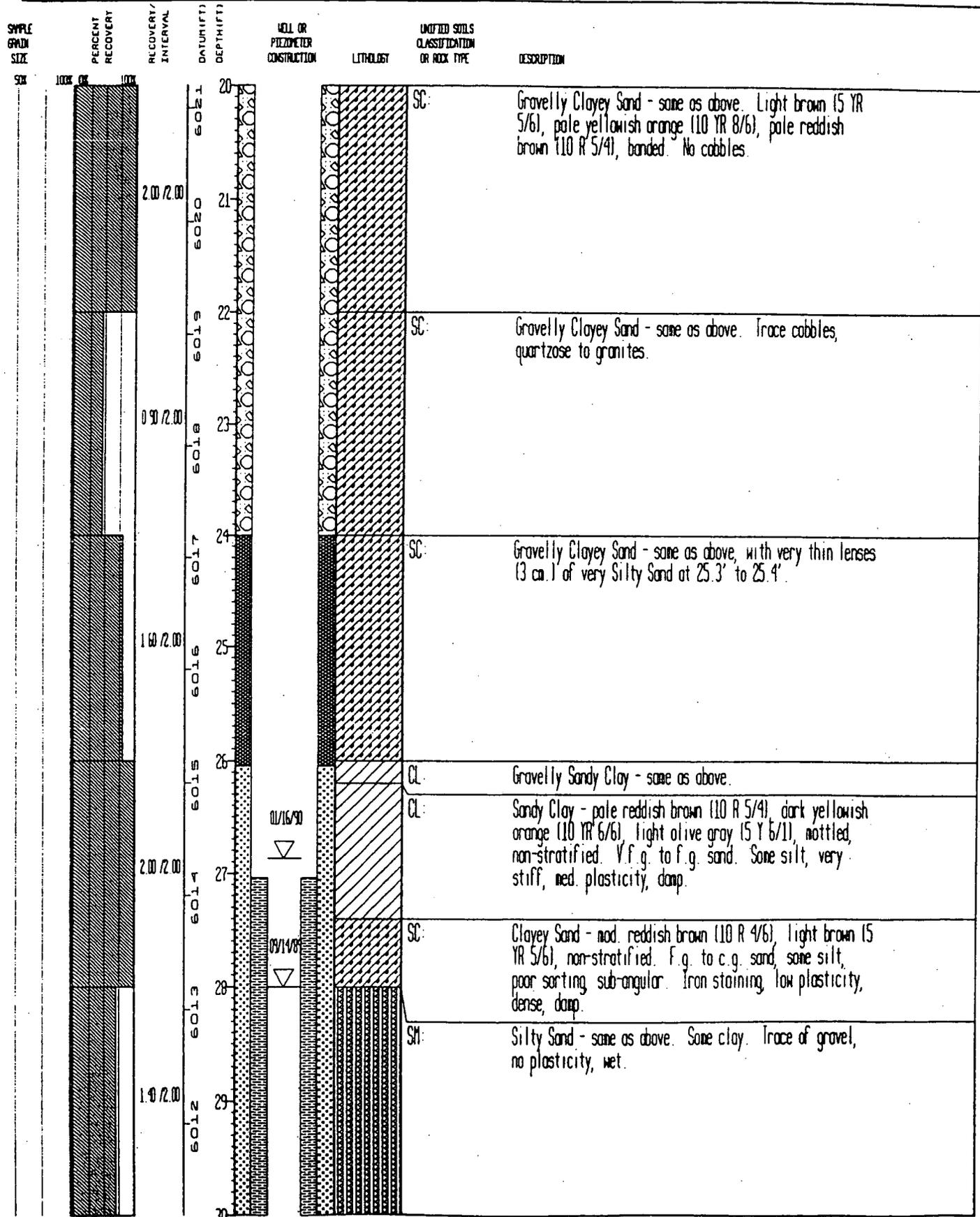
SAMPLE NUMBER



6021214  
 6021216  
 6021415  
 6021518  
 6021520  
 6021820

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  
 EAST: 2081546 LOCATOR NUMBER: 18 BOREHOLE DIAMETER (IN): 7.25 DATE DRILLED: 09/14/89  
 REMARKS: Hollow Stem Auger, Weston Log. P416589

SAMPLE NUMBER  
 6012  
 6013  
 6014  
 6015  
 6016  
 6017  
 6018  
 6019  
 6020  
 6021  
 6022  
 6023  
 6024  
 6025  
 6026  
 6027  
 6028  
 6029  
 6030



STATE PLANE COORDINATE:  
 NORTH: 74211  
 EAST: 209156  
 REMARKS: Hollen Stein Apts. Weston Log.

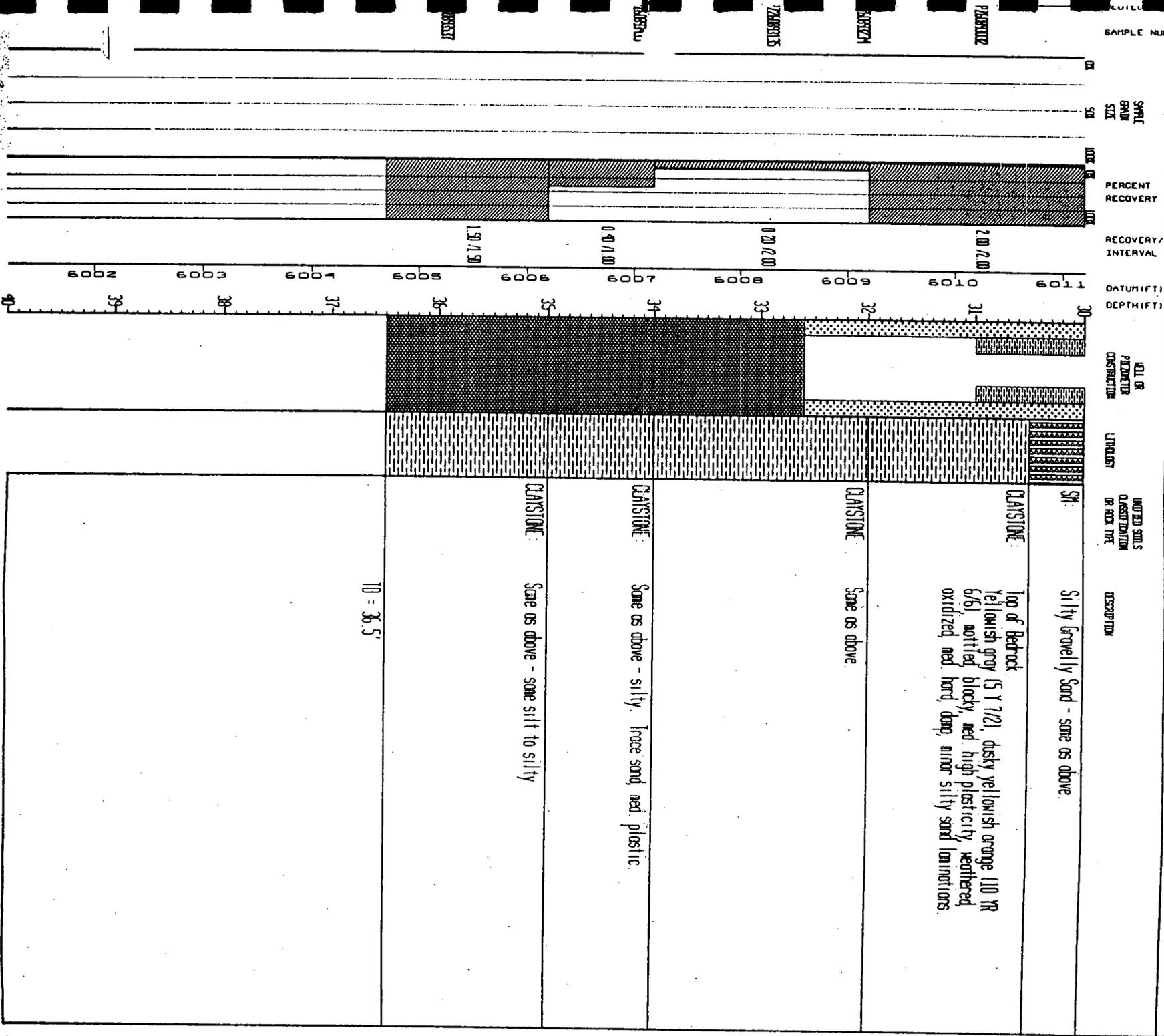
TOTAL DEPTH (FT): 36.5  
 AREA PLANT  
 LOCATION NUMBER: 18

GROUND ELEVATION (FT): 6041.20  
 CASING DIAMETER (IN): 2-3/8 O.D.  
 BOREHOLE DIAMETER (IN): 7.25

OLD WELL NUMBER: P242-89  
 EQUICENT: 3PC  
 DATE DRILLED: 09/14/89

LOG OF BOREHOLE NUMBER:

P416589



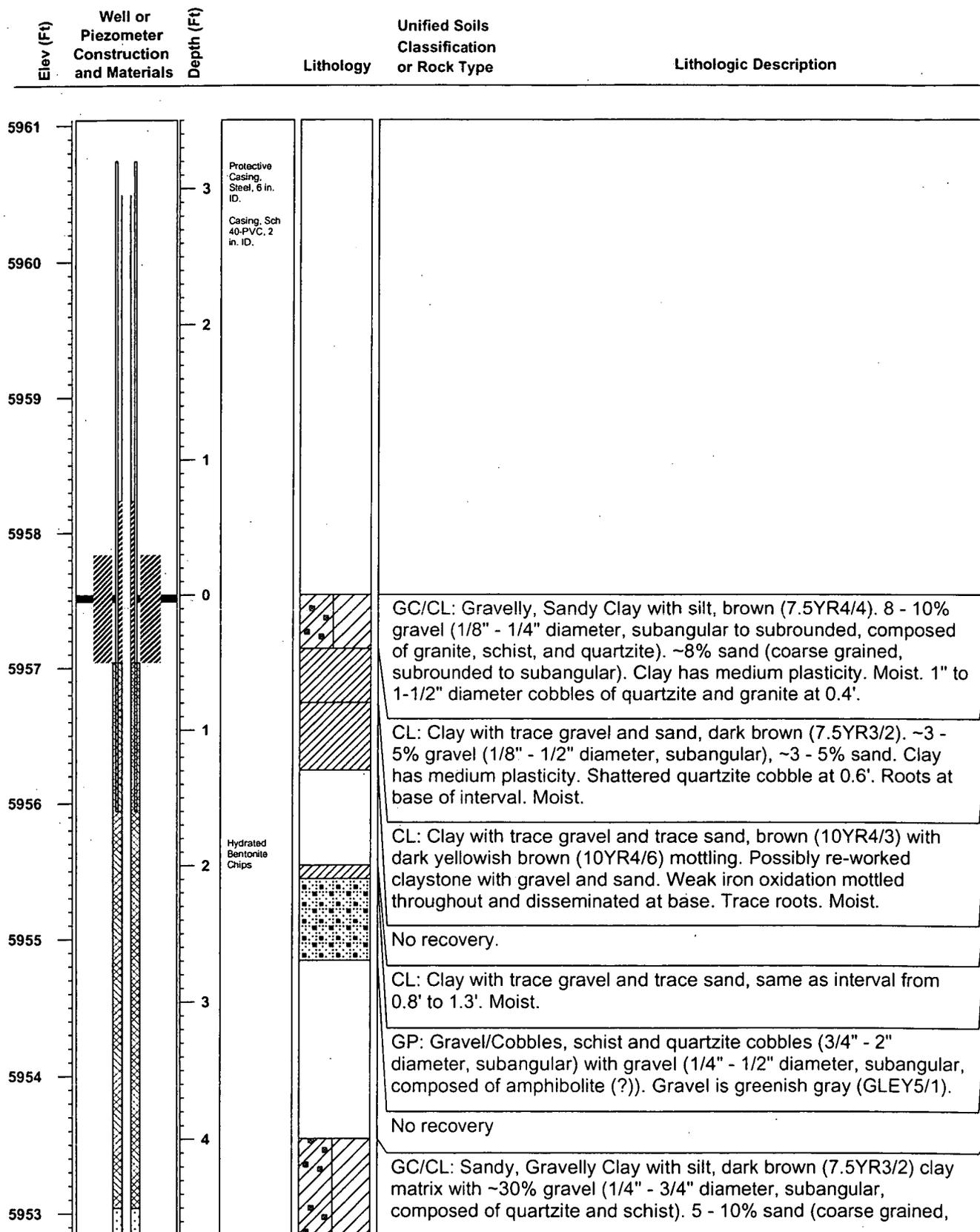
50

STATE PLANE COORDINATES AREA: GRND ELEV. (FT): 5957.54  
 NORTH: 747489.979 TOTAL DEPTH (FT): 21.0  
 EAST: 2081404.042 COMPLETION DATE: 8/9/05  
 PROJECT: Original Landfill GEOLOGIST: E. Warp

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

LOG OF BORING NUMBER:  
**80005**

REMARKS:  
 Routine well installation



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Elev (Ft)

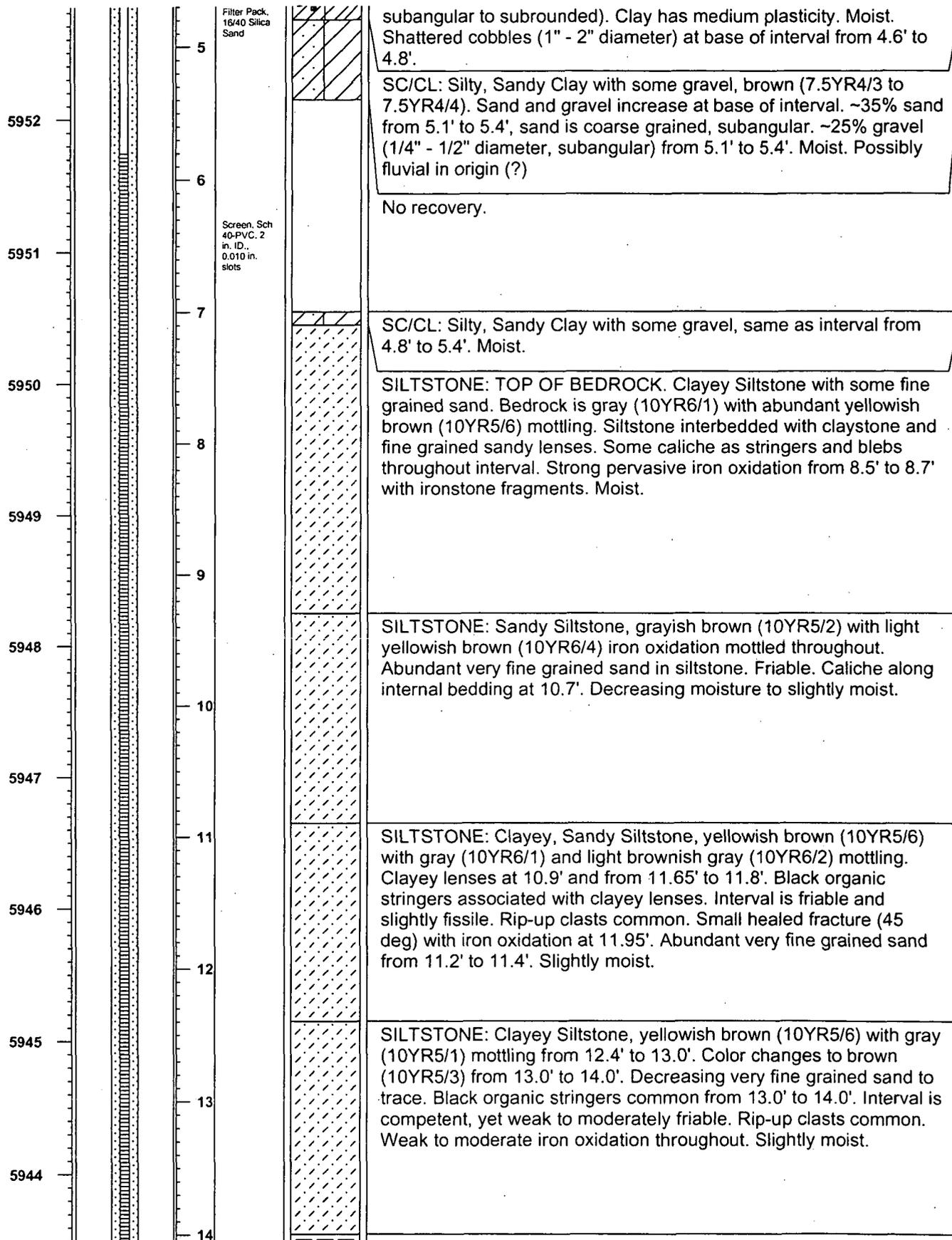
Well or  
Piezometer  
Construction  
and Materials

Depth (Ft)

Lithology

Unified Soils  
Classification  
or Rock TypeLOG OF BORING NUMBER:  
**80005**  
Lithologic Description

Page 2 of 3



Elev (Ft)

Well or Piezometer Construction and Materials

Depth (Ft)

Lithology

Unified Soils Classification or Rock Type

Lithologic Description

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Threaded End Cap - Sump. Sch

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.

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.

No recovery.

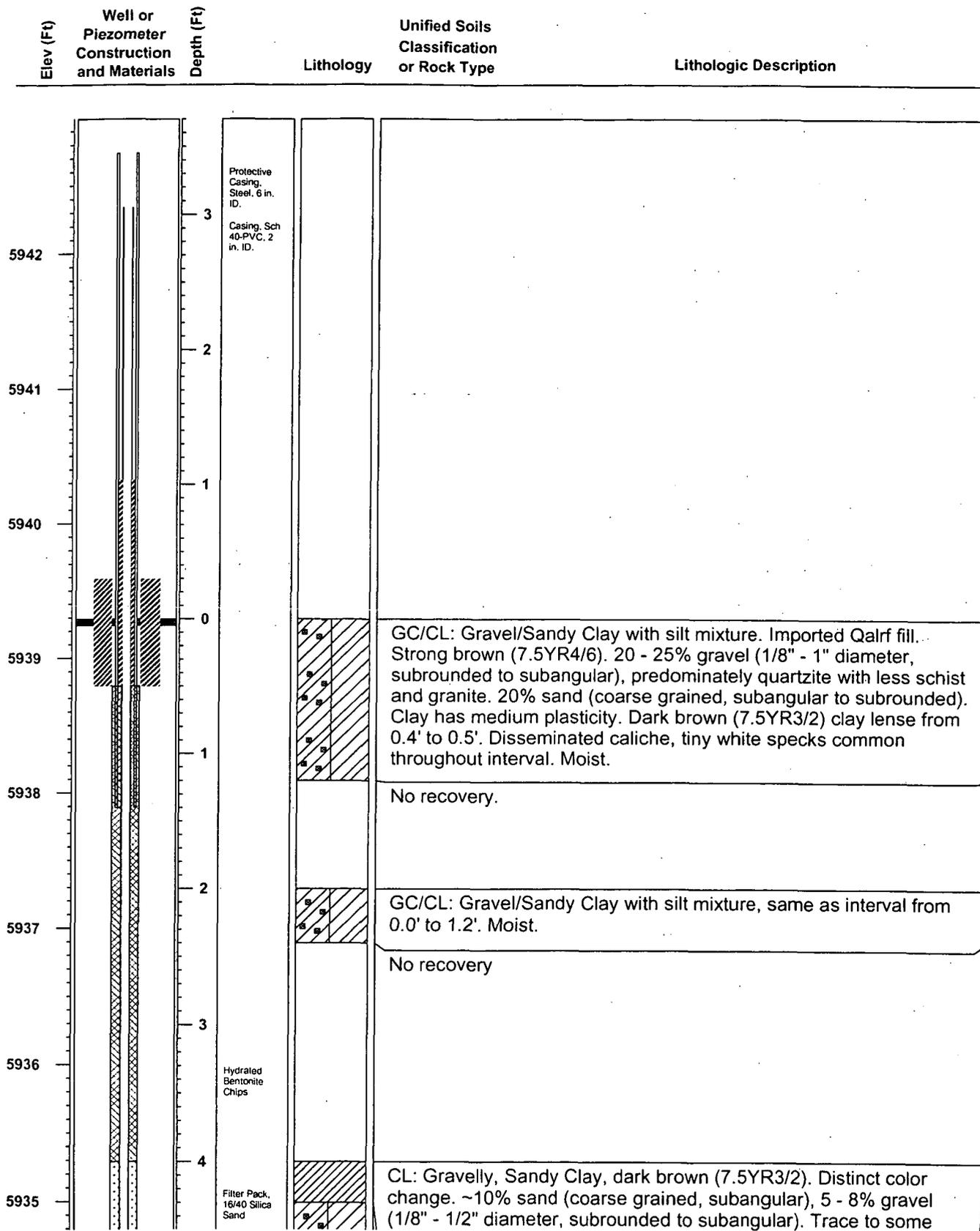
CLAYSTONE: Claystone, un-weathered, dark gray (2.5Y4/1). Dense and firm, weakly fissile, dry.

STATE PLANE COORDINATES AREA: GRND ELEV. (FT): 5939.29  
 NORTH: 747463.414 TOTAL DEPTH (FT): 20.15  
 EAST: 2081942.494 COMPLETION DATE: 8/8/05  
 PROJECT: Original Landfill GEOLOGIST: E. Warp

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

LOG OF BORING NUMBER:  
**80105**

REMARKS:  
 Routine well installation



54

Elev (Ft)

Well or Piezometer Construction and Materials

Depth (Ft)

Lithology

Unified Soils Classification or Rock Type

LOG OF BORING NUMBER: 80105  
Lithologic Description

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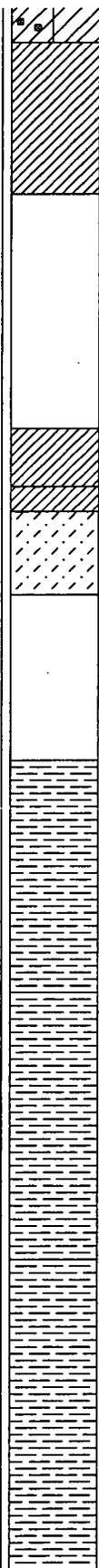
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13

Screen, Sch 40-PVC, 2 in. ID, 0.010 in. slots



organic material (woodchips). Medium to high plasticity, very moist. Color change may indicate prior ground surface (before fill added).

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.

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.

No recovery.

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.

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.

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 "ribbed" in sample tube.] Very moist.

No recovery.

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.

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.

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.

55

Elev (Ft)

Well or Piezometer Construction and Materials

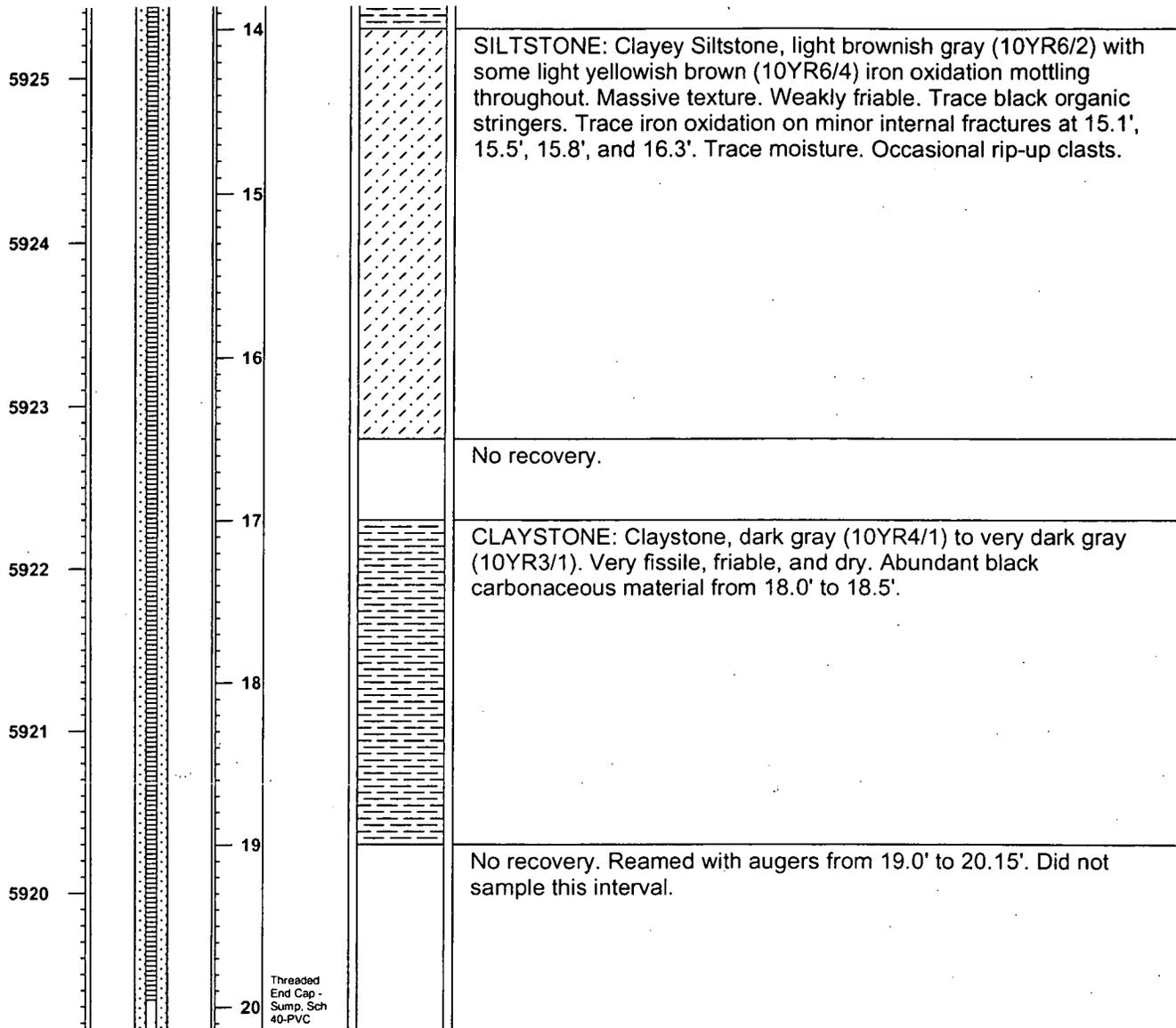
Depth (Ft)

Lithology

Unified Soils Classification or Rock Type

LOG OF BORING NUMBER:  
**80105**  
Lithologic Description

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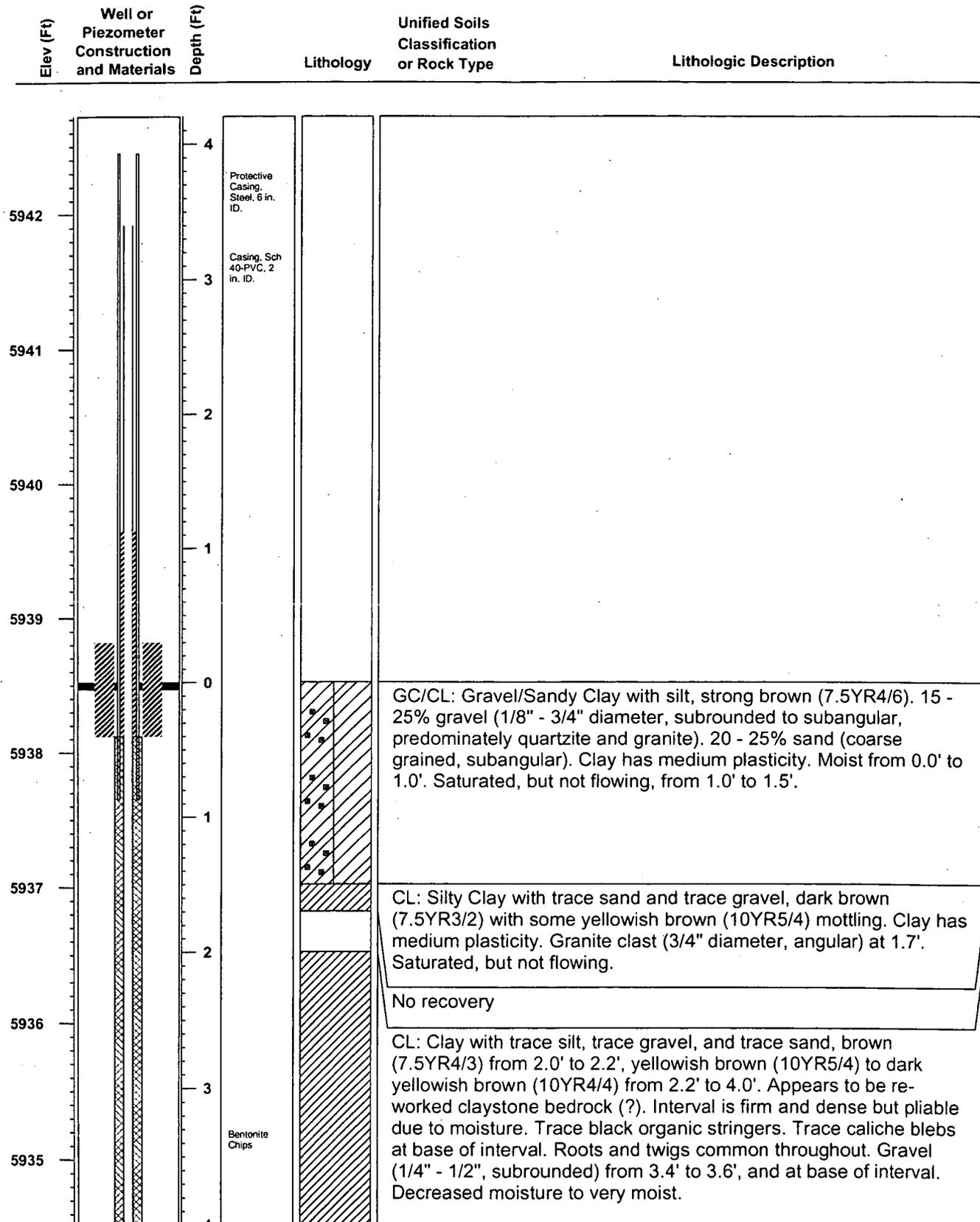
56

STATE PLANE COORDINATES AREA: GRND ELEV. (FT): 5938.52  
 NORTH: 747535.636 TOTAL DEPTH (FT): 20.0  
 EAST: 2082324.443 COMPLETION DATE: 8/10/05  
 PROJECT: Original Landfill GEOLOGIST: E. Warp

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

LOG OF BORING NUMBER:  
**80205**

REMARKS:  
 Routine well installation



Elev (Ft)

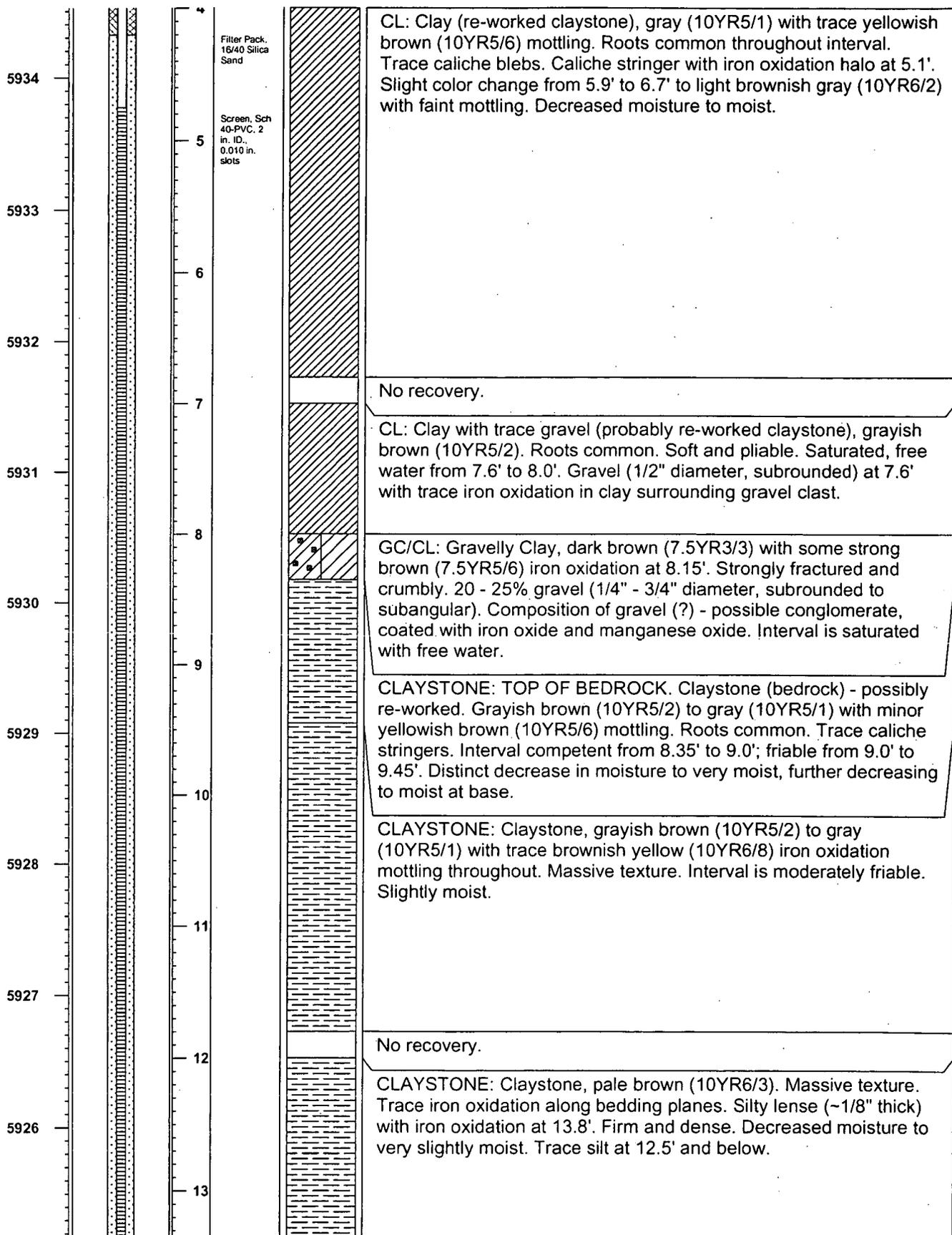
Well or  
Piezometer  
Construction  
and Materials

Depth (Ft)

Lithology

Unified Soils  
Classification  
or Rock TypeLOG OF BORING NUMBER:  
**80205**  
Lithologic Description

Page 2 of 3



58

Elev (Ft)

Well or Piezometer Construction and Materials

Depth (Ft)

Lithology

Unified Soils Classification or Rock Type

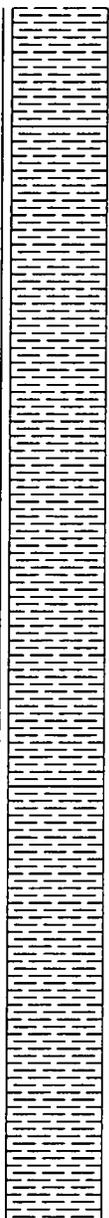
LOG OF BORING NUMBER:  
**80205**  
Lithologic Description

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Conical Threaded End Cap - Sump, Sch 40-PVC



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.

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.

**APPENDIX C**

**RFETS SOPs**



Rocky Mountain  
Remediation Services, L.L.C.  
... protecting the environment

# PROCEDURE

**CONTAINING, PRESERVING, HANDLING,  
AND SHIPPING SOIL AND WATER SAMPLES**

RMRS/OPS-PRO.069  
Revision 0  
Date Effective: 05/15/98  
Page 1 of 17

APPROVED: \_\_\_\_\_ /s/ \_\_\_\_\_  
John Law, Director, Environmental Restoration

## 1. PURPOSE

This standard operating procedure (SOP) describes procedures that shall be used at Rocky Flats Environmental Technology Site (RFETS) for containing, preserving, handling, packaging, and shipping soil and water samples.

## 2. SCOPE

This procedure is to be used as part of the sampling process for Environmental Restoration (ER) and Water Operations activities at RFETS. All personnel performing these procedures are required to have the appropriate health and safety training as specified in the task-specific Health and Safety Plan. In addition, all personnel are required to have a complete understanding of the procedures described within this SOP and receive specific training regarding the activities covered by these procedures.

This procedure addresses soil and water samples that are not regulated as Hazardous or Radioactive by the Department of Transportation (DOT). Samples to which this procedure applies shall be non-hazardous and non-radioactive, as defined by DOT. If samples that are defined as DOT Hazardous and/or Radioactive are encountered, refer to the On-Site Transfer and Off-Site Shipment of Samples procedure (PRO-908-ASD-004) for guidance.

Only qualified personnel shall be allowed to perform these procedures. Required qualifications are based on a minimum of a two year science related degree and/or education, previous experience, on-the-job training, and supervision by an on-site sample coordinator/manager. The subcontractor's project manager will document personnel qualifications related to this procedure in the subcontractor's project QA files.

This procedure supersedes FO.13.

PADC-2000-01754

**CONTROLLED DOCUMENT**  
(If numbered in red ink-black numbering  
indicates information only copy)

805  
Copy Number

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### 3. INSTRUCTIONS

Procedures for containing, preserving, handling and shipping soil and water samples detailed in this SOP follow criteria of the United States Environmental Protection Agency (USEPA). This SOP is intended to present general guidelines for proper sample handling; any deviations or modifications will be documented in the Scope of Work or specific Task Order as well as SOP addendum forms.

In addition, activities performed under this SOP shall be in compliance with DOT, Department of Energy (DOE), and RFETS requirements. These requirements are implemented at RFETS through the On-site Transfer and Off-site Shipment of Samples (OTOSS) procedure (PRO-908-ASD-004) and the Site Transportation Safety Manual (STSM) (MAN-T91-STSM-001).

#### 3.1 Equipment List

The following list of equipment is not intended to be task specific. The equipment and materials shown are the minimum that may be needed to ensure that proper procedures are followed for sample handling, packaging, and shipping.

- Sample containers/bottles
- Coolers
- Thermometer
- Blue ice
- Sample labels
- Chain-of-Custody (COC) forms
- Decontamination equipment
- Preservatives
- Plastic bags for containers and to line sample coolers
- Bubble wrap
- Vermiculite or equivalent
- Strapping and clear tape
- Custody seals
- Garbage bags
- Plastic 5-gallon buckets

Appropriate uses for the equipment are detailed in the following sections of this SOP.

#### 3.2 Radiological Release

Prior to field activities, an evaluation of historical data and process knowledge relevant to the sample matrices shall be performed by appropriate radiological control personnel. Based on this

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screening and/or a Property/Waste Release Evaluation (P/WRE) will be required prior to packaging and shipping samples. Radiological engineering shall ensure that contracted laboratories have the appropriate radiological license to receive samples from RFETS. Supplemental radiological screening and/or a P/WRE may be required to determine that:

- the sample containers are clean and free from radiological contamination
- the radionuclide content of the sample(s) meet the appropriate (DOT) requirements
- the radionuclide content of the sample(s) do not exceed the limits of the receiving laboratory's radioactive materials license

The P/WRE will include, as applicable, the radiological surveys/analyses and the off-site laboratory information to include: name, contact, phone number, and address. A form shall be prepared, or the radiological screening sample report shall be annotated, to document and cross-reference real samples with radiological screening samples, as applicable. A copy of the completed P/WRE shall be provided to the project Radiological Control Technician(s) or Health and Safety Specialist(s) responsible for documentation of the radiological surveys, as applicable. A copy of the completed P/WRE shall be provided to the project sample coordinator/manager or designee responsible for maintaining project files.

### 3.3 Sample Containers and Preservatives

Only sample containers certified as clean by the manufacturer will be used for sample collection. A file of certificates should be maintained by the project sample coordinator/manager or designee. Newly fabricated containers may be utilized for radionuclide samples, and are not required to be certified. The containers and preservatives may be obtained from the contracted analytical laboratory, their designated supplier, or a suitable chemical supply company.

Any preservative(s) required may be added to the container by the contracted analytical laboratory, field sampling team, sample manager, and/or on-site chemist prior to or during sample collection. The chemical preservatives used shall be of reagent/laboratory grade, at a minimum. Extreme care shall be exercised in the addition of preservative to any sample container to ensure that the resulting sample is not overly preserved, as this may require the sample to be handled, packaged, and shipped as DOT Hazardous. (This procedure does not address requirements for handling DOT Hazardous materials; for these materials, the user is referred to the OTOSS procedure.) Per 40 CFR 136.3, samples of water shall comply with DOT Hazardous Materials Regulations if any of the following apply:

- The sample is preserved with hydrochloric acid (HCl) to a pH below 1.96 (HCl concentration is 0.04% or greater by weight);
- The sample is preserved with nitric acid (HNO<sub>3</sub>) to a pH below 1.62 (HNO<sub>3</sub> concentration is 0.15% or greater by weight);

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- The sample is preserved with sulfuric acid ( $H_2SO_4$ ) to a pH below 1.15 ( $H_2SO_4$  concentration is 0.35% or greater by weight);
- The sample is preserved with sodium hydroxide (NaOH) to a pH above 12.30 (NaOH concentration is 0.08% or greater by weight).

The matrices discussed in this SOP for chemical, geotechnical, and radiological parameters are:

Soil Matrix - to include soils, sediments, and sludges

Water Matrix - to include surface water, groundwater, and process liquids

*Note 1: Information presented in the following Tables constitute examples and suggestions, NOT requirements. Representatives of the Analytical Services Division (ASD) should be contacted to determine the exact requirements.*

Tables A-1 and A-2 show parameters of interest for water and soil matrices with the recommended associated container size, preservative (chemical and temperature), and holding times. Table A-3 shows geotechnical parameters, containers, preservatives, and holding times for soil and geosynthetic materials.

### 3.4 Container Labeling, Decontamination and Field Packaging

Subsequent to sampling, the container shall be sealed securely and the exterior of each sample container will be thoroughly cleaned. The exterior of the sample container shall then be radiologically surveyed (if required) in accordance with the P/WRE, HSP 18.10, Health and Safety Practices Manual, the On-site Transfer and Off-site Shipment of Samples procedure, and the STSM. A properly completed (typically with name of sampler and date of sampling) custody seal shall then be applied to the sealed container, so as to be firmly attached to the container body and lid, crossing the interface between the two. The custody seal must be firmly and securely attached, not loose or potentially removable.

The sample bottles shall be labeled immediately after collection by the sample manager or field sampling team. Only ASD-approved (or equivalent) sample labels shall be used; these labels may be generated by specialty software managed by ASD called the AST (Analytical Services Toolkit) program. In rare cases (e.g., sample media exist for a very short time so sample collection may be required at a moment's notice), it may be necessary to apply a temporary label to a sample, but this label shall be replaced as soon as possible with an approved AST (or equivalent) label. Collection time and date shall be completed in the field by the sampler. The labels shall indicate, as applicable:

- Location Code
- Activity name and/or number

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- Unique sample number (RIN-Event-Bottle recommended)
- Sample time and date
- Chemical preservative used
- Sample type (grab, composite)
- Analyses required
- Filtered/Unfiltered
- Comments or special precautions
- Samplers initials
- Laboratory destination (abbreviations)

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The sample label shall be marked with a waterproof pen. If needed, clear tape will be placed over labels after sampling to assure that the labels remain legible. If errors are discovered on the COC, the sampling team shall correct the mistake by striking through the error with a single line and initialing adjacent to the correction. Write-overs are NOT acceptable.

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Samples shall then be individually sealed in appropriately-sized bags. The bagged samples shall then be placed in a designated, bag-lined sample cooler (that is, a large, cooler-size bag placed inside the cooler to provide secondary containment) with blue ice or acceptable substitute and, if the samples are liquid, enough compatible absorbent to absorb twice the volume of the samples. (Note: blue ice is not required if the samples need not be chilled, and absorbent is not required if the samples are not liquid.) If applicable, properly completed Radioactive Material (RAM) tag(s) and/or label(s) shall be attached to the cooler (and removed when the cooler is emptied). (RAM tags must be completed by a qualified individual, typically a Radiological Control Technician.)

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The sample cooler shall then be sealed, placed in the back of the sampling truck, and immobilized to prevent spillage or shifting of contents. Elastic cords (e.g., bungee cords) are NOT approved for sealing or immobilizing sample coolers. The samples will be transferred directly to the laboratory or the onsite sample shipping facility and, if required, to the sample refrigerator as soon as possible to chill the samples to 4°C. Radiological samples do not require refrigeration but must be secured in a cool dry area.

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All packaging and movement of samples shall be performed in accordance with the OTOSS procedure and the STSM. Any required documents (such as RAM tags) shall accompany the samples during onsite transfer. Copies of radiological surveys, if required, shall be provided as soon as the qualified individual (e.g., Radiological Control Technician) can generate them but in all cases must be provided before any samples on the surveys may be shipped.

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It is recommended that multiple analytes be combined in bottles if volume and preservation requirements are comparable and in accordance with the appropriate analytical method. Check with the ASD to confirm analytical laboratory, analytes that may be combined and volumes required by the laboratory. (Instructions regarding combining analytes should be obtained prior to sample collection.)

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3.5 Chain of Custody Record

Official custody of samples shall be maintained and documented from the time of collection until the time that valid analytical results have been obtained or the laboratory has been authorized to dispose of the sample. The Chain of Custody shall be prepared and processed in accordance with PRO-543-ASD-002, Initiation, Preparation, and Implementation of Chain-of-Custody Forms.

The sampling team shall be responsible for initiating the original chain of custody (COC) form and shall sign and date this form when relinquishing custody of samples. In some cases, it may be necessary to use an internal, program-specific COC as the original COC rather than the formal COC generated using ASD's specialty software, AST. (For example, it may not be known whether all requested samples can be collected, so the formal COC listing all samples might be incorrect and need to be reissued. By using an internal COC, custody is properly maintained and time spent generating, revising, and regenerating AST COCs is minimized.) If an internal COC is used, it must be replaced with a formal AST-generated COC. Only approved, AST-generated COCs shall accompany samples to the lab. This internal COC becomes part of the sample records and must be maintained with the other records.

The COC, custody seals, and all sample labels shall be reviewed to ensure that all samples are present and in good condition, and that no errors were made in labeling and/or completing the COC. Corrections to the COC may be made by the person in custody of the samples, as described in section 3.4.

A sample is considered to be in a person's custody if any of the following conditions are met:

- The sample is in the person's physical possession
- The sample is in line of sight of the person after he/she has taken possession
- The sample is secured by that person so that any tampering can be detected
- A sample is secured in an area which only authorized personnel can enter by the person in possession

Tampering of Sample Containers

If, at any time after the samples have been secured, custody seals are identified as having been tampered with, the following steps shall be taken to ensure that sample integrity has not been compromised:

- Check cooler temperature to verify 4°C (if applicable)
- Check with all personnel having access to sample coolers to verify possible inadvertent tampering
- Check every sample container for any signs of tampering, such as loose lids, foreign objects in containers, broken or leaking containers, etc.
- Check to ensure adequate and appropriate packaging
- Document all findings of the incident in the sample manager's field log book

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If it is determined that malicious tampering of samples has occurred and/or it is believed that sample integrity has been compromised the subcontractor shall immediately contact the RFETS project manager.

If it can be determined that sample integrity has not been compromised based on the above criteria, document findings in sample manager's field logbook and proceed with this standard operating procedure.

#### Chain of Custody Form

A one page COC form generated in accordance with ASD requirements is used by Environmental Restoration. The original copy shall be enclosed in a plastic bag and taped inside the lid of the cooler and shipped with the samples. A photocopy of the original will remain on file in the subcontractor's on-site facility and ultimately will be transmitted to the RFETS Records Department with the other QA records generated by the project. The contract laboratory will sign the COC upon receipt of samples and return a photocopy of the COC to RFETS for input into the electronic database. The COC copy shall then be matched and filed to complete the chain of custody procedure. Photocopies of the original COC form shall be made, prior to sample shipment, for internal use and, if necessary, to satisfy records requirements of outside organizations (e.g., Radiological Engineering, Radiological Records).

The COC shall be generated and maintained in accordance with PRO-543-ASD-002, Initiation, Preparation, and Implementation of Chain-of-Custody Forms, and PRO-908-ASD-004, On-Site Transfer and Off-Site Shipment of Samples. These procedures list specific items that are required on the COC; they typically include, but may not be limited to, the following:

- Report Identification Number (RIN)
- Event and bottle numbers
- Unique sample number and sample location
- Project charge number
- Project name
- Organization or company shipping the sample(s)
- Documentation in the "Possible Sample Hazards/Remarks" section stating whether preserved samples are classified as DOT hazardous material, and whether samples are otherwise DOT hazardous [*If any samples are DOT hazardous, this SOP does not apply.*]
- Documentation in the "Possible Sample Hazards/Remarks" section stating the SOP(s) and/or specific project plan (e.g., Sampling and Analysis Plan) that control the method of sample collection followed in collecting the sample(s)
- Date and time of sample collection
- Name of collector or field custodian
- Laboratory designation

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- Sample matrix
- Preservation
- Chain of custody number
- Signature and date blocks for personnel relinquishing or receiving sample custody
- Space for additional comments
- Name and phone number of emergency contact person
- Analysis requested with Analytical Projects Office line item code
- Required turn around time (priority code)
- Delivery information (overnight, 2-day, airbill #, etc.)

### 3.6 Field Data Documentation

All field descriptions, measurements, and observations shall be recorded on the appropriate field data forms (see specific sampling SOPs, task specific sampling analysis plans, and the Field Data Management SOP). The original data forms shall be collected, data entered into the database, then filed on-site by the designated subcontractor's data entry personnel and ultimately transferred to the RFETS Records Department. The field data will be entered into the Soil Water Database Field Cap log sheet form. Data may also be recorded in field logbooks if required. Field data shall be filled out at the time a sample is taken and will include, but not be limited to the following information:

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- Sampling activity name and number
- Sampling point name and number
- Sample number (RIN-Event recommended)
- Name(s) of Collector(s) and others present
- Date and time of sample collection
- Sample container tag/label number (if appropriate)
- Filtered/unfiltered (if applicable)
- Designation of QC samples (DUP, MS, MSD, Trip Blank, etc.)
- Field observations and measurements during sampling (if applicable)
- Analysis requested

For composite samples collected over time, the time and date of the FINAL aliquot shall be recorded as the sample date and time for the RFETS database. The sample log form or field log book shall include the time and dates for the start and end times of the composite period.

### 3.7 Packaging and Shipping

Sample bottles may be packaged in the field or in the subcontractor trailer. In all cases, samples shall be transferred and/or shipped in accordance with PRO-908-ASD-004, On-Site Transfer and Off-Site Shipment of Samples, and the STSM. These procedures take precedence over this SOP.

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This SOP is not intended to replace either of those procedures and, because of the many and various requirements placed on sample shipping, it is not appropriate for this SOP to attempt to summarize the requirements laid out in these procedures. The user is referred to PRO-908-ASD-004, On-Site Transfer and Off-Site Shipment of Samples, for shipping activities.

### 3.8 Quality Assurance / Quality Control Samples

Quality Assurance (QA) and Quality Control (QC) shall be administered according to the Quality Assurance Program Plan (QAPP), the project specific Quality Assurance Addendum (QAA), and the Kaiser-Hill Quality Assurance Program (QAP).

### 4.0 Records

Documentation of observations and data acquired in the field shall create a permanent record as well as provide information on the handling and preparation of the samples collected. Sampling personnel will be responsible for documenting the handling preparation, packaging, and shipping of the samples. These observations and data shall be recorded in ink on the subject specific data sheets (i.e. instrument calibration data sheet, field measurement data sheet and field log books).

Copies of the chain of custody records for the samples shipped during the data collection task shall be kept on file at the site office and the subcontractor's main office (if appropriate). If a RAM tag is required, it shall be kept with the sample(s) to which it corresponds. If it corresponds to a group of samples, some of which are destined for onsite labs and some for offsite labs, it shall be photocopied; the original shall accompany the sample(s) to the onsite lab(s) (if more than one lab, photocopies may be made for the other labs) and a copy shall be kept with the balance of the samples. After all samples have been transferred and/or shipped, the RAM tag and/or copies shall be disposed – it need not be kept with project files. RAM tags or copies of RAM tags shall not be included with offsite shipments, only with onsite transfers. See PRO-908-ASD-004, On-Site Transfer and Off-Site Shipment of Samples, for more information.

The following records generated during the performance of this procedure must be controlled as follows:

| <u>Document</u>              | <u>Record Type</u> | <u>Disposition</u>  |
|------------------------------|--------------------|---|
| Original and ASD COC forms   | QA                 | Becomes part of the ASD project file  |
| P/WRE                        | QA                 | Becomes part of the project file  |
| Sample log sheets or logbook | QA                 | Becomes part of the project file  |
| Survey sheets (if required)  | Non-QA             | Becomes part of the ASD project file  |
| RAM tag (if required)        | Non-QA             | Used for on-sited transfers; kept by on-site lab (if appropriate) or disposed (after sample is shipped) |

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5.0 References

Source References

*A Compendium of Superfund Field Operations Methods.* EPA/540/P-87/001. December 1987.

*American Society for Testing and Materials (ASTM), Soil and Rock; Dimension Stone; Geosynthetics, Section 4, Volume 04.08, 1993.*

*ASTM, Concrete and Aggregates, Section 4, Volume 04.02, 1993.*

DOE 1987: *The Environmental Survey Manual.* DOE/EH-0053, Volumes 1-4. August 1987.  
Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.  
Interim Final. October 1988.

*Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.*  
Interim Final. October 1988.

PRO-543-ASD-002, Revision 1, Initiations, Preparation, and Implementation of Chain-Of-Custody Forms

PRO-908-ASD-004, Revision 0, On-Site Transfer and Off-Site Shipment of Samples

*RCRA Facility Investigation Guidance.* Interim Final. May 1989.

Kaiser-Hill, 1999, *Quality Assurance Program (QAP).* PADC-1996-00051. August, 1999.

Site Transportation Safety Manual (STSM) MAN-T91-STSM-001

*Technical Enforcement Guidance Documentation (TEGD)* USEPS. 1986.

*Test Methods for Evaluating Solid Waste, Volume II: Field Manual Physical/Chemical Methods.*  
USEPA. SW-846. 3<sup>rd</sup> Edition. November 1986.

*User's Guide to the Contract Laboratory Program.* USEPA. December 1988.

TABLE A-1  
SAMPLE CONTAINERS, SAMPLE PRESERVATION, AND SAMPLE HOLDING TIMES  
WATER MATRIX

| Parameter                                  | Sample Volume/Container <sup>a</sup>                   | Preservative   | Holding Time   |
|--|--|--|--|
| <b><u>Volatile Organics (VOCs)</u></b>     |  |  |  |
| Contract Laboratory Program (CLP)          | 2 x 40-mL VOA vials with Teflon lined septum lids      | Cool, 4°C  | 10 days  |
| 40 CFR Part 136                            | 2 x 40-mL VOA vials with Teflon lined septum lids      | Cool, 4°C <sup>b</sup>                                   | 7 days   |
| 40 CFR Part 136                            | 2 x 40-mL VOA vials with Teflon lined septum lids      | Cool, 4°C<br>HCl pH <2 <sup>b</sup>                      | 14 days  |
| SW-846                                     | 2 or 3 x 40-mL VOA vials with Teflon lined septum lids | Cool, 4°C<br>HCl pH <2 <sup>b</sup>                      | 14 days  |
| Drinking Water (500 Series Methods)        | 3 x 40-mL VOA vials with Teflon lined septum lids      | Cool, 4°C<br>HCl pH <2 <sup>a</sup>                      | 14 days  |
| Extractable Organics (BNAs)                | 3 x 1L amber G   | Cool, 4°C <sup>b</sup>                                   | 7 days until extraction,<br>40 days after extraction |
| Pesticides and PCBs                        | 2 x 1L amber G   | Cool, 4°C <sup>b</sup>                                   | 7 days until extraction,<br>40 days after extraction |
| Organophosphorus Pesticides and Herbicides | 2 x 1L amber G   | Cool, 4°C  | 7 days until extraction,<br>40 days after extraction |
| Dioxins/Furans                             | 2 x 1-L amber G  | Cool, 4°C  | 7 days until extraction,<br>40 days after extraction |
| Metals                                     | 1 x 1-L P  | Nitric acid pH <2  | 6 mo <sup>c</sup>                                    |
| Cyanide                                    | 1 x 1-L P  | Sodium hydroxide <sup>d</sup><br>pH>12; Cool, 4°C        | 14 days  |
| Sulfide                                    | 1 x 500 ml P   | 2 ml-zinc acetate and sodium hydroxide to pH>9;Cool, 4°C | 7 days   |
| Acidity                                    | 200 ml/P, G  | Cool, 4° C   | 14 days  |
| Alkalinity                                 | 200 ml/P, G  | Cool, 4° C   | 14 days  |

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TABLE A-1 (continued)  
SAMPLE CONTAINERS, SAMPLE PRESERVATION, AND SAMPLE HOLDING TIMES

## WATER MATRIX

| Parameter   | Sample Volume/Container <sup>A*</sup> | Preservative                         | Holding Time                             |
|---|---------------------------------------|--------------------------------------|--|
| Bacteriological<br>(Coliform)                                 | 1 L/P, G<br>(Sterile)                 | Cool, 4° C <sup>b</sup>              | 6 hr                                     |
| Whole Effluent Toxicity<br>(Acute, Chronic)                   | 16 L/P                                | Cool, 4° C                           | 48 hr                                    |
| Biochemical Oxygen<br>Demand 5 Day (BOD5)                     | 2 L/P, G                              | Cool, 4° C                           | 48 hr                                    |
| Carbonaceous<br>Biochemical Oxygen<br>Demand 5 Day<br>(CBOD5) | 2L/P, G                               | Cool, 4° C                           | 48 hr                                    |
| Chemical Oxygen<br>Demand (COD)                               | 300 ml/P, G                           | Cool, 4° C, Sulfuric Acid<br>to pH<2 | 28 days                                  |
| Ammonia   | 400 ml/P, G                           | Cool, 4° C, Sulfuric Acid<br>to pH<2 | 28 days                                  |
| Chloride  | 200 ml/P, G                           | None                                 | 28 days                                  |
| Chlorine Residual   | In situ, beaker or bucket             | None                                 | Analyze immediately                      |
| Color   | 200 ml                                | Cool, 4° C                           | 48 hr                                    |
| Conductivity  | 300 ml/P, G                           | Cool, 4° C                           | 24 hr (determine on-site<br>if possible) |
| Chromium, Hexavalent  | 200 ml/P, G                           | Cool, 4° C                           | 24 hr                                    |
| Dissolved Oxygen (DO)<br>(Probe)                              | In situ, beaker or bucket             | None                                 | Determine on-site                        |
| Dissolved Oxygen (DO)<br>(Winkler)                            | 300 ml glass, BOD bottle              | Fix on site, store in dark           | 8 hr (determine on-site<br>if possible)  |
| Solids, Settleable  | 2 L/P, G                              | Cool, 4° C                           | 48 hr                                    |
| Solids (Total and<br>Suspended, etc.)                         | 200 ml/P, G                           | Cool, 4° C                           | 7 days                                   |
| Sulfates  | 500 ml/P, G                           | Cool, 4° C                           | 28 days                                  |
| Temperature   | In situ, beaker or bucket             | None                                 | Analyze immediately                      |

TABLE A-1 (continued)  
SAMPLE CONTAINERS, SAMPLE PRESERVATION, AND SAMPLE HOLDING TIMES

WATER MATRIX

| Parameter                          | Sample Volume/Container <sup>a,c</sup>  | Preservative                         | Holding Time                   |
|------------------------------------|---|--------------------------------------|--------------------------------|
| Turbidity                          | 200 ml/P, G                             | Cool, 4° C                           | 48 hr                          |
| Nitrate as N                       | 250 ml/P, G                             | Cool, 4° C                           | 48 hr                          |
| Nitrite as N                       | 250 ml/P, G                             | Cool, 4° C                           | 48 hr                          |
| Nitrate + Nitrite as N             | 250 ml/P, G                             | Cool, 4° C, Sulfuric Acid<br>to pH<2 | 28 days                        |
| Fluoride                           | 100 ml                                  | Cool, 4° C                           | 28 days                        |
| Hardness                           | 300 ml/P, G                             | Nitric Acid, pH<2                    | 28 days                        |
| Total Organic Carbon<br>(TOC)      | 50 ml/P, G                              | Cool, 4° C, Sulfuric Acid<br>to pH<2 | 28 days                        |
| Nutrients <sup>f</sup>             | 1-L/P, G                                | Sulfuric Acid pH<2 ,<br>Cool, 4° C   | 28 days                        |
| Oil and Grease                     | 1-L G with Teflon liner                 | Sulfuric Acid pH<2 ,<br>Cool, 4° C   | 28 days                        |
| Organic Halides - Total<br>(TOX)   | 1-L G with Teflon liner                 | Sulfuric Acid pH<2 ,<br>Cool, 4° C   | 28 days                        |
| pH                                 | In situ, beaker or bucket               | None                                 | Analyze immediately<br>(24 hr) |
| Phenols                            | 250 ml G with Teflon liner              | Sulfuric Acid pH<2 ,<br>Cool, 4° C   | 28 days                        |
| Phosphate-Ortho                    | 500 ml/P, G                             | Cool, 4° C                           | 48 hr                          |
| Phosphorous, Total or<br>Dissolved | 500 ml/P, G                             | Sulfuric Acid pH<2 ,<br>Cool, 4° C   | 28 days                        |
| Radiological Tests <sup>h</sup>    | 3 x 4 L plastic containers <sup>i</sup> | Nitric Acid, pH<2                    | 6 mo.                          |
| Tritium                            | 125 ml G                                | None                                 | None                           |

TABLE A-1 (continued)  
SAMPLE CONTAINERS, SAMPLE PRESERVATION, AND SAMPLE HOLDING TIMES

WATER MATRIX

| Parameter  | Sample Volume/Container <sup>a,c</sup> | Preservative | Holding Time   |
|--|--|--------------|--|
| <u>Toxicity Characteristic Leaching Procedure (TCLP)</u> | 4 L amber glass <sup>f</sup>           | Cool, 4° C   |  |
| TCLP Volatiles   |  |              | Extract within 14 days, analyze within 14 days                     |
| TCLP Semivolatiles<br>Pesticides, and<br>Herbicides      |  |              | Extract within 14 days, prep within 7 days, analyze within 40 days |
| TCLP Metals  |  |              | Extract within 180 days, analyze within 180 days <sup>g</sup>      |

- <sup>a</sup> When nonspecific container type is listed (e.g., 8-oz. wide-mouth glass jar), select a container appropriate to the volume and container requirement given. Samples for more than one parameter can be collected into a single container if container and preservation requirements are the same (e.g., sulfate and turbidity).
- <sup>b</sup> Add 0.008% sodium thiosulfate (Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>) in the presence of residual chlorine.
- <sup>c</sup> Holding time for mercury is 28 days.
- <sup>d</sup> Use ascorbic acid only if the sample contains residual chlorine greater than 0.2 mg/l. Test a drop of sample with potassium iodine-starch test paper; a blue color indicates need for treatment. Add ascorbic acid, a few crystals at a time, until a drop of sample produces no color on the indicator paper. Then add an additional 0.6 g of ascorbic acid for each L of sample volume.
- <sup>e</sup> P = Plastic (polyethylene); G = Glass; BOD = Biological Oxygen Demand; ASAP = As Soon As Possible; NS = Not Specified
- <sup>f</sup> Nutrients include nitrogen, phosphorus, chemical oxygen demand.
- <sup>g</sup> TCLP Mercury maximum holding time is 28 days for extraction and 28 days for analysis.
- <sup>h</sup> For Radiological Testing, the specific analyses will be defined as some or all of the following: Gross Alpha, Gross Beta, Uranium 233+234, 235 and 238, Americium 241, Plutonium 239+240, Tritium, Strontium 90, 89, Cesium 137, Radium 226, 228.
- <sup>i</sup> Full suite, see footnote *h* above.
- <sup>j</sup> If samples contain residual chlorine, and measurements of the concentrations of disinfection by-products (trihalomethanes, etc.) at the time of the sample collection are desired, add about 25 mg of ascorbic acid to the sample bottle before filling.
- <sup>k</sup> Volume required for any or all TCLP analyses.

NOTE: The specified volumes and containers are recommendations and any changes should be approved through ASD. Multiple analytes should be combined in bottles if volume and preservative are comparable and follow the appropriate analytical method. Check with the ASD to confirm combinations allowed and volumes required by the laboratory.

TABLE A-2  
SAMPLE CONTAINERS, SAMPLE PRESERVATION, AND SAMPLE HOLDING TIMES

## SOIL MATRIX

| Parameter   | Sample Volume/Container <sup>a</sup>                                     | Preservative | Holding Time   |
|---|--|--------------|--|
| Purgeable Organics (VOCs)                               | 120-mL capped core, 4 or 8 oz. Wide mouth glass jar Teflon-lined closure | Cool, 4°C    | 14 days  |
| Extractable Organics (BNAs), Pesticides and PCBs        | 1 x 8-oz. Wide-mouth glass jar, Teflon lined closure                     | Cool, 4°C    | 14 days until extraction, 40 days after extraction                 |
| Organophosphorus Pesticides and Herbicides              | 1 x 8-oz. Wide-mouth glass jar, Teflon lined closure                     | Cool, 4°C    | 14 days until extraction, 40 days after extraction                 |
| Dioxins/Furans  | 1 x 8-oz. Wide-mouth glass jar, Teflon lined closure                     | Cool, 4°C    | 14 days until extraction, 40 days after extraction                 |
| Metals  | 1 x 8-oz. Wide-mouth glass jar   | Cool, 4°C    | 6 mo <sup>e</sup>  |
| Cyanide   | 1 x 8-oz. Wide-mouth glass jar   | Cool, 4°C    | 14 days  |
| Sulfide   | 1 x 8-oz. Wide-mouth glass jar   | Cool, 4°C    | 7 days   |
| TCLP Volatiles  | 8-oz. Wide-mouth glass jar, Teflon lined closure                         | Cool, 4°C    | Extract within 14 days, analyze within 14 days                     |
| TCLP Semivolatiles Pesticides, Herbicides               | 8-oz. Wide-mouth glass jar, Teflon lined closure                         | Cool, 4°C    | Extract within 14 days, prep within 7 days, analyze within 40 days |
| Reactivity (CN <sup>-</sup> , H <sub>2</sub> S) pH, EOX | 8-oz. Wide-mouth glass jar, Teflon lined closure                         | Cool, 4°C    | 7-14 days  |
| TCLP Metals   | 8-oz. Wide-mouth glass jar, Teflon lined closure                         | Cool, 4°C    | Extract within 180 days, analyze within 180 days <sup>g</sup>      |
| Nutrients <sup>f</sup>                                  | 8-oz. Wide-mouth glass jar, Teflon lined closure                         | Cool, 4°C    | 28 days  |
| Radiological Tests <sup>h</sup> and Tritium             | 500 ml wide mouth glass <sup>i</sup>                                     | None         | None   |

TABLE A-2 (continued)  
SAMPLE CONTAINERS, SAMPLE PRESERVATION, AND SAMPLE HOLDING TIMES

SOIL MATRIX

- When nonspecific container type is listed (e.g., 8-oz. Wide-mouth glass jar), select a container appropriate to the volume and container requirement given. Samples for more than one parameter can be collected into a single container if container and preservation requirements are the same (e.g., sulfate and turbidity).
- Holding time for mercury is 28 days.
- Nutrients include nitrogen, phosphorus, chemical oxygen demand.
- TCLP Mercury maximum holding time is 28 days for extraction and 28 days for analysis.
- For Radiological Testing, the specific analyses will be defined as some or all of the following: Gross Alpha, Gross Beta, Uranium 233+234, 235 and 238, Americium 241, Plutonium 239+240, Tritium, Strontium 90, 89, Cesium 137, Radium 226, 228.
- Full suite, see footnote *h* above.

**NOTE:** The specified volumes and containers are recommendations and any changes should be approved through ASD. Multiple analytes should be combined in bottles if volume and preservative are comparable and follow the appropriate analytical method. Check with the ASD to confirm combinations allowed and volumes required by the laboratory.

TABLE A-3  
SAMPLE CONTAINERS, SAMPLE PRESERVATION, AND SAMPLE HOLDING TIMES FOR  
GEOTECHNICAL SAMPLES

SOIL/GEOSYNTHETIC MATRIX

| Parameter   | Sample Volume/Container  | Preservative | Holding Time |
|---|--|--------------|--------------|
| <b>Geotechnical Parameters:</b><br>Atterberg Limits <sup>j</sup> , Grain Size Distribution (Particle Size) <sup>l</sup> , Moisture <sup>m</sup> , Specific Gravity, Visual Classification                   | One-gallon Zip-Loc Baggie <sup>k</sup> (500 grams per test if listed once) | None         | 28 days      |
| Bulk Density (Proctor Test), Minimum (Maximum) Index Density  | 5-gallon Bucket <sup>n</sup>   | None         | 6 mo.        |
| <b>Compression:</b><br>Unconfined Compressive: One-dimensional Consolidated; Unconsolidated Undrained Compressive, Direct Shear <sup>p</sup> , Expansion Index  | 1-Shelby tube (3" diameter x 30" length) completely filled <sup>o</sup>    | None         | 6 mo.        |
| <b>Permeability:</b><br>Saturated Hydraulic Conductivity (Constant Head); Saturated Hydraulic Conductivity (Constant Flow, Rate); Capillary Moisture Relationships; Relative Hydraulic Conductivity for Air | 1-Shelby tube (3" diameter x 30" length) completely filled <sup>o</sup>    | None         | 6 mo.        |

<sup>j</sup> Atterberg Limits include Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

<sup>k</sup> The entire suite of analytical parameters can be performed on approximately 2-3 kilograms of material provided that the maximum grain diameter does not exceed 1-1/2 inches. Individually, the parameter test will require 500 grams of sample; therefore, use individual 500 gram samples if less than three of these parameters are requested for each sample.

<sup>l</sup> Grain Size Distribution includes Sieve Analysis of Fine and Course Aggregates and Particle Size Analysis.

<sup>m</sup> Moisture includes Laboratory Determination of Water (Moisture) Content of Soil and Rocks.

<sup>n</sup> Thirty pounds of material is required.

<sup>o</sup> Shelby tubes may be replaced with three California liners or three 2.5 inch U-type samples.

<sup>p</sup> Direct Shear includes Soils Under Consolidated Drained Conditions. For Geosynthetic material collect a 12 inch x 12 inch sample.

NOTE: The specified volumes and containers are recommendations and any changes should be approved through ASD. Multiple analytes should be combined in bottles if volume and preservative are comparable and follow the appropriate analytical method. Check with the ASD to confirm combinations allowed and volumes required by the laboratory.

**ROCKY FLATS  
ENVIRONMENTAL TECHNOLOGY SITE  
PRO-0105-WLM  
REVISION 0  
WATER LEVEL MEASUREMENTS IN WELLS AND  
PIEZOMETERS**

Responsible K-H Organization: Environmental Media Management Effective Date: 11/19/02

Approved By: MANAGER, WATER PROGRAMS 11/19/02  
*Title* *Date*

Stephen Singer *Stephen M. Singer*  
*Print Name* *Approval Signature*

Robert Nininger  
*Print Name of Responsible Manager (N/A if RM is Approval Authority)*

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## 1.0 PURPOSE

This document contains guidelines for measuring water levels in wells and piezometers at the Rocky Flats Environmental Technology Site (RFETS or Site). Water level data can be obtained from wells and piezometers, as well as surface water manifestations of the Upper Hydrostratigraphic Unit (UHSU) such as springs, ponds, and streams.

## 2.0 SCOPE

This document applies to all Water Programs personnel and subcontractors conducting groundwater-related work at the RFETS. This document, which constitutes a Standard Operating Procedure (SOP), describes various acceptable methods for measuring water levels in wells and piezometers that will meet regulatory guidelines for accuracy. This document supercedes groundwater SOP RMRS/OPS-PRO.105.

## 3.0 REQUIREMENTS

The following sections identify the personnel qualifications and equipment for measuring water levels in wells and piezometers.

### 3.1 Personnel Qualifications

Personnel performing water level measurement procedures are required to have completed the initial 40-hour OSHA classroom training that meets the Department of Labor requirements of 29 CFR 1910.120(e)(3)(i), and must maintain a current training status by completing the annual 8-hour OSHA refresher course. Personnel must also have read and signed the Health and Safety Plan for the Groundwater Monitoring Program (HASP). Prior to engaging in water level measurement activities, personnel must have a complete understanding of the procedures described in this SOP and, if necessary, will be given specific training regarding these procedures by other personnel experienced in the methods outlined herein.

Only qualified personnel will be allowed to perform these procedures. Required qualifications vary depending on the activity to be performed. The subcontractor Field Supervisor will document personnel qualifications related to this procedure in the subcontractor project QA files.

### 3.2 Equipment

The following is a list of typical equipment required when measuring water levels. Additional equipment that may be required during an atypical water level measurement application will be specified in a project-specific Work Plan, Sampling and Analysis Plan (SAP), or other appropriate document. The Groundwater Level Measurements/Calculations form (form PRO.0105A) shall be used to record data from manual water level measurement activities.

- Electronic water level sounder
- Manometer and appropriate polyethylene or polytetrafluoroethylene (Teflon) tubing
- Interface probe (if required)
- Graduated steel tape and appropriate chalk (if required)
- Decontamination equipment and supplies
- Health and safety equipment and supplies (organic vapor monitor [OVM] and personal protective equipment)

In most water level measuring activities at RFETS, an electronic water level sounder is preferred. However, some small-diameter well points exist which require the use of a manometer, and some wells may contain immiscible layers that will require an interface probe and/or graduated steel tape and chalk. Some wells may contain down-hole pressure transducers that require additional equipment such as a portable computer, diskettes, and instructions for downloading data. Groundwater Level Data from Down-Hole Pressure Transducer forms (form PRO.0105B) shall be utilized for wells with down-hole pressure transducers.

#### 4.0 INSTRUCTIONS

Field measurements typically include depth to water (from the top of the well casing) and the total depth of the well. Water level measurements will be recorded to the nearest 0.01 foot as specified by the RCRA Groundwater Monitoring Technical Enforcement Guidance Document.

Each well will have a permanent, easy to identify, measuring point (MP) on the top of the well casing from which the depth to water measurement will be made. For the purpose of this SOP, the MP is defined as a surveyed point on the northern side of the polyvinyl chloride (PVC) or stainless steel well casing. Certain wells may have a permanent mark; certain wells may have a notch etched into the top of the well casing. If a well casing is notched, the measurement should be made from the top of the well casing immediately adjacent to the notch. If the MP is not established at a specific well, the water level will be measured from the northern edge of the well casing, and the point marked by notching the well casing with a file. The addition of the permanent MP will be noted on form PRO.105A.

In addition, the following conditions must be met in order to obtain acceptable and accurate groundwater level measurements:

- Water levels in wells and piezometers will be allowed to stabilize for a minimum of 24 hours following well construction or well development before the water level is measured. Water levels require varying time periods to reach static conditions in new wells; therefore, the date and time of well construction, and the date, time, and reading of the initial water level measurement will be noted.
- Water levels should be measured before initiating any purging activities whether related to sampling or well development.
- At RFETS, sampling events may occasionally occur over an extended period of time. For wells that recharge slowly, the water level measured may not reflect static water conditions. In order to prevent a misinterpretation of the water level in these cases, the date of the last sampling or well purging event will be documented in the water level measurement database. The water level(s) measured on subsequent visits of the same sampling event should be compared to the original water level (at the first well visit for a specific sampling event) before the water level is considered for data entry.
- Static water levels will usually be measured with electronic sounders. If the well or piezometer is too small in diameter to utilize an electronic sounder, a manometer and appropriately sized Teflon tubing will be used. If non-aqueous phase liquid (NAPL) is potentially present, an interface probe will be used. In some cases, a graduated steel tape and chalk may be preferable to an interface probe.

- Water level measurements that show the water level to be within a well sump, if the well was constructed with one, will be considered technically dry for purposes of recording water level information.

#### 4.1 Surveying the Measuring Point

Each well must have a permanent, easily identified, notched MP on the north edge of the well casing. Preferably, the elevation of the MP should be established by a licensed surveyor and should be referenced to an established benchmark. However, depending upon the purpose and location of some wells, the coordinates of the wells and the elevations of their respective MPs may be established by use of Global Positioning System (GPS) technology. In this case the elevation will be established to the nearest foot. Regardless of the survey method or accuracy of the well casing elevation, the depth to water should be measured as accurately as possible to the nearest 0.01 foot. For consistency, water level measurements must be referenced to the same datum or elevation. The MP is surveyed with reference to the land surface datum (LSD), and all water levels and total depth measurements are converted to elevations with relation to mean sea level (MSL).

A reference point (RP) for water level measurements is an additional datum elevation established from a permanent benchmark and surveyed by a licensed surveyor. The RP is usually located on the top of the protective casing of a well and is used as a backup to the MP. If the MP is disturbed or destroyed, the RP will be used to establish a new MP.

#### 4.2 Using an Organic Vapor Monitor

Prior to measuring the water level in any well or piezometer, an OVM or accepted substitute (as defined by the HASP) will be used to measure the levels of organic vapors in ambient (background), well casing, and breathing zone air. Operation of the OVM shall be in accordance with the manufacturer's instructions and the HASP.

- The background air will be monitored in the vicinity of the well and working area before the well cap is removed. The effects of any potential sources of organic vapors, such as operating generators and vehicles, or the like, will be minimized as much as is practicable (e.g. the vehicle will be turned off or parked downwind of the location of the field activities). The presence of potential sources of organic vapors that are beyond the control of water level measurement personnel will be noted on form PRO.0105A as well as the level of organic vapors in ambient air.
- The well cap will be removed and the tip of the OVM placed within the opening of the well casing (well bore) to measure the level of organic vapors within the well casing. The result of this measurement will be recorded on form PRO.0105A.
- Finally, the level of organic vapors in the breathing zone will be measured and recorded on form PRO.0105A.

#### 4.3 Instruments and Associated Water Level Measurement Techniques

Water level measurement instruments are used to determine the water level in boreholes, wells, piezometers and some accessible subsurface structures such as building basements and waste storage vaults. Measurements may be made with a number of different devices and utilizing various procedures. Outside power sources are not generally required to operate most instruments, however, some instruments require that batteries be replaced or recharged periodically.

The following subsections describe the use of electronic water level sounders, use of manometers to measure water levels in small diameter well points, use of an interface probe in the determination of depth to and thickness of immiscible layers, and use of a graduated steel tape to measure water levels and total depths of wells.

Electronic water level sounders are the preferred water level measuring instruments at the Site. Typically, a steel tape will only be used for measuring the total depth of a well when light non-aqueous phase liquid (LNAPL) is present. Using a steel tape under these conditions will help ensure that the interface probe and other electronic water level measuring devices do not become grossly contaminated, which helps to prevent cross-contamination between monitoring wells.

#### 4.3.1 *Electric Water Level Sounder*

Typically, an electronic water level sounder marked in 0.01-foot increments will be used to measure groundwater levels and total depths of wells at the Site. Before lowering the electronic sounder probe into the well, the circuitry shall be checked by pressing the test button, if the unit is so equipped, or by dipping the probe in clean water. If the unit is working properly, the results of either test should be an audible tone. The probe will be lowered slowly into the well, minimizing contact with the well casing, until contact with the water surface is indicated. Two initial consecutive measurements that are within 0.01 foot shall be collected. If the initial two measurements do not agree within 0.01 foot, the water level shall continue to be measured until two consecutive measurements within 0.01 foot are obtained.

If difficulties or inconsistencies persist, another person shall repeat this process. Measurement shall continue until measurements obtained by the two individuals agree within 0.05 foot. An average of the two readings shall be used to determine the water level. The two readings that agree within 0.05 foot shall be recorded and averaged on form PRO.0105A. The difficulties or inconsistencies also will be recorded on form PRO.0105A, as they may indicate the presence of NAPL, damage to the water level sounder, or other problems with the well.

Electronic sounders are recommended for measuring the depth to water in wells that have dedicated downhole bladder pumps installed because sounders generally do not require removal of the pump from the well for each reading. However, if oil is present in the well, if water is cascading into the well, or if the water surface is turbulent, measuring the water level with an electronic sounder may be difficult. Oil not only insulates the contacts of the probe, but it will also give an erroneous reading if there is a considerable thickness of oil. If LNAPL is present, as noted previously and discussed subsequently in subsection 4.3.4, a steel tape shall be utilized for measuring the total depth of the well.

#### 4.3.2 *Measuring Water Levels in Well Points*

A manometer may be required to measure the water level in well points (polyethylene or Teflon tube wells) because they are often of too small a diameter to accept the electric sounder probe and tape. Before using a manometer, the unit shall be checked to ensure that it is in working order. The manometer should be able to read 0.1 inches of water. Manometers shall be used to measure water levels as follows:

- Attach an appropriate length of appropriately sized polyethylene or Teflon tubing to the manometer.
- Using the adjustment knob, zero the display reading.

- Insert the tubing into the well point tubing while watching the manometer. When a change in the manometer reading is observed, mark a point on the inserted tube.
- Withdraw the inserted tubing and measure its length (to the nearest 0.01-foot) from the down-hole end to the marked point. Be sure not to stretch the tubing during this measurement.
- Record the required information on form PRO.105A.

#### 4.3.3 *Immiscible Layers and Use of an Interface Probe*

There are locations at RFETS that have observable immiscible layers of volatile organic compounds (VOCs) in groundwater. These are currently limited to very small areas within the Industrial Area. Because the potential exists for the presence of immiscible layers of VOCs at these or similar locations, procedures have been established to detect the presence of these layers and to sample them when necessary.

The first step is to determine whether VOCs are present at a specific well location with the use of an OVM. If the response of the OVM indicates that VOCs are present, the next step is to determine if NAPL is present, and if so, to determine the thickness of the NAPL layer by use of an interface probe. In areas where the potential exists for NAPL, an interface probe will be used to measure water levels. If groundwater samples are to be collected, the interface probe will be used in each well prior to each sampling event.

- The manufacturer's instructions shall be followed when using the interface probe. The probe shall be sufficiently precise to measure the water level and the NAPL level and layer thickness to the nearest 0.01-foot.
- The accuracy of repeated measurements must agree within 0.05 foot, and shall be measured from the MP on the well casing.
- The probe will be lowered very slowly so as to minimize disturbance of any NAPL layer(s) that may be present, and to limit the depth of penetration of any LNAPL layer so as to contaminate the shortest length of probe and tape possible. When lowering the probe, care will be taken to minimize rubbing of the tape against the well casing.
- Typically, the interface probe will produce different sounds to distinguish between aqueous and non-aqueous layers. Depth to aqueous or non-aqueous phases will be recorded to the nearest 0.01 foot as measured from the MP on the well casing.

If LNAPL is not present, the interface probe may be used to determine the presence and thickness of dense non-aqueous phase liquid (DNAPL) layers and the total depth of the well.

- The interface probe will be slowly raised and lowered to pinpoint the depth that the appropriate indicator tone is obtained from. This will be done slowly and with care to minimize disruption of any DNAPL layers.

- Measurements from three consecutive readings shall be taken by two individuals, if necessary, and must not differ by more than 0.05 foot. If the difference is greater than 0.05 foot then three more readings must be taken.
- An average of the acceptable readings will be used to determine the water and DNAPL levels. The results of all measurements shall be recorded on form PRO.0105A.

Once the liquid level(s) have been determined and recorded, the probe will be carefully retrieved to ensure minimal rubbing of the tape against the well casing. The probe and tape shall be decontaminated between use at each well following procedures given in Section 4.5 and SOP PRO-1455-FDO, Field Decontamination Operations.

If LNAPL is present, the interface probe will not be used to check for DNAPL or to measure the total depth of the well. One reason is because of the difficulty in decontaminating the interface probe and tape after it has passed through a NAPL layer. Also, once the probe and tape is coated with NAPL, it may give inaccurate measurements and/or contaminate a deeper portion of the well casing until it is decontaminated. Instead, fluid from the bottom of the well will be collected to check for DNAPL, and a graduated steel tape and chalk shall be used to measure the total depth as described in Section 4.3.4. If no LNAPL is detected in a well, the interface probe can be used initially to detect for DNAPL.

Wells containing LNAPL shall be checked for the presence of DNAPL by very slowly lowering a purge pump or pump tubing to the bottom of the well and collecting the first purge liquid from the bottom of the well in a one liter colorless glass container. The container will be initially checked with an OVM to determine if there are any health and safety concerns associated with the pumped liquid. The liquid shall be allowed to stand for 15 minutes and visually observed for the presence of separate phases. If no phases have separated out of the solution after 15 minutes, and no readings above background are observed with the OVM, the well shall be presumed free of DNAPL. If there is a sufficiently thick layer of DNAPL present in the well, phase separation in the sample may not occur because no groundwater has been pumped from the well. If no phases have separated out of the solution after 15 minutes and moderate to high readings are being obtained by the OVM, additional liquid will be pumped approximately one foot higher in the well than the previous sample. This will continue until phase separation is noted or the determination is made that the concentration of VOCs in the groundwater is high but no DNAPL is present.

If requested by a project-specific Work Plan, a NAPL can be sampled as described in OPS-PRO.113, Groundwater Sampling. It is important to note that well construction can influence whether NAPL that exists at a given location can be observed. In the case of an LNAPL, if the interface between the LNAPL and groundwater is always above the top of the well screen, there will be no LNAPL in the well even though there is LNAPL at that location. Conversely, if a well does not fully penetrate an aquifer where a layer of DNAPL resides at the base, there may be no DNAPL in the well, unless the base of the screen intersects the groundwater/DNAPL interface.

#### 4.3.4 *Graduated Steel Tape*

The use of a graduated steel tape will normally be limited to determination of the total well depth of wells containing LNAPL. A slender, stainless steel weight shall be attached to the end of the tape to create tautness and to permit a feel for obstructions and the bottom of the well. The weight will be attached using wire, rivets, or any other method that does not have the potential for contributing contaminants to the well. The tape will be lowered to the bottom of the well, and the total depth will be read off the tape at the MP on the well casing.

Before and after each measurement, that part of the graduated steel tape that extends down the well will be decontaminated. Decontamination procedures are discussed in Section 4.5 of this SOP, Decontamination, and in PRO-1455-FDO, Field Decontamination Operations.

#### 4.4 Down-Hole Water Level Pressure Transducer

Water levels may be measured on a continuous basis through the use of a pressure transducer that is lowered below the static water level in a well. The pressure transducer is part of a probe that is attached to a network of cables and tubing. The transducer measures pressure changes that result from changes in the length of the column of water (head) above the probe. The cables and tubing may perform such functions as positioning the probe at the desired depth, relaying transducer data to a data logger, and venting the probe so that fluctuations in barometric pressure are not recorded as changes in the water level. Because water level is derived from pressure changes detected by the transducer, only vented water level pressure transducer probes are used at RFETS.

A data logger, which stores the information collected by the pressure transducer, may be a separate, stand-alone unit that can be placed on the ground next to the well. It may also be contained within the probe assembly, and feature a data transfer (downloading) cable that extends from the probe to the top of the well casing; or it may be stationed within the top of the well casing. Accumulated data are periodically downloaded from the data logger to a portable computer.

##### 4.4.1 *Preparation*

If the down-hole pressure transducer probe is to be installed in a well for long-term water level monitoring, it may be advantageous to assemble the components to fit the individual well to be studied. Custom fitting will typically be performed by the manufacturer, but at times may be performed by Water Programs or subcontractor personnel. In most cases this requires cutting the assorted cables and tubing to lengths that, when assembled, allow the probe to be suspended at a depth below the lowest anticipated water level or at the bottom of the well. Personnel performing these activities will be careful not to twist, kink, or otherwise damage cables and tubing.

A variety of diaphragms, with associated pressure ranges, are typically available for the pressure transducer. A diaphragm with a low-pressure rating allows the unit to be used in short water column (low head) applications, and higher-pressure ratings allow the unit to be used in long water column (high head) applications. Using the wrong diaphragm may result in poor resolution or faulty data.

The manufacturer's instructions shall be followed during all assembly and modification activities. If the unit is being modified by the manufacturer to fit a particular well, care will be taken to ensure that all well depth and depth to water information reported to the manufacturer are accurate.

Prior to installing a probe in a well, (1) the desiccant in the unit (if applicable) will be checked to ensure that it is fresh; (2) all communications between the probe, data logger, and downloading computer will be checked to ensure that they are functioning properly; (3) the data logger shall be programmed to collect and store the required data at the desired frequency; and (4) the unit's internal clock and calendar will be set.

The power source for the data logger and the amount of available memory on the logger will be checked to ensure they are adequate. The probe, cables and tubing, connectors and other down-hole components

will be decontaminated according to PRO-1455-FDO, Field Decontamination Operations or, if these instructions are not appropriate, the manufacturer's instructions. Connectors or other parts that would be damaged if they were to get wet shall be kept dry.

Immediately before the probe is installed, the water level in the well will be measured and recorded using an electronic water level sounder. The data logger will be set to the manually measured water level, if appropriate. The manufacturer's instructions will be followed to ensure all pre-installation tasks have been performed.

#### 4.4.2 *Installation*

Proper installation of the down-hole pressure transducer probe and data logger is crucial. A secure probe placement, together with proper connections to and programming of the data logger, are critical to ensuring that high quality water level data are collected and stored.

Because of stretching of the cables and tubing, the depth at which the probe will be positioned shall be determined to within 0.1 foot. Measuring to a smaller increment will accomplish little more than proving that the cables stretch. The probe shall be lowered slowly down the well and when it has been positioned and secured the data logger can be activated although this is not imperative until water level equilibration has occurred. The probe will not be allowed to "free fall" as this may damage the transducer, strain gauge, and/or the data logger and in the case of a shallow PVC well, may break out the bottom of the well. When the probe is positioned, a reading can be taken from the probe and recorded on the data logger, and if water level equilibration data are required, the data logger can be utilized.

The position of the probe will gradually stabilize as the cables straighten and stretch from its weight (unless it has been placed on the bottom of the well) and the water level will equilibrate to account for the volume of water displaced by the probe and cable. As with any other activity that disturbs the water level elevation, and as stated above in the introductory portion of Section 4.0, 24 hours will be allowed for water level equilibration before the data logger is turned on and the collection of real time data begins. If equilibration data are deemed important, the data logger can be utilized to record this information. The frequency at which measurements are made may need to be adjusted to adequately characterize the equilibration period, then reset to the frequency desired for the long-term measurements. The decision to collect stabilization data shall be made by the Project Manager.

If possible, the down-hole equipment should be installed in such a way that the water level may be measured using manual equipment (i.e., electric water level sounder) without disturbing the down-hole equipment. Generally, this will not be a problem where the column of water in the well is greater than 3-4 feet. Pulling up the well cap a few inches in order to get the sounder tape down the well should not influence the transducer reading as long as the transducer is still fully submerged in the water column and a reading is not collected at the precise moment that the data logger is lifted. Using the sounder to collect additional water level measurements may be helpful, and sometimes necessary, in order to convert and/or calibrate transducer data to meaningful water levels. If the manual measurement is being used to convert and/or calibrate transducer data, the transducer should be programmed to collect a measurement as close as is practicable to simultaneously with the manual measurement. That is the only way to accurately compare the two measurements. Also, if the transducer is greatly disturbed in order to get the manual measurement, the sounder measurement and the transducer measurement may not be measurements of the same water level. If the down-hole probe is raised partially or totally out of the water column, the manual (sounder) measurement probably will be of an unequilibrated water level.

#### 4.4.3 Operation

Unless requested by the Project Manager, measurement of the total depth of a well will not be made in wells equipped with a down-hole water level probe at the same frequency as it is in wells lacking this equipment. To do so will require removal of the unit (unless it is a 4-inch well), which is impractical and time consuming, and can result in damage to the equipment and loss of data.

The data logger has a finite amount of memory storage space. Data will not be allowed to be overwritten or otherwise lost (e.g., because of delay in downloading data or battery failure). Downloading the data logger will occur on a regular schedule that allows ample time for unforeseen problems (such as weather delays) without a loss of data. Unless the data logger is recording measurements every five minutes or less, it should not be necessary to halt data collection during downloading. The communication cable will be plugged into the computer and the data downloaded according to the manufacturer's instructions. After the data have been downloaded to the computer and it has been verified that the downloaded file contains data, the data on the data logger will be deleted and the unit returned to use. This activity will be performed efficiently and carefully so as to ensure that all new data were downloaded, and downloaded data recorded on the data logger were erased. It is extremely important to verify that the downloaded data file contains data before deleting the current data from the data logger.

The condition of the unit (battery life remaining, desiccant, etc.) will be checked each time that the unit is downloaded. If the manufacturer's instructions recommend more frequent checks, these recommendations shall be followed. If requested by Water Programs or the subcontractor Field Supervisor, the water level may be measured using other equipment such as an electric sounder (see Subsection 4.3.1) each time this unit is downloaded. If so, the down-hole probe will be minimally disturbed during this procedure as per the discussion above. Should a unit have to be removed from a well (for well or transducer maintenance), the withdrawn components will not be allowed to contact potentially contaminated media and will be sheltered from windblown dust and debris. If they do contact contaminated media or become dirty, they will be decontaminated according to PRO-1455-FDO, Field Decontamination Operations, and/or the manufacturer's instructions. Components will be restored to their proper place as quickly and carefully as practicable. A chronological log of these activities and their results will be maintained within the comments section of the Groundwater Level Data from Down-Hole Pressure Transducer form (Form PRO.105B).

If groundwater sampling is to be performed on a well equipped with a down-hole water level probe, provisions must be made in advance for storing the probe, cables, tubing, data logger, and associated components during these activities. Depending on the duration of the sampling activities (potentially multiple days), the size of the unit, and the quantity of cables and tubing, it may be desirable to store the submersible components in a clean, covered tub filled with deionized or distilled water. The remaining components can be stored in a clean plastic bag adjoining the tub. The manufacturer's instructions will be consulted first to ensure that the unit is compatible with the type of water to be used, as some pieces of equipment are sensitive to deionized water. Alternatively, the entire unit may be placed in a clean plastic bag. If the well takes more than one day to complete sampling, the probe and its associated down-hole components will be safely stored in a clean enclosure, such as one or more large, heavy-duty plastic bags until sampling has concluded, and will be decontaminated as described above before being reinstalled in the well.

Regardless of the method of temporary storage, the components will not be allowed to contact potentially contaminated media and will be sheltered from windblown dust and debris. Data collection from the probe will be halted if sampling will extend beyond the next scheduled water level measurement of the probe. Withdrawal of the unit from the well will proceed slowly and carefully, and in accordance with the.

manufacturer's instructions. All components of the down-hole probe assembly will be visually inspected as they are withdrawn. Any necessary cleaning or repairs (for example, removing accumulated sediments from the probe) will be performed following the manufacturer's instructions and/or PRO-1455-FDO, Field Decontamination Operations. The well will then be sampled as per SOP PRO.113, Groundwater Sampling. After sampling has concluded and the down-hole probe reinstalled, data collection will be reactivated. General maintenance will be performed as recommended by the manufacturer. Routine maintenance may include replacing the desiccant, cleaning the filter at the pressure transducer, clearing the ports at the pressure transducer, replacing the batteries, recalibrating the probe, and general cleaning and checking of components and connections. Depending on the unit, many of these tasks may only be performed by the manufacturer. If necessary, the unit will be removed from the well, decontaminated, and returned to the manufacturer for service.

Computer connectors will be handled carefully and used properly. Some probes have specially designed connector caps or storage that adequately addresses potential moisture problems. If this is not the case with the connector being used, it will be kept dry by storing it in a plastic bag within the wellhead. If condensation is a problem, a packet of desiccant may be kept in the bag, unless the manufacturer's instructions specify other alternatives.

#### 4.5 Decontamination

Methods used to prevent cross contamination include scheduling activities to proceed from locations with potentially lesser to those with potentially greater levels of contamination, and thorough decontamination of all materials contacted by potentially contaminated media. Water level measurement equipment shall be decontaminated between data collection locations for the purpose of minimizing cross contamination. Workers will wear the appropriate PPE based on historical knowledge of the well and current OVM readings.

Downhole pressure transducers and associated equipment should be constructed of stainless steel, Teflon, or other inert materials that have been approved by Water Programs. Equipment shall be decontaminated before and after use at each well. If freshly decontaminated equipment is kept clean during transport to the next well by being stored in a clean plastic bag, clean plastic wrap, or clean equipment storage case, the need for decontamination prior to using the equipment at the next well is eliminated. Procedures for decontamination are set forth in the HASP and PRO-1455-FDO, Field Decontamination Operations.

#### 5.0 **QUALITY ASSURANCE / QUALITY CONTROL**

The frequency of measurements and the accuracy desired in measuring changes in water level depends on the objectives established in the project specific Work Plan or SAP or the instructions of the Project Manager. All appropriate data will be recorded on a Groundwater Level Measurements/Calculations form (form PRO.105A) or Groundwater Level Data from Down-Hole Pressure Transducer form (form PRO.105B) before leaving the well site.

Electronic water level sounders will be calibrated quarterly by following the manufacturer's instructions or by suspending the sounder and measuring it against a calibrated steel tape if no other calibration instructions are supplied. Down-hole water level probes will be calibrated by the methods and frequency recommended by the manufacturer and the results documented on a log sheet kept on file in the groundwater monitoring field office.

## 6.0 RECORDS

A permanent record of the implementation of this SOP will be kept by documenting field observations and data in black or blue waterproof ink on a Groundwater Level Measurements/Calculations form (form PRO.0105A). If the well is equipped with a down-hole pressure transducer, the appropriate observations and data will be recorded on a Groundwater Level Data from Down-Hole Pressure Transducer form (form PRO.0105B). However, if the water level in a well equipped with a down-hole pressure transducer is being measured in preparation for sampling or development, water level and total depth information will be recorded as instructed in the appropriate SOP (RMRS/OPS-PRO.113 for sampling, RMRS/OPS-PRO.106 for well development). In this instance, separate completion of form PRO.0105A is not required.

When measuring with tools other than a down-hole pressure transducer, the following information should be recorded for each well location:

- The RFETS project name and well number
- The date and time of the water level measurements
- The names of personnel performing the measurements
- The equipment manufacturer, model, serial number, and calibration date
- Results of OVM monitoring
- Depth to water and total depth of well, both relative to the MP
- The perceived condition of the bottom of the well (soft vs. hard)
- Any unusual conditions that may relate to these data, as appropriate
- The name of the QC reviewer and the date of the QC review

Individual measurements shall be obtained as instructed elsewhere in this SOP and shall then be entered onto the Groundwater Level Measurements/Calculations form (form PRO.0105A) as the measurements are performed. The information is recorded as follows:

1. Record well number in the first column.
2. Measure and record in the second column (WD) the depth to water from the MP.
3. Measure and record in column three (MTD) the total depth of the well from the MP.
4. In some devices the length of the probe end may not have been taken into consideration when the measuring tape was marked. In this case, the length of the probe end will need to be added to the measured total depth in order to determine the total depth of the well from the MP. Record the length of the probe end in column four (Probe end).
5. Determine the total depth of the well from the MP by adding the length of the probe end to the measured total depth from the MP and record this value in column four (TD). Total depths of wells may be measured monthly, quarterly, or as instructed by the Water Programs Project Manager.

6. In the blank marked "Chk'd by", record the initials of the individual who checks the calculation performed in Step 5.
7. In the "Comments" section, note any significant features or activities near the well that could affect the water level, OVM readings, or any other data recorded on form PRO.0105A.

In wells equipped with down-hole pressure transducers, form PRO.0105B shall be used. The following information shall be recorded for each well location:

- The RFETS project name and well number
- The names of personnel downloading the data and performing associated activities
- The equipment manufacturer, model, and serial number
- Results of OVM monitoring
- The date and time of the first and last water level measurements recorded on the data logger
- The number of records downloaded and the frequency of measurement
- The depth of the probe
- Water level and probe datum, if other than the MP
- Battery condition
- The identity of the diskette(s) on which downloaded data were stored
- Whether the water level was checked using other means, and if so, the results of this measurement
- Comments regarding any unusual conditions that may relate to these data, as appropriate
- The name of the QC reviewer and the date of the QC review

Water level data downloaded from wells equipped with down-hole pressure transducers and data loggers will be archived electronically in their original form without conversion or other data manipulation. If conversion is necessary to render the data useable, converted data shall be archived separately and an explanation of the conversions shall be included. Data diskettes (original and converted forms) will be transmitted to the Water Programs Project Manager on the same schedule as data from wells without down-hole probes unless the Project Manager requests otherwise. The subcontractor will also store copies of the data diskettes. Hard copies of the data shall not be provided unless the Water Programs Project Manager requests them.

## 7.0 REFERENCES

### 7.1 Source References

The following references were reviewed before this procedure was written:

Freeze, R. Allen, and John A. Cherry, 1977, *Groundwater*, Prentice-Hall, Inc., Englewood Cliffs, NJ

U.S. Department of Energy (DOE), August 1987, *The Environmental Survey Manual*, Volumes 1-4, DOE/EH-0053.

U.S. Department of Interior, Water Resources Division, 1977, *National Handbook of Recommended Methods for Water-data Acquisition*.

U.S. Environmental Protection Agency (EPA), September 1986, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1.

U.S. Environmental Protection Agency, December 1987, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.

U.S. Environmental Protection Agency (EPA), October 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final*.

U.S. Environmental Protection Agency (EPA), May 1989, *RCRA Facility Investigation Guidance, Interim Final*.

## 7.2 Internal References

Related SOPs cross-referenced by this SOP are as follows:

- SOP RMRS/OPS-PRO.106, Well Development
- SOP RMRS/OPS-PRO.113, Groundwater Sampling
- SOP PRO-1455-FDO, Field Decontamination Operations

WATER LEVEL MEASUREMENTS IN WELLS  
 AND PIEZOMETERS

PRO.0105-WLM, Rev. 0

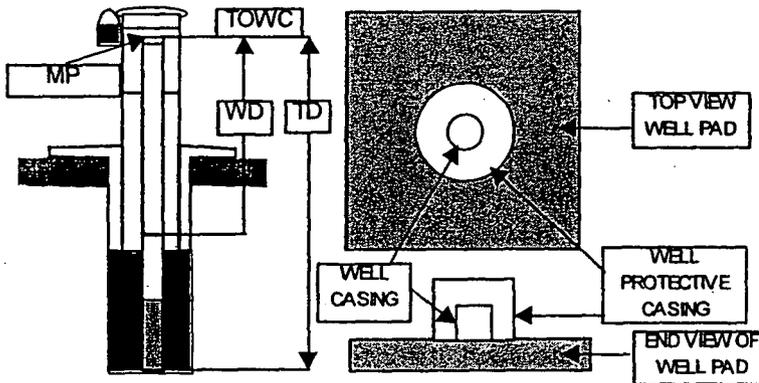
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Form PRO.0105A  
 GROUND WATER LEVELS  
 MEASUREMENTS / CALCULATIONS

|                      |                  |                         |  |
|----------------------|------------------|-------------------------|--|
| ROCKY FLATS PROJECT: |                  | EQUIPMENT MANUFACTURER: |  |
| PROJECT NO.:         |                  | MODEL:                  |  |
| DATE:                |                  | SERIAL NO.:             |  |
| PERSONNEL: (1)       | CALIBRATION DATE | DATE DUE                |  |
| (2)                  | QC REVIEW: NAME  | DATE                    |  |

- Quarterly
- Monthly
- Special

| WELL NO.      | WD         | MTD         | Background | Well Bore | Breathing Zone | Comments: | MINIRAE* |
|---------------|------------|-------------|------------|-----------|----------------|-----------|----------|
| MEASUREMENT 1 |            |             |            |           |                |           |          |
| MEASUREMENT 2 |            |             |            |           |                |           |          |
| TIME:         |            |             |            |           |                |           |          |
|               | AVERAGE WD | AVERAGE MTD | PROBE END  | TD        | CHK'D BY       |           |          |



COMMENTS:

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SIGNATURE:

DATE:

FOOTNOTES:

- TOWC=TOP OF WELL CASING
- WD = DEPTH OF WATER FROM MP
- MTD = MEASURED TOTAL DEPTH FROM MP
- PROBE END = LENGTH BEYOND MEASURING POINT OF PROBE
- TD = DEPTH OF BOTTOM OF WELL FROM MP

NOTES:

- ALL MEASUREMENTS ARE MADE IN FEET RELATIVE TO MEASURING POINT (MP) = N. SIDE OF TOWC.
- QC REVIEW IS A CHECK OF REASONABLENESS
- MEASUREMENTS 1 AND 2 MUST BE WITHIN 0.05 FT.

OH





Rocky Mountain  
Remediation Services, L.L.C.  
... protecting the environment

# PROCEDURE

## MEASUREMENT OF GROUNDWATER FIELD PARAMETERS

Procedure No. RMRS/OPS-PRO.108

Revision 0

Date effective: 12/21/98

APPROVED: *[Signature]*  
Manager, Water Operations/Waste Operations Division

12-15-98  
Date

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### USE CATEGORY 2

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and information only copy)

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## 1.0 PURPOSE

This document contains guidelines for measuring certain chemical and physical parameters during the collection of groundwater samples and the development and redevelopment of groundwater monitoring wells at the Rocky Flats Environmental Technology Site (RFETS). Data collected in the field are referred to as field parameters. These data supplement the corresponding laboratory results for groundwater samples or, in the case of well development and redevelopment, provide an indication of the effectiveness of development procedures.

## 2.0 SCOPE

This document, which supercedes Procedure No. GW.05, constitutes a Standard Operating Procedure (SOP) that applies to all Rocky Mountain Remediation Services (RMRS) personnel and subcontractors conducting groundwater-related work at the RFETS. This SOP describes the procedures that will be used for the measurement of specific field parameters. The parameters currently required are pH, specific conductivity, temperature, turbidity, and alkalinity.

Measurements of field parameters in groundwater have consistently been conducted using instruments manufactured by the Hach Company. These procedures, although generally applicable to the use of these instruments, can be applied to other instruments.

Occasionally modifications may be made requiring the measurement of additional field parameters. If these requirements are sitewide, measurement of the additional field parameters will be described in an addendum to this SOP. If the added parameters are for a specific project, or on an otherwise limited scale, they will be described in project-specific work plans rather than as additions to this SOP.

## 3.0 REQUIREMENTS

The following sections identify the personnel qualifications and equipment for measuring groundwater field parameters.

### 3.1 Personnel Qualifications

Personnel performing these procedures are required to have completed the initial 40-hour OSHA classroom training that meets Department of Labor Regulation 29 CFR 1910.120(e)(3)(i), and must maintain a current training status by completing the appropriate 8-hour OSHA refresher courses. Personnel must also have read and signed the appropriate Health and Safety Plan(s).

Prior to engaging in groundwater sampling and measurement of field parameters, personnel are required to have a complete understanding of the procedures described within this and other related SOPs and receive specific training regarding these procedures if necessary.

### 3.2 Equipment

The following is a list of basic equipment typically required when measuring field parameters. Additional equipment may be required in less typical applications, and will be specified in the project-specific work plan or other appropriate document.

- Well sampling equipment (see SOP PRO.113)

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- pH probe, meter, and standard buffer solutions
- Specific conductivity probe, meter, and standard solution
- Turbidity meter (turbidimeter)
- Alkalinity solution and pH table
- Reagent and graduated cylinder or bottle for the measurement of the solution
- Several clean beakers (typically 100 ml to 250 ml in volume)
- Decontamination equipment and supplies
- Health and safety equipment and supplies

For wells with dedicated pumps the following additional equipment is required to pump and sample the well:

- Portable air compressor
- Pump control unit
- Solomat Sonde and Data Logger, or equivalent continuous sampler instruments (can be optional since parameters can be taken on recovered water with the equipment listed above)
- One to two liter graduated cylinder

Some of the meters listed above (pH and specific conductivity) may be multipurpose units that can also be used for temperature measurements. In addition, alternatives to listed meters may be used, such as a spectrophotometer for the measurement of turbidity rather than a turbidimeter. Substitutions such as these are acceptable so long as the substituted equipment is designed to perform the required measurement (as documented in the equipment's instruction manual and manufacturers specifications), and can meet the required detection limits.

#### 4.0 INSTRUCTIONS

Field parameters are routinely measured when groundwater monitoring wells (and, on occasion, piezometers and well points) are purged, sampled, developed, or redeveloped. Procedures for performing these tasks are presented in SOPs PRO.113, Groundwater Sampling, and PRO.106, Well Development.

Several of the parameters that must be measured are physically or chemically unstable and must be tested either in the borehole using a probe (*in situ*) or immediately after collection using a field test kit or instrument (EPA 1986). Unstable parameters include pH, temperature, and alkalinity. Although the specific conductivity of a substance is relatively stable, it is recommended that this characteristic also be measured in the field. Most instruments measuring pH and conductivity require temperature compensation; therefore, the temperature of the samples should be measured at the time pH and conductivity is measured.

The standardization/calibration of *in situ* monitoring equipment, portable and laboratory meters and probes, and field test kits will be completed according to the manufacturer's specifications, and at the minimum frequency specified in Table 108-1 of this SOP, unless the appropriate work plans or the manufactures instructions state otherwise. Instruments meeting the acceptance criteria specified in Table 108-1, or more stringent criteria specified in the work plans, are acceptable for use in the field. Instruments not meeting the specified criteria must be calibrated prior to each use so that the acceptance criteria are met. Any change in these frequencies or criteria to lower frequencies or less stringent criteria must be approved by the RMRS project manager prior to being implemented.

Instruments and instrument components will be maintained and cleaned in accordance with the manufacturers' recommendations, and will be inspected during field activities and routine calibration and standardization

procedures. Damaged instruments or components will be removed from service and professionally repaired or replaced.

Solutions used for standardizing, calibrating, or titrating will be checked prior to use in the field to determine if the expiration dates have been exceeded. Any expired solutions will be replaced with new solutions.

TABLE 108-1. Calibration/standardization frequencies and minimum acceptance criteria for field parameter measurements.\*

| <u>Parameter</u>      | <u>Frequency</u>            | <u>Minimum Procedure</u> | <u>Acceptance Criteria</u>         |
|-----------------------|-----------------------------|--------------------------|------------------------------------|
| Temperature           | Weekly                      | Standardize              | $\pm 1.0^{\circ}\text{C}^{**}$     |
| pH                    | Daily                       | Calibrate                | Standard Value $\pm 0.2$ pH units  |
| Specific Conductivity | Daily                       | Calibrate                | Standard Value $\pm 10\%$          |
| Turbidity             | Each well                   | Zero Instrument          | 0 FTUs / Standard Value $\pm 10\%$ |
| Total Alkalinity      | For each new lot of titrant | Standardize              | Standard Value $\pm 10\%$          |

\* Standards from equipment manufactures recommendations and RFETS requirements.

\*\* Temperature difference between measured value and that reported by a NIST-calibrated thermometer or thermometer calibrated against a NIST-traceable thermometer.

Samples for field parameter measurements will be collected according to SOP PRO.113, Groundwater Sampling. Chemical-resistant gloves will be worn when measuring field parameters, and will be changed between locations. All measurements will be recorded on the appropriate forms, which are contained in SOP PRO.113, Groundwater Sampling, or (for developing/redeveloping activities) SOP PRO.106, Well Development.

#### 4.1 Temperature

Temperature measurements can be made with a high quality mercury-filled thermometer or thermistor having an analog or digital readout that has been standardized weekly by comparison with a thermometer calibrated against a National Institute of Standards and Technology (NIST)-calibrated thermometer. All temperature-measuring devices will be scaled to indicate degrees Celsius ( $^{\circ}\text{C}$ ) in increments of  $1^{\circ}\text{C}$  or less as appropriate to meet data quality objectives. Mercury thermometers will be of the Teflon<sup>®</sup>-coated safety type. Thermometers will be transported in protective cases to prevent breakage.

The Hach pH meters currently in use at RFETS are routinely used for temperature measurements (displayed digitally) taken concurrently with the pH of water samples immediately after sample recovery. The probe is standardized weekly against a NIST calibrated thermometer as specified in Table 108-1.

Standardization will be verified weekly and will consist of comparing the temperature measured with the field instrument against the temperature measured by a NIST-traceable thermometer, preferably within the temperature range that is typical of that of groundwater. If the results of this verification vary by more than  $1.0^{\circ}\text{C}$ , the field

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thermometer or thermistor will be removed from service. Thermometers and thermistors that cannot be calibrated within the variance criteria will be replaced.

4.1.1 *Temperature Measurement using a Thermometer*

The following procedure will be used when collecting temperature measurements using a thermometer

- A mercury filled standardized thermometer will be used.
- Standardize the field thermometer at least weekly to the criteria specified in Table 108-1. If the acceptance criteria specified are not met, replace the thermometer so that the criteria are met.
- The thermometer will be inspected before each field trip to ensure that there are neither cracks in the glass nor air spaces or bubbles in the mercury.
- A portion of the ground water will be transferred to a beaker previously rinsed with distilled water and acclimated with groundwater. The thermometer will be inserted into the sample collection container, and the sample will be swirled. The temperature reading will be taken when the mercury column stabilizes.
- The temperature will be recorded on the field logsheet to the nearest  $\pm 0.1^{\circ}\text{C}$ .
- The thermometer will be decontaminated in accordance with SOP FO.3, General Equipment Decontamination, blotted dry, and stored in a protective case.
- Liquids and materials from decontamination operations will be handled in accordance with SOP PRO.112, Handling of Decontamination Water and Wash Water.

4.1.2 *Temperature Measurement using a pH or Other Meter*

The following procedures will be followed when performing temperature measurements using a Hach One pH meter (model 43800-00) or equivalent type meter:

- Standardize the probe at least weekly to the criteria specified in Table 108-1. If the acceptance criteria specified are not met, replace the probe and/or meter, as necessary, so that the criteria are met.
- A portion of the ground water will be transferred to a beaker previously rinsed with distilled water and acclimated with groundwater. The probe will be inserted into the sample collection container, and the sample will be swirled. The temperature reading will be taken when the digital readout stabilizes.
- The temperature will be recorded on the field logsheet to the nearest  $\pm 0.1^{\circ}\text{C}$ .
- Upon completing all pH measurements at a location, the probe will be rinsed thoroughly with distilled or deionized water, blotted dry, and stored in accordance with the manufactures recommendations.
- Liquids and materials from decontamination operations will be handled in accordance with SOP PRO.112, Handling of Decontamination Water and Wash Water.

4.2 pH

This procedure describes the method that will be used to measure pH in the field using a Hach One pH meter (model 43800-00) or equivalent type hand-held, portable pH meter. In all cases, the manufacturer's instructions will be followed for calibration and use. All pH meters used for field measurements will be temperature compensating.

The following procedures will be followed when performing pH measurements:

- Meters will be calibrated daily prior to the start of field activities following the manufacturer's instructions. The appropriate calibration mode will be used with buffers of pH 7 and pH 10.
- Before each field activity, the meter will be checked for damage to the probe and for weak batteries in accordance with manufacturer's recommendations.
- Calibration will be verified immediately before beginning measurement activities at each location. Verification will consist of recording the instrument reading of a pH 7 standard solution.
- The probe will be rinsed with distilled or deionized water and blotted dry.
- A clean sample beaker will be rinsed with a small volume of sample groundwater to acclimate the beaker to the groundwater.
- An appropriate volume of groundwater (100 ml or so) will be poured into the acclimated beaker. The probe tip will be immersed in this water, swirled gently, and the pH measured following the manufacturer's instructions. Care will be taken to minimize surface disturbance of the sample while stirring.
- The pH will be read and recorded to the nearest  $\pm 0.01$  pH unit. The temperature will also be recorded.
- If the first measurement of groundwater produces a reading closer to a different standard solution rather than the pH 7 used to field calibrate the instrument, then the field personnel may want to consider repeating the calibration verification using a different standard solution (pH 4 or 10 instead of pH 7).
- If a number of pH measurements are to occur at the same location over a short period of time, the probe tip may be placed in a second clean beaker containing distilled, deionized, or groundwater from the location (between sampling events) for the duration of the sampling period.
- Upon completing all pH measurements at a location, the probe will be rinsed thoroughly with distilled or deionized water, blotted dry, and stored in accordance with the manufacturer's recommendations.
- Sampling tools, instruments, and equipment will be protected from extraneous sources of contamination and will be decontaminated after use as specified in SOPOPS-PRO.127, General Equipment Decontamination, or according to the manufacturer's instructions.
- Calibration will be verified at the end of each workday. Verification will consist of recording the instrument reading of a pH 7 standard solution. If the instrument reading varies from the standard by more than  $\pm 0.2$  pH units, the instrument will be checked for a malfunction. If the variance continues for

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two consecutive days, the frequency of calibration of that instrument will be increased. Calibration will then be performed prior to use at each site. If the instrument cannot be calibrated to the minimum acceptance criteria it will be taken out of service for repair or replacement.

#### 4.3 Specific Conductivity

Conductivity, also referred to as conductance, is the reciprocal of resistance and is therefore often reported in units of reciprocal ohms, or "mhos." The international system of units, the siemen (S), will be used to report conductivity for RFETS groundwater programs. Because most groundwater has a specific conductivity much less than 1 siemen, data will be reported in either microsiemens ( $\mu\text{S}/\text{cm}$ ) or millisiemens ( $\text{mS}/\text{cm}$ ).

If the pH probe being used employs electrolyte-dispensing technology, the conductivity measurement will be made prior to pH measurement or on a different volume of sample water.

This procedure describes the method to be used to measure specific conductivity in the field using a Hach Conductivity/TDS Meter (model 44600) or equivalent type conductivity meter. In all cases, the manufacturer's instructions will be followed for calibration and use of the conductivity meter. Conductivity meters used for field measurements will be temperature compensating. This will allow for the recording of specific conductivity measurements directly from the meter. Meters will also have adjustable readings that will allow for accurate calibration to a known standard.

- The meter will be calibrated at the start of each day prior to any field activities. Calibration will be performed according to manufacturer's instructions and the guidance given in Table 108-1. All instrument ranges will be calibrated with a single standard solution. A sodium chloride standard solution having a conductivity of  $1000 \mu\text{S}/\text{cm}$  is generally appropriate.
- Before each field activity, the meter will be checked for damage to the probe and for weak batteries in accordance with manufacturer's recommendations.

The following procedures will be followed when performing field conductivity measurements:

- Calibration will be verified immediately before beginning measurement activities at each location. Verification will consist of recording the instrument reading of a  $1000 \mu\text{S}/\text{cm}$  standard solution.
- The probe will be thoroughly rinsed with distilled or deionized water and blotted dry.
- A clean sample beaker will be rinsed with a small volume of sample groundwater to acclimate the beaker to the groundwater.
- The beaker will be filled with a volume of groundwater sufficient to immerse the probe 1 inch below the surface of the sample. The probe will be gently agitated vertically and swirled to dislodge any trapped air bubbles and the reading will be allowed to stabilize.
- The temperature (from pH meter) and temperature-compensated conductivity reading will be recorded on the field form.

- If a number of conductivity measurements are to occur at the same location over a short period of time, the probe tip may be placed in a second clean beaker containing distilled, deionized, or groundwater from the location (between sampling events) for the duration of the sampling period.
- The probe will be rinsed thoroughly with distilled or deionized water, blotted dry, and stored in accordance with the manufacturer's recommendations.
- Sampling tools, instruments, and equipment will be protected from extraneous sources of contamination and will be decontaminated after use as specified in SOP PRO.127, General Equipment Decontamination and/or the manufacturer's instructions.
- Calibration will be verified at the end of each workday. Verification will consist of recording the instrument reading of a standard solution of the same conductivity as that used to calibrate the meter prior to beginning the day's activities. If the instrument reading varies by more than 10 percent of the standard, the instrument will be checked for malfunction. If the variance continues for two consecutive days, the calibration frequency for that instrument will be increased. Calibration will then be performed prior to each sampling event. If the instrument cannot be calibrated to the minimum acceptance criteria it will be taken out of service for repair or replacement.

#### 4.4 Turbidity

Turbidity may be measured with a turbidity meter (turbidimeter) or by other equipment or methods designed to measure this property. This procedure describes the measurement of turbidity using the Hach DR20000 spectrophotometer absorption method that is currently being used for most wells at RFETS. The turbidity test measures an optical property of a water sample that results from the scattering and absorbing of light by particulate matter that may be present within the sample. The amount of turbidity registered is dependent on such variables as the size, shape, and refractive properties of the particles.

The sample is contained within a clear sample cell that is inserted into a light-shielded enclosure within the meter. Because this method of determining turbidity is based upon light transmitted through the sample, it is important that sample cells be kept clean and undamaged. Sample cells, which are used in matched pairs, must be replaced if one is scratched, cracked, or permanently discolored.

Regardless of the instrument being used, it will be calibrated according to the methods and frequency suggested in the manufacturer's instructions. The DR2000 may be calibrated using formazin standards, and the readings are in terms of formazin turbidity units (FTU).

The following procedures will be followed when performing turbidity measurements using the Hach DR2000 spectrophotometer:

- Sample cells will be inspected prior to each use. Defective cells will not be used.
- Enter the stored program number for turbidity; press "750 Read/Enter." The display will show "Dial nm to 450."
- Rotate the wave length dial until the small display shows "450 nm."
- Press "Read/Enter." The display will show "FTU Turbidity."

- Place a prepared blank (a clean, permanently sealed glass sample cell filled with 25 ml of deionized water) into the cell holder and close the light shield.
- Press "zero" and the display will show "wait" and then "0. FTU Turbidity".
- Fill a beaker with an appropriate volume of sample water and swirl the water gently to keep any particulate matter suspended. Transfer a sample to a clean sample cell, place into the cell holder, and close the light shield.
- Press "Read/Enter" and the display will show "wait" and the result in FTUs will then be displayed.
- After all turbidity measurements have been completed, the sample cell will be decontaminated, blotted dry, and stored in accordance with the manufacturer's recommendations.

The stored program has been calibrated using a standard polymer solution called formazin. Standard formazin solutions for checking the spectrophotometer accuracy can be prepared following the manufacture's instructions.

#### 4.5 Total Alkalinity

Total alkalinity, which may be defined as the ability of a water to neutralize acid, is expressed as ppm  $\text{CaCO}_3$ . This section describes the procedure that will be followed in order to measure total alkalinity in the field using an ORION Total Alkalinity Test Kit and Hach One pH meter. The ORION test kit includes a reagent composed of several acids and a conversion wheel. After the pH of a solution is recorded, the reagent is added to a fresh aliquot of solution, and the pH is recorded again. Using the conversion wheel, the new pH is converted to total alkalinity as ppm  $\text{CaCO}_3$ .

Total alkalinity will be measured once, upon the completion of purging activities. The procedure for determining total alkalinity is as follows:

- The pH meter will be calibrated as described in Subsection 4.2. Once each week, verification of proper alkalinity measurement will be performed using a standard of known alkalinity and following the manufacturer's instructions. If the verification measurement varies by more than 10 percent, the total alkalinity reagent will be replaced.
- After determining the pH of the sample of interest, collect a fresh 100 mL of sample in a clean beaker.
- Add 10 mL of Total Alkalinity Reagent to the sample and stir well using the pH probe.
- Measure and record the resulting pH of the sample as described in Subsection 4.2.
- Using the gray side of the Total Alkalinity Conversion Wheel, find the resulting pH value. Record the corresponding total alkalinity of the sample.
- If the alkalinity is off scale, the pH will be recorded and the alkalinity measurement will be repeated using a fresh sample. This time, 10 ml of sample and 10 ml of reagent will be added to 90 ml of distilled or deionized water. This mixture will be stirred and the pH measured as above. The conversion wheel will be consulted to determine the alkalinity of the mixture. This value will be recorded, then multiplied by ten to determine the total alkalinity, which will also be recorded.

- Upon completion of all alkalinity measurements, the probe will be thoroughly rinsed with distilled or deionized water blotted dry, and stored in accordance with the manufacturer's recommendations.
- Sampling tools, instruments, and equipment will be protected from extraneous sources of contamination (i.e., non-groundwater) and will be decontaminated after use as specified in SOP PRO.127, General Equipment Decontamination.

## 5.0 USE OF SOLOMAT TO MEASURE PARAMETERS

Numerous monitoring wells at RFETS are equipped with down-hole pumps. These pumps are used to purge the well and collect the required water samples through "micropurging" procedures. Groundwater field parameters at these monitoring wells will typically be measured using a Solomat water quality monitoring system, which consists of a data logger (Model WP4007) and sonde (Model 803PS). The sonde houses probes capable of measuring temperature, pH, conductivity, turbidity, and other parameters not currently measured at RFETS. A variety of different pumps, sondes, flow cells, and probes are available. All operate on essentially the same principles, and the calibration, standardization, cleaning, decontamination, and storage and maintenance of the Solomat or any equivalent system shall be conducted in accordance with the manufacturer's instructions.

The procedures that follow are specific to the Solomat system.

### 5.1 Calibration/Standardization

The frequencies of calibration/standardization and the minimum acceptance criteria presented in Table 108-1 shall be maintained unless the manufacturer's instructions dictate otherwise. Any change in these frequencies or criteria to lower frequencies or less stringent criteria must be approved by the RMRS project manager prior to being implemented. During periods of use, the Solomat system shall be calibrated daily and standardized weekly. In order to track instrument drift, calibration shall be performed before taking the instrument out in the field, and checked upon returning from the field. The readings taken upon returning from the field are recorded only without resetting the instrument.

Calibration of the system follows a two-stage procedure and employs a calibration cup. The respective chambers of the cup are filled with the appropriate calibration solutions up to the internal marks on the chambers (about half way). Individual chambers are marked with the appropriate parameter(s). Markings are defined as follows: pH-ISE- NH<sub>4</sub> refers to pH, ion-specific electrode, and ammonium; TURB refers to turbidity; and  $\mu$ S refers to conductivity. In the first stage of calibration, only the pH-ISE- NH<sub>4</sub> and TURB chambers are filled. In the second stage, the pH-ISE- NH<sub>4</sub>, TURB, and  $\mu$ S chambers are filled.

- All three of the pH suite chambers will be filled every time a calibration is performed, because the system uses all three to calculate the pH.
- The Solomat system reports turbidity in nephelometric turbidity units (NTUs) instead of in formazin turbidity units (FTUs).

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The following steps describe the calibration process.

1. Fill the "pH-ISE-NH<sub>4</sub>" calibration cup chambers with pH 7 standard solution and the "TURB" chamber with distilled water. These solutions are used to calibrate the low-range values.
2. Remove the storage cup and storage teats from the sonde and respective probes. If the sonde has not been used for a period of time, it will be rinsed with distilled water before being inserted into the calibration cup.
3. Place the sonde in the calibration cup and turn the system on by pushing the Shift and On/Off buttons simultaneously. If the system is operating normally, the screen will display a series of numbers, including the date and time; it will then cycle through the channels corresponding to the parameters being measured. Depending on the setting, each channel/parameter reading should appear on the screen in sequence for between 4 and 8 seconds. (The 4-8 seconds can be adjusted.) Each channel can be set to display any of the parameters. In the following example the channels are set as follows:
  - Channel 1 = Temperature (in degrees centigrade)
  - Channel 2 = pH (in ISO pH units)
  - Channel 3 = Conductivity (in microSiemens (μS); depending on the range, the unit may measure in milliSiemens (mS))
  - Channel 4 = Turbidity (in NTU's)
  - Channel 8 = Battery life (in mV; 4.0 represents a full charge)
4. Record the "low" values for the pH and turbidity on the log sheet. Adjust the values as necessary. (Note: the data logger connects to the probe at the B-socket on the logger.)
5. Turn off the logger and remove the sonde from the calibration cup. Rinse the sonde and the cup with distilled water. Dry the cup and prepare it for calibrations of the "high" range values of pH and turbidity, as well as conductivity and temperature.
6. Fill the pH-ISE-NH<sub>4</sub> chamber with pH 10 standard solution. Fill the conductivity chamber with 1000 μS/cm standard solution, which will also fill the temperature chamber. Fill the turbidity chamber with 100 NTU standard solution. If a lower pH is anticipated, the Solomat can be standardized and calibrated using pH standard solutions of 4 (high range) and pH 7 (low range). The pH 7 solution is always considered low range in the calibration process.
7. Insert the sonde in the calibration cup and turn on the data logger. Record the temperature, pH (high range), conductivity, and turbidity (high range) values on the data sheet.
8. Turn off the data logger and remove the sonde from the calibration cup. Rinse the sonde and the cup with distilled water. Dry the cup. Replace the teats on the probes and the storage cup on the sonde. Disconnect the sonde from the data logger. Assuming the Solomat readings are within acceptable ranges, as defined by Table 108-1, it is now ready for field use and should be returned to its carrying case.

If any of the readings for the calibration solutions fall outside of the acceptance criteria in Table 108-1, it is acceptable to reset the Solomat system using the calibration solutions already in the cup. If it becomes necessary to switch to different calibration solutions, the Solomat can be restandardized to accept the new solutions.

If the values of any of the parameters (pH, conductivity, turbidity) fall outside the acceptance limits presented in Table 108-1, the Solomat can be recalibrated in the following manner. (Note: temperature is set at the factory

and cannot be adjusted by the user.) Although the procedure described below is the same for all three parameters, only pH is discussed below by way of example. If a calibration gives an unacceptable reading, both the high and low calibration ranges shall be reset.

Assume that a pH standard of 7.0 gives a reading of 6.79, which is unacceptable according to Table 108-1. The sonde is still immersed in the calibration cup and the data logger is turned on (step 5 above; for clarity, the following steps will be independently numbered).

1. Press and hold the SHIFT and TSS NTU/CAL/6 keys simultaneously for 1-2 seconds.
2. The Solomat screen will begin flashing "CAL".
3. The screen will automatically switch to a particular channel (i.e., Ch. 1, 2, 3, 4 or 8 will appear over "CHAN=").
4. Enter the number of the channel to be calibrated: 2=pH, 3=conductivity, and 4=Turbidity (1=Temperature and 8=battery condition, neither of which shall be calibrated).
5. Push ENTER/YES.
6. Two numbers will appear. The upper number represents the value the Solomat is currently detecting (6.79 in this example). The lower number is the value to which the Solomat is calibrated (7.00 in this example). By pressing the ENTER/YES key, the unit will be recalibrated to pH=7.00. (If, instead, the high range of pH was being recalibrated using a pH=10.00 solution in the calibration cup, the NO/> key would be pressed. This action would bypass the low range calibration and set up the high range calibration. The screen would then show two numbers, the upper being the current reading for the calibration cup and the lower the 10.00 calibration setting. To recalibrate to the high value solution, the ENTER/YES key would be pressed.)
7. After the ENTER/YES key has been pressed, the data logger will return to its usual cycling from one parameter value to the next on the screen.
  - If another parameter is to be recalibrated, the SHIFT and TSS NTU/CAL/6 keys shall again be pressed, and the appropriate channel shall be selected.
  - To recalibrate to the high range (e.g., pH 10.00) while the low range solution (e.g., pH 7.00) is in the calibration cup, the Solomat must be turned off, solutions in the cup must be changed, and the calibration process must be restarted.

#### 5.2 Field Measurements

Remove the Solomat sonde and data logger from the carrying case. Remove the storage cup from the sonde and the storage teats from the individual probes. Attach the Solomat sampling cup firmly onto the sonde. The sampling cup has two interchangeable tubing couplings: one directs water into the sample chamber, the other directs water out to the purge receptacle.

Connect the Solomat sonde wiring coupling to the data logger at the B-socket. Place the sonde in a safe position, either on the ground or hung from a support attached to the well casing. If possible, the sonde should be positioned

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in the shade. Place the data logger next to the pump control box. For convenience, a table may be used to support the logger and control box.

Connect the pump airline to the well. From the well casing, connect the 3/8 inch outflow tubing to one side of the sampling cup of the Solomat sonde. The opposing side of the Solomat cup is connected through tubing to the purge bucket (a 2L graduated cylinder). Use a short piece of flexible tubing to complete the connection between the end of the outflow tubing and the graduated cylinder. With the pump and Solomat in place, well purging and water quality measurement can begin. (See SOP PRO.113 for instructions on purging wells.)

Turn on the pump. Adjust the pump mechanism so that water flows gently from the well into the sample chamber (with minimal turbulence). Hold the Solomat sonde horizontal with the inflow line down and the outflow line up until all the probes are immersed in water and the air is purged from the sample chamber. When the chamber is completely filled with water, return the sonde to a vertical position.

Once the sample cup has filled with water and a steady flow through the cup has been established, turn on the data logger and record the various parameters on the sample log sheet. This sheet includes sections pertaining to the Solomat and water quality parameters and to pump operation. Purging and measuring parameters should continue as per SOP PRO.113, Groundwater Sampling.

After completing the purge cycle but before the Solomat sonde has been disconnected or the data logger has been turned off, collect an aliquot of water and perform a total alkalinity measurement as described in Section 4.5. Parameters will also be taken if dissolved metals and/or uranium isotope samples are to be taken.

Upon completion of the purge cycle and alkalinity measurement, and collection of the dissolved metals, and/or uranium isotope samples, if required, disconnect the Solomat sonde from the well. The tubing used to direct water from the well casing to the Solomat sampling cup may continue to be used during the sampling activities by turning the water line valve so the pumped water exits through the sample tubing rather than the solomat.

Rinse the Solomat sonde and probes thoroughly with distilled water. Decontaminate the sample cup and tubing (if removed) as per SOP PRO.127, General Equipment Decontamination. Replace the teats on the sonde probes and then attach the storage cup. Make sure that the teats and cup are moist. The sonde, data logger and sample cup shall then be replaced in the case.

## 6.0 RECORDS

All records of field measurements will be recorded on the appropriate forms contained in SOP PRO.113, Groundwater Sampling, or PRO.106, Well Development.

All instrument calibrations, standardizations, and calibration/standardization verifications will be recorded on a calibration/standardization log or in a bound field notebook kept specifically for each instrument. Records will be maintained in a locked filing cabinet or locked room and will be reviewed periodically by the project or program QA/QC officer.

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7.0 REFERENCES

7.1 Source References

The following references were reviewed in order to write this procedure:

U.S. Environmental Protection Agency (EPA), December 1987, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.

U.S. Environmental Protection Agency (EPA), 1987, *Data Quality Objective for Remedial Activities Development Process*, EPA/540/G-87/003.

Hach Company, 1988, *Hach DR/2000 Spectrophotometer Handbook*. Loveland, Colorado.

Hach Company, 1989, *Hach Water Analysis Handbook*. Loveland, Colorado.

Environmental Protection Agency (EPA), September 1986, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1.

*Standard Methods for the Examination of Water and Wastewater*, 16th Edition. 1985, Method 212.

U.S. Department of Energy (DOE), 1987, *The Environmental Survey Manual*, DOE/EH-0053. Appendix E, "Field Protocols and Guidance."

7.2.1 Internal References

Related SOPs cross-referenced by this SOP are as follows:

- SOP OPS-PRO.127, General Equipment Decontamination
- SOP OPS-PRO.112, Handling of Decontamination Water and Wash Water
- SOP OPS-PRO.106, Well Development
- SOP OPS-PRO.113, Groundwater Sampling
- SOP FO.13, Containerizing, Preserving, Handling, and Shipping Soil and Water Samples



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# PROCEDURE

## GROUNDWATER SAMPLING

Procedure No. RMRS/OPS-PRO.113

Revision 0

Date effective: 03/01/99

APPROVED: \_\_\_\_\_ /s/ \_\_\_\_\_  
23 Norman P. Cypher, Manager, Water Operations Date

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### USE CATEGORY 2

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02/11/00

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## 1.0 PURPOSE

This standard operating procedure (SOP) describes procedures that will be used at the Rocky Flats Environmental Technology Site (RFETS) to sample groundwater from monitoring wells. Monitoring wells are currently sampled on a semi-annual, quarterly, or monthly basis, or by special request in support for specific projects. All new wells to be installed in the future will be sampled following these procedures.

This SOP describes equipment decontamination and transport, site preparation, detection and sampling of immiscible layers, water level measurements, well purging, sample collection, field and analytical parameters, quality assurance/quality control (QA/QC) requirements, and documentation that will be used for field data collection.

## 2.0 SCOPE

This document, which supersedes groundwater SOP GW.06, applies to all Rocky Mountain Remediation Services (RMRS) personnel and subcontractors conducting groundwater-related work at the RFETS. This (SOP) describes acceptable methods for the sampling of wells and piezometers installed at RFETS.

## 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel performing groundwater sampling procedures are required to have completed the initial 40-hour OSHA classroom training that meets the Department of Labor requirements 29 CFR 1910.120(e)(3)(i), and must maintain a current training status by completing the appropriate annual 8-hour OSHA refresher courses. Personnel must also have read and signed the appropriate Health and Safety Plan(s). Prior to engaging in groundwater sampling activities, personnel must have a complete understanding of the procedures described within this SOP and, if necessary, will be given specific training regarding these procedures by other personnel experienced in the methods described within this SOP.

## 4.0 GROUNDWATER SAMPLING PROCEDURES

### 4.1 Introduction

The monitoring wells currently active at the RFETS include wells installed from 1986 through the present time, which are constructed of either 2-inch stainless steel, or 2 or 4-inch flush threaded PVC casing. Some piezometers have been completed as monitoring wells that are usually constructed of ¾ inch inside diameter, flush threaded PVC casing. Since 1989, wells have been constructed to incorporate a sump below the well screen. Since these vary in length, the well construction diagrams should be consulted to determine the sump lengths for specific wells. Most piezometers are constructed with a flush threaded cap at the bottom of the well screen. However, the well construction diagrams should also be consulted for information about specific piezometers.

Procedures for groundwater sampling are designed to obtain a sample that is representative of the formation water beneath the site in question. Since an analysis of the quality of formation water is desired, standing water within the well must be purged before sampling. Also, a measure of the static water elevations is important to determine the effect of seasonal horizontal and vertical flow gradient changes during site characterization activities.

Groundwater sampling procedures can be initiated after taking the required water level measurements (SOP RMRS/OPS-PRO.105, Water Level Measurements in Wells and Piezometers) and purging the well in accordance with this SOP. Methods

be decontaminated between sample locations. If field conditions require more frequent decontamination, the frequency will be increased appropriately.

Transportation of all equipment will be performed in a manner that eliminates any possibility of cross-contamination. Calibration solutions, fuel, decontamination solutions and wastewater, and all other sources of contamination will be segregated from sampling equipment during transport. Purge water being transported to holding areas will be kept in closed containers.

If the decontamination of downhole equipment is not performed at the well, used downhole equipment will be wrapped in plastic sheeting and/or segregated from clean equipment to eliminate the possibility of cross contamination. The equipment will then be decontaminated as soon as possible.

#### 4.3.1 *Routine Field Decontamination*

Decontamination of delicate equipment and the routine decontamination of sampling equipment prior to use at each well will consist of the following steps:

- The equipment will be vigorously scrubbed with a brush and solution of phosphate-free laboratory grade detergent (e.g. Liquinox) and distilled water.
- The equipment will then be rinsed thoroughly with approved distilled water.
- If the decontaminated equipment will not immediately be packaged to eliminate any adhesion of airborne impurities, an additional final rinse, or decontamination and rinse, should be performed immediately prior to actual sampling operations.

#### 4.3.2 *Routine Decontamination of Sampling Pumps*

The external surfaces of all non-dedicated pumping equipment will be decontaminated as described in Subsection 4.3.1. Internal surfaces will be decontaminated according to the following procedures, except under special situations where the pump(s) must be disassembled and the internal parts cleaned separately (see Subsection 4.3.3) For routine decontamination, the following procedures will be followed:

- Pump several pump volumes of a solution of a phosphate-free laboratory grade detergent (e.g. Liquinox) and water through the equipment.
- Displace the soap solution immediately by pumping approved distilled water, equivalent to 3 or more volumes of the pump storage capacity, through the equipment.
- If any detergent solution remains in the pump, continue pumping distilled water through the system until the detergent is no longer visibly present. Sudsing will be the common indicator used to determine incomplete rinsing.

#### 4.3.3 *Unusual Decontamination Requirements*

When equipment becomes grossly contaminated, such as from the collection of immiscible layer samples (see Subsection 4.5) routine decontamination of sampling equipment is not considered sufficient and thus is not allowed. This situation and other unusual equipment decontamination problems shall be reported to the field site supervisor. Under certain circumstances

- At no time should the bailer or line be allowed to touch the ground or come in contact with other physical objects that might introduce contaminants into the well.
- Immediately after sampling is completed, all equipment will be decontaminated. Dedicated bailers will be suspended in the well from the well cap. The bailer will be suspended above the high water level. Silicon tubing used with peristaltic pumps will be discarded.

#### 4.6 Well Purging

Purging stagnant water from a well is required so that the collected sample is representative of the formation groundwater. The device used (bailer or pump) depends upon aquifer properties, individual well construction, and data quality objectives. Wells which contain immiscible layers will not be purged unless specified in the site specific work plan. Any well scheduled for purging and sampling that subsequently is found to contain immiscible layers must be reported to RMRS. The RMRS project manager will be notified immediately prior to continued activities.

Before obtaining water level elevations or initiating purge activities, obtain the following information in reference to the well to be sampled, and enter the applicable information on the sample collection log (Form PRO.113B or PRO.113C).

- Location code (well number)
- Previous purge volume (information only)
- Depth to top of screen (bailed wells only- Form PRO.113B)
- Well sample number
- RIN number (Report Identification Number)
- Sample event number

Record the location code (well number), date, sampling team members, visitors, well condition, and any other pertinent information on the sample collection log. Enter the well number, time well is opened, and other information regarding the field activities on the Field Activity Daily Log (form No PRO.113A).

The field instruments will be standardized (to check calibration) and the results recorded on the sample collection form. Instruments will be calibrated as described in SOP RMRS/OPS-PRO.108, Measurements of Groundwater Field Parameters.

Water level measurements will be collected as specified in SOP RMRS/OPS-PRO.105, Water Level Measurements in Wells and Piezometers. Measure the depth to the top of the water column and the total depth of the well in order to determine the height of the water column in the well. Calculate the well casing volume using the well casing inner diameter and the height of the water column in the well. The formula for calculating the volume in gallons of water in the well casing is as follows:

$$(\pi r^2 h) 7.481 = \text{gallons; where } \pi = 3.142$$

r = inside radius of the well pipe in feet  
h = linear feet of water in well  
7.481 = gallons per cubic foot of water  
1 gallon = 3785 ml

Calculations of the volume of water in typical well casings may be done as follows:

- a. 2" diameter well:

- When purging a well with a bailer, the site will be prepared as discussed in Subsection 4.4. Properly decontaminated equipment will then be used to determine the static water level of the well. The total depth of the well will be measured. This information will be used to determine the volume of water in the well casing.
- Prior to the initiation of purging all dedicated bailers will be decontaminated as described in Subsection 4.3 of this SOP.
- A mechanical reel equipped with Teflon® coated stainless steel cable attached to a bailer is used for bailing and sampling operations. The bailer will be slowly lowered into the well until water is encountered. Agitation of the well water will be minimized. Lowering the bailer to the bottom of the well will be avoided so sediments accumulated in the bottom do not become suspended. For wells that dewater, the bailer should not be allowed to strike the well bottom with force. The bailer will be raised ensuring that cable does not come in contact with any potentially contaminated surfaces. The bailer should be raised and lowered slowly to limit surge energy. Also, the cable should not be allowed to drag along the well casing or against other objects that will cause fraying. The amount of water purged will be monitored.

Wells with significant levels of contamination may have dedicated bailers installed. These wells will be selected by RMRS. Dedicated bailer systems will consist of a Teflon® bailer with check valve or double check valve for DNAPLS and a 5-foot leader of Teflon® coated stainless steel cable. Bailer sampling attachments and the stainless steel reel cable will not be dedicated to individual wells.

Dedicated bailers will be decontaminated at the conclusion of sampling activities and suspended from the well cap above the high water table. If the well interval above the high water table is not adequate to allow for storage in the casing, the dedicated bailers will be stored in labeled and sealed plastic bags at the equipment trailer.

#### 4.6.2.2 Pumping

Pump designs that meet the following criteria are allowed for purging:

- The pump is constructed of a material that does not introduce a source of contamination to the well.
- The pump drive system does not introduce a source of contamination into the well.
- All downhole parts to the pump can be easily decontaminated.
- A return check system that does not allow pumped water to return to the well is integral in the pump design.
- The pump is easily used and does not require excessive amounts of time to install, use, remove, and decontaminate.

The pumps currently in use to purge groundwater include peristaltic pumps and dedicated submersible bladder pumps. A procedure for the use of each style of pump is specific to its applications. User manuals, which accompany each pump, will be referenced for operating procedures.

Basic operating procedures common to all pumps are as follows:

- Regardless of the type of pump being utilized, the site will be prepared as described in Subsection 4.4.

Each instrument will also be given an identification number. All logbook and field form references to individual instruments will refer to this number for ease of identification.

Field parameters will be measured at the following intervals:

- Conductivity, pH, temperature, and turbidity will be measured from the first water removed from the well when initiating well purging procedures. For bailed wells, the initial bail of water will be carefully removed from the well and the water transferred to a sample beaker by decanting the bailer through a bottom control valve. Wells purged with a peristaltic pump will similarly collect the first water removed in a sample beaker to be measured for parameters. Wells with dedicated pumps will measure the parameters of the first recovered water that is collected in the continuous sampler.
- During purging operations, conductivity, pH, and temperature will be measured for every half-casing volume (one half of the initial casing volume as calculated on the sample collection log form) of water removed from the well (because of the accuracy of the graduated containers for the purge water, the purge volume will be estimated as close as feasible). Wells that have half volumes less than the volume of a sample bailer (approximately 1 liter) will only have parameters measured after each full casing volume of water is removed from the well. Turbidity will be measured on every other sample recovered for parameters for bailed wells, or wells purged with a peristaltic pump. All parameters, including turbidity, will be measured at predetermined intervals while purging wells with dedicated pumps.
- During purging, if a well is dewatered prior to the measurement of the final required set of parameters, then conductivity, pH, temperature, and turbidity will be measured immediately before the start of sample collection. These parameters may be delayed until sampling is completed if, at the discretion of the sampling crew, the well recharge has provided insufficient water volume to collect all the samples and also measure parameters. If there is insufficient water for samples and field parameters, the parameters will not be measured.
- Total alkalinity measurements will be collected only once upon completion of purging. For wells that do not dewater and sample collection proceeds to completion immediately after purging, alkalinity will be measured after the completion of all other final purge field parameters. Wells that dewater and require repeated visits for the collection of samples will have alkalinity measured subsequent to the collection of the sample for inorganic water chemistry. Alkalinity will not be measured if sufficient water is not available.
- For micro purged wells, a purge is considered completed when the parameters have stabilized.
- Whenever a method used to remove well water is changed, a set of field parameters will be recorded from water removed with the new method.

#### 4.8 Groundwater Sampling

Techniques used to withdraw groundwater samples from a well will be based on consideration of the parameters of interest. The order of collection, collection techniques, choice of sample containers, preservatives, and equipment are all critical to ensure that samples are not altered or contaminated. The preferred methods for collection of groundwater samples are either bailing and/or the use of bladder pumps.

The order of sample collection may be changed at the discretion of the sampling team. Changes in the order that various analyte samples will be collected will be based on the predicted volume of water that will be recovered, and the priority stated in the controlling document. The sampling team will document their sample selections on the sample collection log.

Sample containers will be stored away from sunlight and will be cooled to 4°C prior to filling. Immediately after collection, samples requiring cooling will be cooled to 4°C. A chilled cooler will be used as the storage container. Whenever a sample bottle that requires chilling is not being physically handled, it will be placed in the cooler to prevent heating or freezing, exposure to sunlight, and possible breakage.

VOC samples will be collected using a bailer equipped with a bottom-decanting control valve or directly from the pump discharge line on wells equipped with bladder pumps. The procedures for collecting VOC samples are discussed in Subsections 4.8.1.1 and 4.8.1.2 of this SOP.

VOC vials will never be filled and stored below capacity because of insufficient quantities of water in the well. Except for the VOC vials, adequate air space should be left in the sample bottles to allow for expansion.

Sites will be prepared prior to sampling as described in Subsection 4.4. All necessary and appropriate information will be recorded on the sample collection log (form PRO.113B or PRO.113C) and on the Field Activity Daily Log (form PRO.113A).

Samples will be placed in the appropriate containers and packed with ice in coolers as soon as practical. VOC samples will be stored in the cooler in an inverted position immediately after collection. Packaging, labeling, and preparation for shipment will follow procedures as specified in SOP RMRS/OPS-PRO.069, Containing, Preserving, Handling, and Shipping of Soil and Water Samples. When sampling is complete, the well cap will be replaced and locked.

Sampling tools, instruments, and equipment will be protected from sources of contamination before use and decontaminated after use as specified in Subsection 4.3. *Liquids from decontamination operations will be handled in accordance with the procedures in Subsection 4.6.3 of this SOP.* Sample containers will also be protected from sources of contamination. Sampling personnel will wear chemical-resistant gloves (e.g. nitrile) when handling samples and the gloves will be disposed of between well sites.

#### 4.8.1.1 Groundwater Sampling Using a Bailer

This Subsection describes the use of a bailer for collecting groundwater samples that may be used to obtain physical, chemical, or radiological samples.

A bailer attached to a Teflon® coated stainless steel cable is carefully lowered into the well. After filling within the well, the bailer is withdrawn by rewinding the bailer line, and the bailer contents are drained into the appropriate containers. Certain recommendations and/or constraints should be observed when using bailers for sampling groundwater quality monitoring wells:

- Only bottom-filling Teflon® bailers or bailers made of other inert materials will be used.
- Bailers will be attached to a Teflon® coated stainless steel line that is pre-wound on a reel.

- Bailers constructed with adhesive joints will not be used.

Lower the bailer slowly to the interval from which the sample is to be collected. VOC samples will be collected using a bailer equipped with a bottom-decanting control valve. The first water through the valve assembly will be discarded into the purge water container. Vials will be filled by dispensing water through the control valve along the inside edge of the slightly tilted sample vial. Care will be taken to eliminate aeration of the sample water. The vials will be filled beyond capacity so the resulting meniscus will produce an airtight seal when capped. The capped vial will be checked for trapped air by lightly tapping the vial in an inverted position. If air becomes trapped in the vial, the sample water will be discarded, and the vial will be refilled. If two consecutive attempts to fill a VOC vial result in trapped air bubbles, the vial will be discarded.

The remainder of the sampling water will be collected in a stainless steel container from which the remaining sample bottles will be filled. Samples requiring filtration will be filtered and then containerized.

#### 4.8.1.2 Groundwater Sampling Using a Peristaltic Pump

Use of peristaltic pumps will generally be limited to collecting sample aliquots for radionuclides, metals, and other species that are not subject to volatilization and degassing. Peristaltic pumps will never be used to collect VOCs or other volatile species in routine wells, although such samples may be collected for special screening applications. All downhole tubing will be Teflon® except in areas of special concern (e.g., where immiscible layers exist) where special tubing, such as stainless steel or Viton®, may be required. If so, this will be determined and provided by the RMRS project manager. Only the portion of tubing that is inserted into the mechanical drive will be made of silicon. This drive portion of the tubing will be discarded after each use.

#### 4.8.1.3 Groundwater Sampling Using a Downhole Bladder Pump

Several wells at RFETS have been equipped with dedicated downhole bladder pumps for purging and sampling of the wells. These are wells that will normally produce an adequate amount of water during a single visit to complete the required sampling suite. The equipment required to purge and sample a well consist of a pump control unit, a portable air compressor, a continuous sampler for measuring the field parameters (see SOP RMRS/OPS-PRO.108), and the necessary sample containers, graduated cylinders, and container(s) to collect the purge and excess water. The following precautions should be observed during the sampling operation:

- The compressor used to power the pump will be located downwind from the well to eliminate the contamination of equipment and samples with exhaust.
- If the flow-through cell will not maintain a full sample chamber (tends to drain back), then the check valve on the pump is fouled and needs to be cleaned, or the pump replaced.
- The minimum purge volume is routinely calculated using the formula on Form PRO.113C. However, a purge is considered completed only when the groundwater parameters have stabilized.
- Upon completion of purging, sampling should be initiated with the collection of the VOC sample(s). The pump should operate with minimum interruptions while the full sample suite is collected. Allowing the pump to stop for an extended period of time will cause the water trapped in the discharge lines to equilibrate to ambient temperatures which is not acceptable. During sampling, the pump can be slowed to any rate that allows efficient sampling while also maintaining stable field parameters.

- A small amount of sample will be poured from the sample bottle directly onto approved pH paper. Care will be used so that the threaded neck of the bottle does not contact the pH paper. Under no circumstances should the pH paper be inserted into the sample bottle.
- The pH paper will be checked against the supplied color chart. If the appropriate pH has not been achieved, additional preservative will be added to the sample in 5ml aliquots, and the pH test will be repeated.

#### 4.8.3 *Sample Screening*

A sample for radiation screening will be collected for each well sampled, unless the sampling history for any specific well shows that the samples meet the radiation screening requirements for shipping and analysis. The radiation screen is usually collected during the sampling event and may be obtained from the purge water prior to completion of purging. This sample will be delivered to the RMRS or subcontracted radiation screening laboratory to be screened for gross alpha. Samples from the corresponding well will be handled according to the levels of radioactivity detected in the sample, as specified in SOP RMRS/OPS-PRO.069, Containing, Preserving, Handling, and Shipping Soil and Water Samples.

#### 4.8.4 *QA/QC Samples*

The frequency and types of field QA/QC samples collected during groundwater sampling are described in RMRS-QAPD-001, Quality Assurance Program Description. This document details the applicable criteria for collecting QA/QC samples.

##### 4.8.4.1 *Duplicates*

Duplicate samples will be collected only from wells that produce enough water to collect two full suites of analytes without dewatering. The wells which produce sufficient water will be incorporated into the sampling program such that the required duplicate frequency can be maintained.

Wells scheduled for duplicate sample collection will be sampled as described in Subsection 4.8 of this SOP, and in Subsection 3.5.1, Appendix 3, RMRS-QAPD-001, Quality Assurance Program Description. Field duplicates are collected following the same sampling procedures used to obtain the real samples. With the exception of VOCs, the typical procedure for a location is to collect the real and duplicate of each sample at the same time, in two equal portions, with each portion going to the laboratory in separate containers. This is accomplished by alternately filling two sample bottles one half at a time to minimize heterogeneity. Procedure RMRS-QAPD-100 states the real and duplicate VOC samples will be collected independently to reduce the possibility of volatilization of the sample.

When a well with a dedicated pump is being used for sample collection, all samples will be collected in the normal order, with duplicate VOC samples being collected first. The remaining samples will be sampled as described above.

If a well is being used for matrix spike (MS) and matrix spike duplicate (MSD) samples the duplicate will be collected after collection of the MS and MSD.

All duplicate samples will be given a sample number different from the original sample and the information recorded on form PRO.113-D, Field QC Groundwater Sample Collection Log.

Field equipment rinses will be collected in a manner designed to reflect sampling techniques. All equipment used during sampling will be fully decontaminated as described in Subsection 4.3, then rinsed with distilled or deionized water. The rinse water will then be collected in bottles identical to those used for the original sample, and assigned a separate sample number. Analytes requiring filtration will be filtered using a new filter and tubing as required for the real sample. All information will be recorded on form PRO.113D, Field QC, Groundwater Sample Collection Log.

#### 4.8.4.4.1 Bailed Wells

After completion of sampling, all equipment will be decontaminated. Prior to leaving the well location, the equipment rinse will then be collected as follows:

- The bailer will be filled with distilled or deionized water by pouring the water into the top opening.
- The rinse water should then be decanted to the VOC vials through the bottom valve. This will be done in the same manner used during sample collection.
- For the remaining unfiltered samples, the bailer will be filled with distilled or deionized water each time additional rinsate is needed. The rinsate will then be transferred to sample bottles or to a stainless steel bucket and then to sample containers in the same manner used during collection.
- Filtered samples will also be collected in an identical manner as the real samples. The bailer will be filled with distilled or deionized water. The rinse water will then be transferred to a stainless steel bucket. The rinse water in the bucket will then be filtered through a new disposable filter.
- Rinse samples will be preserved in the same manner as the real samples.

#### 4.8.4.4.2 Pumped Wells

Rinsate samples are not routinely collected from wells that are equipped with dedicated bladder pumps because the samples from these wells are collected directly from the pump discharge line. However, wells sampled using peristaltic pumps for sampling may be selected for rinsate sampling, with equipment used in sample collection (down hole tubing, filter tubing and the stainless steel bucket used for sample water collection, etc.) being decontaminated prior to rinsate sampling. The tubing at the pump head will be replaced, and a new filter used for filtered analytes. To collect the samples, distilled or deionized water will be poured into the decontaminated stainless steel bucket and pumped, using the decontaminated tubing, into the sample containers. The equipment used to collect the real VOC samples will also be decontaminated, rinsed, and used to collect the VOC rinse samples. All samples will be preserved at the same pH levels as the real samples.

#### 4.8.4.5 Distilled Water Blanks

Distilled water sample blanks are not submitted on a routine basis, but will be made up if so designated in a site specific sampling plan, or if requested by the RMRS project manager. Samples of the distilled or deionized water used for the final decontamination of equipment will be transferred directly to sample bottles to determine any baseline contamination the water may have introduced into the samples. Five gallon bottles of the distilled or deionized water will be opened in a controlled area, such as the bottle storage room, and then poured directly into the appropriate sample bottle. A Teflon®, glass, or stainless steel funnel may be used to help control flows into small mouth bottles. Blank samples will be preserved to the appropriate pH required for each analyte. All information will be recorded on form PRO.113D, Field QC, Groundwater Sample Collection Log.

- Date and time
- Names of field personnel
- Names of all visitors
- Location of field activities
- Description of sampling sites including weather conditions
- All field observations and comments
- Field parameters
- Sample identification information
- References to all prepared field activity forms and chain-of-custody records

Field logbooks, when required on specific projects, will normally be kept only by the field sampling team leaders and the site supervisor and will typically be used only to summarize field activities and to document project information not required by the SOP field forms.

Logbooks will be maintained and entries made in accordance with procedure 2-S47-ER-ADM-.05.14, Use of Field Logbooks and Forms. Permanent ink will be used for all entries in the logbooks and on the field forms. Mistakes will be crossed out with a single line, initialed, and dated. Unused pages or partial pages will be voided by drawing a line through the blank sections that is initialed and dated. Any deviation from this SOP will require documentation in the site supervisor's logbook.

The field activity daily log narrative should create a chronological record of the sampling team's activities, including the time and location of each activity. Descriptions of problems encountered, personnel contacted, deviations from the SOP, and visitors on site should also be included. The weather conditions, date, signature of the person responsible for entries, and the number of field activity daily log sheets used to record media team activities for a given day will also be included.

The Groundwater Levels Measurement/Calculations Form (see SOP RMRS/OPS-PRO.105, Water Level Measurements in Wells and Piezometers) and the Chain of Custody Record (see SOP RMRS/OPS-PRO.069, Containing, Preserving, Handling, and Shipping Soil and Water Samples) will also be completed for each site. All blank fields on the forms must be completed or voided.

## 6.0 REFERENCES

### 6.1 Source References

The following references were reviewed before this procedure was written:

Environmental Protection Agency, 1982, *Test Methods for Evaluating Solid Waste, SW-846, Volume II. Field Methods*, 2nd edition.

Environmental Protection Agency, 1986a, *Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual*, EPA Region IV Environmental Service Division.

Environmental Protection Agency, September 1986b, *RCRA Ground Water Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1.

**APPENDIX A**  
**STANDARD GROUNDWATER FORMS**

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
 Side 1 of 2 GROUNDWATER SAMPLE COLLECTION LOG

FORM PRO. 113B  
 REVISION 1

|                  |                 |
|------------------|-----------------|
| Location Code:   | Dates:          |
| Project Name:    |                 |
| Project Charged: | Team Members:   |
| Sample Number:   |                 |
| Grid:            | Sub-Contractor: |

| Equipment Type                     | Equipment Identification | Standard (Reported Value) | Temp (°C) | Equipment Reading | Reading Acceptable? | Date | Time |
|------------------------------------|--------------------------|---------------------------|-----------|-------------------|---------------------|------|------|
| Conductivity                       |                          |                           |           |                   |                     |      |      |
| pH Meter                           |                          |                           |           |                   |                     |      |      |
| Turbidity Meter                    |                          |                           |           |                   |                     |      |      |
| Conductivity (2 <sup>nd</sup> )    |                          |                           |           |                   |                     |      |      |
| pH Meter (2 <sup>nd</sup> )        |                          |                           |           |                   |                     |      |      |
| Turbidity Meter (2 <sup>nd</sup> ) |                          |                           |           |                   |                     |      |      |

| Air Monitoring        | Background | Well Bore | Breathing Zone | Other | Instrument # | Comment |
|-----------------------|------------|-----------|----------------|-------|--------------|---------|
| 1 <sup>st</sup> Visit |            |           |                |       |              |         |
| 2 <sup>nd</sup> Visit |            |           |                |       |              |         |
| 3 <sup>rd</sup> Visit |            |           |                |       |              |         |
| 4 <sup>th</sup> Visit |            |           |                |       |              |         |
| 5 <sup>th</sup> Visit |            |           |                |       |              |         |

PURGE METHOD USED:  Peristaltic Pump;  Bailer; (  Teflon  SS )  Other:

PURGE VOLUME CALCULATION - DATUM: TOP OF WELL CASING (TOWC) Date: \_\_\_\_\_

Well Casing Inside Diameter (in.) = \_\_\_\_\_ (ID) Unit Casing Volume/Foot ( gal or  ml) = \_\_\_\_\_ (UV)

Depth to Water (Ft) = \_\_\_\_\_ (WD)

Measured Total Depth \_\_\_\_\_ (MTD) + Probe End (Feet) \_\_\_\_\_ = Total Depth (Feet) \_\_\_\_\_ (TD)

TD \_\_\_\_\_ - WD \_\_\_\_\_ = Initial Water Column (Feet) \_\_\_\_\_ (IC)

UV \_\_\_\_\_ X IC \_\_\_\_\_ = Initial Water Volume (units as marked above) \_\_\_\_\_ (IV)

3 X IV = Purge Volume (units as marked above) \_\_\_\_\_ (PV)

*(CHECK CALCULATIONS BEFORE STARTING PURGE)* Checked By (initials): \_\_\_\_\_

PURGED VOLUMES AND FIELD WATER QUALITY MEASUREMENTS

| Time (24-hour) | Volume Purged <input type="checkbox"/> gal or <input type="checkbox"/> ml | Temp (°C) | pH (SU) | Conductivity <input type="checkbox"/> mS/cm or <input type="checkbox"/> µS/cm | Turbidity <input type="checkbox"/> FTU <input type="checkbox"/> NTU | Water Description |      |
|----------------|---|-----------|---------|---|---|-------------------|------|
|                |   |           |         |   |   | Appearance        | Odor |
|                | Initial   |           |         |   |   |                   |      |
|                |   |           |         |   |   |                   |      |
|                |   |           |         |   |   |                   |      |
|                |   |           |         |   |   |                   |      |
|                |   |           |         |   |   |                   |      |
|                |   |           |         |   |   |                   |      |
|                |   |           |         |   |   |                   |      |
|                |   |           |         |   |   |                   |      |
|                |   |           |         |   |   |                   |      |

Does the well dewater?  Yes  No If Yes, perform recharge rate calculation. If No, enter volume purged and sample well.

Actual Purged Volume = \_\_\_\_\_  gal or  ml

RECHARGE RATE CALCULATION 10-Min. Water Level Recovery: Date \_\_\_\_\_ Start Time: \_\_\_\_\_ End Time \_\_\_\_\_

(TD \_\_\_\_\_ - 10 Minute Water Depth \_\_\_\_\_)(X3) = \_\_\_\_\_ Estimated 30 Minute Recharge

If a second 10-minute recharge calculation is needed: Date: \_\_\_\_\_ Start Time: \_\_\_\_\_ End Time \_\_\_\_\_

(TD \_\_\_\_\_ - 10 Minute Water Depth \_\_\_\_\_)(X3) = \_\_\_\_\_ Estimated 30 Minute Recharge

Sufficient recharge to continue purging?  Yes  No If Yes, resume purging and revise Actual Purged Volume above.

If No: Sufficient water to collect VOA sample?  Yes  No  NA

|  | Wtr Depth | Wtr Col | %Rchg (of IC) | Date | Time | Initials |
|--|-----------|---------|---------------|------|------|----------|
| Depth to Water Before Sampling (2nd visit) |           |         |               |      |      |          |
| Depth to Water Before Sampling (3rd visit) |           |         |               |      |      |          |
| Depth to Water Before Sampling (4th visit) |           |         |               |      |      |          |
| Depth to Water Before Sampling (5th visit) |           |         |               |      |      |          |



**ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
SAMPLE COLLECTION LOG FOR DEDICATED PUMP SYSTEM**

Form PRO.113C (Rev.1)  
Page 1 - Side 2

LOCATION CODE: \_\_\_\_\_ SAMPLE NUMBER: \_\_\_\_\_ DATE(S): \_\_\_\_\_  
 RIN NUMBER(S): \_\_\_\_\_ EVENT NUMBER(S): \_\_\_\_\_  
 Sample Method: Marschalk pump  Other  Pump replacement required? (Y/N) \_\_\_\_\_  
 pH Offscale,  Yes  No pH Offscale reading = \_\_\_\_\_ Checked by (initials): \_\_\_\_\_  
 If YES - At \_\_\_\_\_ pH, Total Alkalinity = \_\_\_\_\_ x 10 \_\_\_\_\_ ppm  
 If NO - At \_\_\_\_\_ pH, Total Alkalinity (full range) = \_\_\_\_\_ ppm

**Summary of Final Purge Parameters**

| Date | Time (24-hr) | Temp (°C) | pH (SU) | Cond. (uS/cm) | Turb. (NTU) | D.O. (mg/l) | Eh/ORP (mV) | Appearance | Odor | Fe <sup>2+</sup> (mg/l) |
|------|--------------|-----------|---------|---------------|-------------|-------------|-------------|------------|------|-------------------------|
|      |              |           |         |               |             |             |             |            |      |                         |

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Field Data Completed By: \_\_\_\_\_ Date: \_\_\_\_\_

Field Data Checked By: \_\_\_\_\_ Date: \_\_\_\_\_

Print Name \_\_\_\_\_ Signature \_\_\_\_\_

| Analysis                         | Container    | Preserve                            | Filter | Line Item                           | RIN# Event | Bottle # | Date | Time | Lab | Ship Date |
|----------------------------------|--------------|-------------------------------------|--------|-------------------------------------|------------|----------|------|------|-----|-----------|
| Rad Screen                       | 120 ml Poly  | No Pres.                            |        | OS01A002                            |            |          |      |      |     |           |
| VOA-524.2                        | 3 x 40 ml AG | 4°C                                 |        | VOA-A-007                           |            |          |      |      |     |           |
| Semi-vol's                       | 3 x 1L AG    | 4°C                                 |        | SVO-A-009                           |            |          |      |      |     |           |
| Pest./PCB                        | 1 L Poly     | 4°C                                 |        | PEP-A-003                           |            |          |      |      |     |           |
| Metals**                         | 1 L Poly     | 4°C                                 |        | MET-A-013                           |            |          |      |      |     |           |
| Diss. Metals                     | 1 L Poly     | 4°C                                 | Filter | MET-A-013                           |            |          |      |      |     |           |
| NO <sub>3</sub> /NO <sub>2</sub> | 250 ml Poly  | H <sub>2</sub> SO <sub>4</sub> /4°C |        | WCH-A-022                           |            |          |      |      |     |           |
| TDS                              | 1 L Poly     | 4°C                                 |        | WCH-A-033                           |            |          |      |      |     |           |
| TDS, SO <sub>4</sub>             | 1 L Poly     | 4°C                                 |        | WCH-A-033<br>WCH-A-036              |            |          |      |      |     |           |
| TDS, SO <sub>4</sub> , F         | 1 L Poly     | 4°C                                 |        | WCH-A-033<br>WCH-A-036<br>WCH-A-018 |            |          |      |      |     |           |
| U-isotopes**                     | 1 L Poly     | HNO <sub>3</sub>                    |        | ASP-A-024                           |            |          |      |      |     |           |
| U-isotopes                       | 1 L Poly     | HNO <sub>3</sub>                    | Filter | ASP-A-024                           |            |          |      |      |     |           |
| Pu 239/240<br>Am 241             | 1 Gal. Poly  | HNO <sub>3</sub>                    |        | ASP-A-022<br>ASP-A-020              |            |          |      |      |     |           |
| Np-237                           |              | HNO <sub>3</sub>                    |        | ASP-A-014                           |            |          |      |      |     |           |
| Sr**                             | 1 L Poly     | HNO <sub>3</sub>                    |        |                                     |            |          |      |      |     |           |
| Tritium (H <sub>3</sub> )        | 100 ml AG    | No Pres.                            |        | LSC-A-001                           |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |
|                                  |              |                                     |        |                                     |            |          |      |      |     |           |

\*\*Unfiltered if micropurged AND meets pump-well unfiltered requirements. Write in "Filtered" if appropriate.

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## ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE FIELD QC GROUNDWATER SAMPLE COLLECTION LOG

|                     |                                  |                            |
|---------------------|----------------------------------|----------------------------|
| LOCATION CODE:      | DATE:                            |                            |
| PROJECT CHARGE NO.: | SUB-CONTRACTOR:                  |                            |
| SAMPLE NUMBER:      | SAMPLE NUMBER FOR "REAL" SAMPLE: | OTHER QC SAMPLE TYPES/NOs: |
| PROJECCT NAME:      | SAMPLE TEAM MEMBERS:             |                            |
| QA/QC:              | DATE:                            | MEMBERS:                   |

### SAMPLE PARAMETER MEASUREMENTS

| DATE | TIME | TEMP (°C) | pH | CONDUCTIVITY |          | TURBIDITY |     | ORP<br>mV | Fe <sup>+2</sup> mg/l | D.O. % | INITIALS |
|------|------|-----------|----|--------------|----------|-----------|-----|-----------|-----------------------|--------|----------|
|      |      |           |    | mS/cm        | or uS/cm | FTU       | NTU |           |                       |        |          |
|      |      |           |    |              |          |           |     |           |                       |        |          |
|      |      |           |    |              |          |           |     |           |                       |        |          |
|      |      |           |    |              |          |           |     |           |                       |        |          |

COMMENTS:

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|                            |            |       |
|----------------------------|------------|-------|
| Completed by (Print Name): | Signature: | Date: |
| Checked by (Print Name):   | Signature: | Date: |

- DUPLICATE
- EQUIP. RINSE
- FIELD BLANK
- TRIP BLANK
- MS
- MSD
- OTHER

| ANALYSIS                 | VOLUME           | PRESERVATIVE                         | FILTER   | LINE ITEM CODE                      | RINEVENT | BOTTLE # | DATE | TIME | LAB | SHIP DATE |
|--------------------------|------------------|--------------------------------------|----------|-------------------------------------|----------|----------|------|------|-----|-----------|
| Rad Screen               | 120 ML<br>POLY   | None                                 |          | OS01A002                            |          |          |      |      |     |           |
| VOA                      | (GL)<br>3 X40 ml | 4°C                                  |          | VOA-A-007                           |          |          |      |      |     |           |
| Dissolved<br>Metals      | 1 liter          | 4°C / HNO <sub>3</sub>               | filter** | MET-A-013                           |          |          |      |      |     |           |
| Total Metals             | 1 liter          | 4°C / HNO <sub>3</sub>               |          | MET-A-013                           |          |          |      |      |     |           |
| Nitrate/Nitrite          | 250 ml           | 4°C / H <sub>2</sub> SO <sub>4</sub> |          | WCH-A-022                           |          |          |      |      |     |           |
| TDS                      | 1 liter          | 4°C                                  |          | WCH-A-033                           |          |          |      |      |     |           |
| TDS, SO <sub>4</sub>     | 1 liter          | 4°C                                  |          | WCH-A-033<br>WCH-A-036              |          |          |      |      |     |           |
| TDS, SO <sub>4</sub> , F | 1 liter          | 4°C                                  |          | WCH-A-033<br>WCH-A-036<br>WCH-A-018 |          |          |      |      |     |           |
| U-Isotope                | 1 liter          | HNO <sub>3</sub>                     | filter** | ASP-A-024                           |          |          |      |      |     |           |
| PU/AM                    | 1 gallon         | HNO <sub>3</sub>                     |          | ASP-A-022<br>ASP-A-020              |          |          |      |      |     |           |
| Tritium                  | (GL) 100 mL      | None                                 |          | LSC-A-001                           |          |          |      |      |     |           |
| Sr 89/90                 | 1 liter          | HNO <sub>3</sub>                     | filter** | GPC-A-007                           |          |          |      |      |     |           |
| TOC                      | 250 ml           | H <sub>2</sub> SO <sub>4</sub>       |          | MIS-A-021                           |          |          |      |      |     |           |
| ALKALINITY               | 500 ml           | None                                 |          | WCH-A-002                           |          |          |      |      |     |           |
| METHANE                  | 2 x 40 ml        | 4°C                                  |          | TSK-A-020                           |          |          |      |      |     |           |
| CSN                      | 500 ml           | 4°C                                  |          | WCH-A-011<br>WCH-A-020              |          |          |      |      |     |           |
| H <sub>2</sub> S         | 500 ml           | ZnAc/NaOH                            |          | WCH-A-038                           |          |          |      |      |     |           |

\*\*Do not filter if well is micropurged and meets unfiltered requirements.

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ROCK FLATS ENVIRONMENTAL TECHNOLOGY SITE  
FIELD QC GROUNDWATER SAMPLE COLLECTION LOG

LOCATION CODE: \_\_\_\_\_ DATE: \_\_\_\_\_  
 PROJECT CHARGE NO.: \_\_\_\_\_ SUB-CONTRACTOR: \_\_\_\_\_  
 SAMPLE NUMBER: \_\_\_\_\_ SAMPLE NUMBER FOR "REAL" SAMPLE: \_\_\_\_\_ OTHER QC SAMPLE TYPES/NO.: \_\_\_\_\_  
 PROJECT NAME: \_\_\_\_\_ SAMPLE TEAM MEMBERS: \_\_\_\_\_  
 QA/QC: \_\_\_\_\_ DATE: \_\_\_\_\_ MEMBERS: \_\_\_\_\_

SAMPLE PARAMETER MEASUREMENTS

| DATE | TIME | TEMP (°C) | pH | CONDUCTIVITY                   |                                   | TURBIDITY                    |                              | ORP mV | Fe <sup>+2</sup> mg/l | D.O. mg/l | INITIALS |
|------|------|-----------|----|--------------------------------|-----------------------------------|------------------------------|------------------------------|--------|-----------------------|-----------|----------|
|      |      |           |    | <input type="checkbox"/> mS/cm | or <input type="checkbox"/> uS/cm | <input type="checkbox"/> FTU | <input type="checkbox"/> NTU |        |                       |           |          |
|      |      |           |    |                                |                                   |                              |                              |        |                       |           |          |
|      |      |           |    |                                |                                   |                              |                              |        |                       |           |          |
|      |      |           |    |                                |                                   |                              |                              |        |                       |           |          |

COMMENTS: \_\_\_\_\_

Completed by (Print Name): \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Checked by (Print Name): \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

- DUPLICATE
- EQUIP. RINSE
- FIELD BLANK
- TRIP BLANK
- MS
- MSD
- OTHER

| ANALYSIS  | VOLUME           | PRESERV.                               | FILTER   | LINE ITEM CODE                      | RINSE EVENT | BOTTLE # | DATE | TIME | LAB | SHIP DATE |
|---|------------------|--|----------|-------------------------------------|-------------|----------|------|------|-----|-----------|
| Rad Screen  | 120 ml (Poly)    | None                                   |          | OS01A002                            |             |          |      |      |     |           |
| VOA   | (AG)<br>3 X40 ml | 4°C                                    |          | VOA-A-007                           |             |          |      |      |     |           |
| Dissolved Metals  | 1 liter (Poly)   | 4°C / HNO <sub>3</sub>                 | filter** | MET-A-013                           |             |          |      |      |     |           |
| Total Metals  | 1 liter (Poly)   | 4°C / HNO <sub>3</sub>                 |          | MET-A-013                           |             |          |      |      |     |           |
| Nitrate/Nitrite   | 250 ml (Poly)    | 4°C / H <sub>2</sub> SO <sub>4</sub>   |          | WCH-A-022                           |             |          |      |      |     |           |
| TDS   | 1 liter (Poly)   | 4°C                                    |          | WCH-A-033                           |             |          |      |      |     |           |
| TDS,SO <sub>4</sub>   | 1 liter (Poly)   | 4°C                                    |          | WCH-A-033<br>WCH-A-036              |             |          |      |      |     |           |
| TDS,SO <sub>4</sub> , F   | 1 liter (Poly)   | 4°C                                    |          | WCH-A-033<br>WCH-A-036<br>WCH-A-018 |             |          |      |      |     |           |
| U-Isotope   | 1 liter (Poly)   | HNO <sub>3</sub>                       | filter** | ASP-A-024                           |             |          |      |      |     |           |
| PU/AM   | 1 gallon (Poly)  | HNO <sub>3</sub>                       |          | ASP-A-022<br>ASP-A-020              |             |          |      |      |     |           |
| Tritium   | (AG) 250 mL      | None                                   |          | LSC-A-001                           |             |          |      |      |     |           |
| Sr 89/90  | 1 liter (Poly)   | 4°C/<br>HNO <sub>3</sub>               | filter** | GPC-A-007                           |             |          |      |      |     |           |
| TOC   | (AG)<br>250 ml   | 4°C/<br>H <sub>2</sub> SO <sub>4</sub> |          | WCH-A-025                           |             |          |      |      |     |           |
| ALKALINITY  | 500 ml (Poly)    | None                                   |          | WCH-A-002                           |             |          |      |      |     |           |
| METHANE   | ... x 40 ml (AG) | 4°C                                    |          | TSK-A-020                           |             |          |      |      |     |           |
| Cl <sup>-</sup><br>SO <sub>4</sub> <sup>2-</sup><br>NO <sub>3</sub> | 500 ml (Poly)    | 4°C                                    |          | WCH-A-011<br>WCH-A-036<br>WCH-A-020 |             |          |      |      |     |           |
| H <sub>2</sub> S  | 500 ml (Poly)    | 4°C/<br>ZnAc/NaOH                      |          | WCH-A-038                           |             |          |      |      |     |           |
|   |                  |  |          |                                     |             |          |      |      |     |           |
|   |                  |  |          |                                     |             |          |      |      |     |           |
|   |                  |  |          |                                     |             |          |      |      |     |           |

\*\*Do not filter if well is microparged and meets unfiltered requirements.











# ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE PRO-1455-FDO

## FIELD DECONTAMINATION OPERATIONS

Responsible K-H Organization: Environmental Restoration Program Effective Date: 11/01/01

Approved By: MANAGER/ER PROGRAM / 10/09/01  
Title Date

Lane Butler / [Signature]  
Print Name Approval Signature

Annette Primrose  
Print Name of Responsible Manager (N/A if RM is Approval Authority)

The Responsible Manager Has Determined The Following Organizations' Review Is Required. Review Documentation Is Contained In the Document History File:

Environmental Media Management

### IMPORTANT NOTES

Periodic Review Frequency  
4

Documents Superseded (if any)  
OPS-FO.03

REVIEWED FOR CLASSIFICATION/ UCNI

By: [Signature] [Signature]  
(If Required)

Date: 10/9/01

PADC-2001-00580

CONTROLLED DOCUMENT  
(if numbered in red ink-black numbering indicates information only copy)

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Copy 1 of 1

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## 1. PURPOSE

This standard operating procedure (SOP) describes the method that SHALL be used at the Rocky Flats Environmental Technology Site (hereinafter referred to as the Site) for decontaminating sampling equipment and other small equipment in the field.

## 2. SCOPE

The collection of environmental samples requires that all equipment associated with collecting these samples be decontaminated prior to and following their use. This requirement minimizes the potential for contaminants to be introduced into the sample from external sources and for cross-contamination of areas. In addition, miscellaneous tools and small equipment used on remediation projects may need to be decontaminated prior to removal from the project site. This procedure establishes the field decontamination methods for achieving this goal.

## 3. RESPONSIBILITIES AND QUALIFICATONS

The K-H Team project manager has the overall responsibility for implementing this SOP. The project manager SHALL be responsible for assigning project staff to implement this SOP and for ensuring that all site and subcontractor personnel follow the procedures.

All personnel performing these procedures are required to have the appropriate health and safety documentation and training as specified in the Site-specific Health & Safety Plan. In addition, all personnel are required to have a complete understanding of the tasks described within this SOP and receive specific training regarding these tasks, if necessary.

All project staff are responsible for reporting nonconformances relative to this SOP to the K-H Team project manager for inclusion in the project files.

## 4. OVERVIEW

This procedure applies to the Site employees and subcontractors who are engaged in environmental activities at the Site. This procedure addresses decontamination of the following items and equipment:

- Field sampling equipment;
- Automatic water sampling equipment; and
- Miscellaneous tools and equipment.

## 5. INSTRUCTIONS

### 5.1 INTRODUCTION

This procedure describes the method for physically removing both chemical and radioactive contaminants from sampling equipment, tools and other small equipment. If the equipment is not discarded and replaced with new equipment (it is not reusable), it SHALL be decontaminated before sample collection, and before being removed from the sampling location.

Ideally, sufficient clean sample equipment are transported to the field so that an entire study can be conducted without the need for field cleaning. However, this may not be feasible or practical for some larger sampling equipment. During particularly large-scale studies, it may not be practical or possible to transport to the field all of the necessary clean field equipment, i.e., it may be necessary to decontaminate smaller items of equipment inside the contamination reduction zone in order to have these items ready for repeated use. In addition, it may be necessary to decontaminate small tools and equipment from remedial actions in order to have these items ready for repeated use.

#### 5.1.1 Definitions

Laboratory detergent means a standard brand of non-phosphate laboratory detergent, such as Liquinox or an equivalent.

Tap water is defined as the Site or offsite supplied drinking water. It may not be obtained from hydrants or the Site fire department. The use of an untreated potable water supply is

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not an acceptable substitute for the Site drinking water. The substitution of a higher-grade water (such as deionized or distilled water) for tap water is permitted and need not be noted as a variation.

### 5.1.2 General Requirements

- Tools and equipment used in radiological areas and/or in areas where the potential for radiological contamination may exceed the release limits of Table 2-2 of the Site Radiological Control Manual must be surveyed by a Radiological Control Technician (RCT). Decontamination of any item which exceed these limits must be conducted under the proper control of a Radiological Work Permit (RWP) specific to these decontamination operations.
- Decontamination procedures specified for a specific project, e.g., via task-specific Operating Procedures or project-specific work control documents (such as Work Plans or Operation Orders) take precedence over requirements stated in this procedure.
- The brushes used to clean equipment as outlined in the various sections of this procedure SHALL not be of the wire-wrapped type.
- Plastic sheeting SHALL be laid down in the area where decontamination is performed if no other adequate means of secondary wash/rinse water containment is available.
- Solvents, nitric acid solution, laboratory detergent, and rinse waters used to clean equipment SHALL not be re-used, except as specifically permitted.
- Used non-decontaminated field equipment SHALL not be stored with clean equipment, sample tubing, or sample containers. Unused materials SHALL not be replaced in storage without being decontaminated if these materials were in an area where contamination or suspected contamination was present, and the items had potential for exposure to the contamination (for example, a sealed case of tubing was opened in a contaminated area).
- Decontaminated sample containers and field equipment SHALL be stored in an area and handled in a manner that protects them from exposure to contaminants. Sample containers and field equipment SHALL be stored separately from all other equipment and supplies.
- Sample containers that contain a sample, regardless of the assumed or known level of hazard associated with that sample, SHALL have all surfaces decontaminated. For

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sample containers used in areas other than a controlled access area, a wipedown with disposable rags or toweling, or rinse with deionized or distilled water followed by drying with disposable rags or toweling, will suffice. Any visible dirt, water droplets, stains, or other extraneous materials SHALL be removed. For containers used in controlled access areas, a more rigorous decontamination and/or radiation monitoring may be required.

- Solvents, including water and mineral acids used for equipment decontamination purposes other than as described in this SOP SHALL be justified and approved by the responsible K-H Team project manager and SHALL be documented in logbooks. If decontamination fluid samples are required, the laboratory to which the samples are sent SHALL be informed of the type of liquid used as well.
- Decontamination water shall be managed as described in Section 5.6.

## 5.2 DECONTAMINATION PROCEDURES FOR FIELD SAMPLING EQUIPMENT WITHOUT THE USE OF STEAM

- [1] To the extent possible, scrape visible dirt and contamination from equipment while in the exclusion zone.
- [2] Transfer equipment from the exclusion zone to the contamination reduction zone, place the equipment in a wash basin containing non-phosphate detergent and deionized or distilled water, and remove residual visible contamination using a brush.
- [3] Transfer the equipment to a second wash basin containing non-phosphate detergent, and decontaminate equipment to remove any remaining particulate matter or surface film.
- [4] While holding the equipment over this wash basin, rinse equipment thoroughly with deionized or distilled water using a sprayer.
- [5] Transfer the equipment to a third wash basin containing deionized or distilled water for a final rinse.
- [6] Equipment may now be either wrapped in plastic to prevent cross-contamination during storage and/or transport, or re-used immediately.

*Note: For sampling equipment that is not visibly contaminated, Steps 3 and 5 can be eliminated.*

If the field equipment cannot be decontaminated utilizing this process, it should be either

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steam cleaned (see Section 5.3) or properly discarded in accordance with the Site-level waste management procedure 1-PRO-079-WGI-001 (WGI-001), *Waste Characterization, Generation, and Packaging*. If the equipment is not decontaminated immediately after use, rinse the sampling equipment thoroughly with tap water in the field as soon as possible after use. This process will make later decontamination easier and SHALL help prevent the spread of contamination.

### **5.3 DECONTAMINATION OF SAMPLING EQUIPMENT IN THE FIELD USING PRESSURIZED STEAM**

When sampling equipment is used to collect samples that contain oil, grease, or other hard-to-remove materials, it may be necessary to steam clean the field equipment. Pressurized steam may be used onsite to steam clean equipment such as:

- Split spoons;
- Hand augers;
- Slide hammers;
- Shovels; and
- Other small miscellaneous equipment

This method is to be used when the procedures described in Section 5.2 are not successful (i.e., films, residues, or other forms of contamination remain on the equipment after completing the decontamination process) or the equipment warrants more thorough decontamination. Steam-cleaning in the field is only permitted when access is available to a self contained mobile station consisting of:

- Steam/pressure generating unit that has been approved for use by the Rocky Flats Fire Department
- Curtained cleaning station that is open on one side only
- Source of clean supply water to the generator unit
- Used water collection system consisting of a drain in the bottom of the wash station leading to a gray water tank.

Site requirements, such as those imposed by the Fire Department shall be followed in the operation and use of steam cleaning equipment. In addition, personnel selected to use this equipment shall be trained in its operation and experienced with the specific

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equipment to be used. The Health and Safety Plan and JHA under which the work is being performed shall specifically address the operation and use of the steam cleaning equipment to be used.

- [1] Scrape heavy contamination from the equipment (into an IDM drum with other drill cuttings, if appropriate, or other receptacle identified by the project manager, if containment is required) before placing the equipment on the wash stand.
- [2] Place the equipment inside the curtained wash stand.
- [3] Ensure that none of the equipment to be washed extends out of the curtained area.
- [4] Decontaminate the equipment thoroughly, rotating the piece to ensure that all surfaces are decontaminated.
- [5] Ensure that all free water has drained from the equipment before removing from the wash stand.

## 5.4 DECONTAMINATION PROCEDURES FOR AUTOMATIC WATER SAMPLING EQUIPMENT

### 5.4.1 General

Decontamination of automatic samplers is only performed when automated samplers are removed from service for general cleaning or if they are redeployed elsewhere. The automated samplers are sealed, and the intake lines are purged with each and every grab sample pulled.

Automatic samplers SHALL be cleaned as follows:

- [1] The exterior and accessible interior portions (excluding the waterproof timing mechanism) of automatic samplers SHALL be washed with non-phosphate detergent and rinsed with tap water.
- [2] New silastic pump tubing SHALL be installed.

*Note: Silastic tubing for automatic samplers and other peristaltic pumps is to be discarded after use, i.e., it is not to be decontaminated or reused. Teflon® tubing that is attached to the silastic tubing may be discarded, or decontaminated and reused in accordance with the instructions provided in Section 5.5.2.*

#### 5.4.2 Automatic Sampler Headers

- [1] Disassemble header and, using a bottle brush, wash with tap water and non-phosphate laboratory detergent.
- [2] Rinse thoroughly with deionized or distilled water.
- [3] Reassemble header, let dry thoroughly, and wrap with plastic or re-install immediately.

#### 5.4.3 Plastic Composite Containers

Usually reusable plastic containers are supplied "certified" clean by the laboratory. When this is not the case, decontaminate the composite container using the procedures as outlined in Section 5.2 prior to use.

#### 5.4.4 Bottle Siphons Used to Transfer Sample From Composite Container

- [1] Use a new dedicated siphon for each sampling location.
- [2] Use new 3/8-inch Teflon tubing for samples collected for organic compounds analyses. The siphon and tubing should be flushed with sample thoroughly before use.

### 5.5 DECONTAMINATION PROCEDURES FOR MISCELLANEOUS EQUIPMENT

Miscellaneous equipment such as well sounders, tapes, field tools, analytical equipment, and ice chests and other shipping containers SHALL be decontaminated using the following processes.

#### 5.5.1 Well Sounders or Tapes Used to Measure Groundwater Levels

When this equipment is decontaminated in the field:

- [1] Decontaminate with laboratory non-phosphorus detergent and tap water.
- [2] Rinse with deionized or distilled water.
- [3] Equipment SHALL either be wrapped with non-reactive plastic or placed in a carrying case to prevent contamination during storage or transit.

#### 5.5.2 Equipment Used to Purge Groundwater Wells

Where appropriate, pumps and associated tubing are employed to purge and sample

groundwater-monitoring wells. This equipment SHALL be decontaminated as follows:

- [1] The external surfaces of the equipment SHALL be vigorously hand scrubbed with a solution of a non-phosphate, laboratory grade detergent and tap water, followed by rinsing with water by submerging or spraying. The equipment SHALL then be triple rinsed thoroughly with approved deionized or distilled water.
- [2] Internal surfaces SHALL be decontaminated by pumping a solution of non-phosphate detergent and water through the equipment. The soap solution SHALL be displaced immediately by pumping deionized or distilled water equivalent to at least 10 volumes of the pump storage capacity through the equipment.
- [3] Reusable bailers used to purge and/or sample groundwater monitoring wells SHALL be disassembled prior to decontaminating. All parts SHALL then be scrubbed thoroughly using a brush in a solution of non-phosphate detergent and water. All surfaces SHALL be thoroughly scrubbed, including the interior of the bailer body (using a long bottle brush of the appropriate diameter). Following this soap scrub, each part SHALL be rinsed in deionized or distilled water and excess water SHALL be allowed to runoff. The bailer SHALL then be reassembled and stored so as to prevent cross-contamination during storage and transport.
- [4] The line used to lower and raise the bailer in the well SHALL be scrubbed using non-phosphate laboratory grade detergent and tap water and rinsed in the deionized or distilled water.

### 5.5.3 Other Field Instrumentation and Tools

The exterior of sealed, watertight equipment should be washed with non-phosphate laboratory detergent and rinsed with tap water before storage. The interior of such equipment may be wiped with a damp cloth if necessary. Ensure that the equipment is dry prior to storage.

Other field instrumentation should be wiped with a clean, damp cloth. Conductivity probes, pH meter probes, dissolved oxygen (DO) meter probes, etc. SHALL be rinsed with deionized or distilled water before storage.

If desiccant is present in flow meters or other equipment, the equipment should be checked each time the equipment is cleaned (once dry) and replaced, if necessary.

For small tools and miscellaneous equipment, as well as equipment used for surface water quality and sediment sampling (such as Kemmerers, buckets, DO dunkers, dredges, etc.), decontaminate with laboratory-grade non-phosphate detergent and water, and rinse with deionized or distilled water between sampling locations. A brush may be used to remove deposits of material or sediment, if necessary. Water samplers should be flushed with ambient water at the next sampling location before the sample is collected.

Flow measuring equipment (such as, weirs, staff gauges, velocity meters, and other stream gauging equipment) SHALL be cleaned with tap water after use and between measuring locations.

#### **5.5.4 Ice Chests and Shipping Containers**

All ice chests and reusable containers SHALL be decontaminated using non-phosphate detergent and water, followed by a deionized or distilled water rinse.

#### **5.5.5 Small Stainless Steel or Teflon Equipment Used to Sample Media Possibly Containing Polychlorinated Biphenyls (PCBs)**

When equipment is decontaminated in the field, decontaminate objects by:

- [1] Using a hand held spray bottle, spray equipment with iso-octanol, or a solution of tap water and a non-phosphate laboratory detergent such as pipex or liquinox.
- [2] Thoroughly scrub equipment as appropriate, then wipe equipment with a disposable cloth or other suitable material and discard used wipe properly.
- [3] Using a hand held spray bottle, spray equipment with tap water.
- [4] Thoroughly wipe equipment, properly discarding the cloth.
- [5] Using a hand held spray bottle, spray equipment with deionized or distilled water.
- [6] Thoroughly wipe equipment, and properly discard the cloth.
- [7] If the equipment is not to be used immediately after decontamination, then the equipment should be wrapped in plastic or aluminum foil.

#### **5.6 DISPOSITION OF DECONTAMINATION WATER**

Spent decontamination water SHALL be managed in accordance with RMRS/OPS-PRO.112, *Handling of Field Decontamination Water and Field Wash Water*. This

procedure addresses transport of the water on Site, and transfer of the water to either the Main Decontamination Facility or the Consolidated Water Treatment Facility for subsequent treatment.

## 6. QUALITY ASSURANCE/QUALITY CONTROL

Quality Assurance (QA) and Quality Control (QC) activities SHALL be conducted according to applicable sampling and analysis plans.

As detailed in these documents, the effectiveness of the sample equipment cleaning generally will be monitored by submitting rinse water to the laboratory for low-level analysis of the parameters of interest. Rinsate samples are collected by pouring deionized or distilled water over the representative equipment.

## 7. DOCUMENTATION

Analytical results of equipment rinsate samples are considered adequate documentation of the decontamination process.

## 8. SOURCE REFERENCES

Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual. U.S. Environmental Protection Agency. Athens, GA. 1986

Federal Register, Volume 44.40 CFR Part 136. "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act."

Test Methods for Evaluating Solid Waste. SW-846, 2<sup>nd</sup> Edition. U.S. Environmental Protection Agency. Washington, D.C. 1982.

Technical Enforcement Guidance Document (TEGD). EPA, 1986.



Rocky Mountain  
Remediation Services, L.L.C.  
... protecting the environment

# PROCEDURE

Handling of Field Decontamination Water  
and Field Wash Water

RMRS/OPS-PRO.112

Rev.0

Date Effective: 12/30/98

Page 1 of 3

APPROVED: \_\_\_\_\_

Norman Cypher, Water Operations, RMRS

## 1. PURPOSE

This document describes procedures used by subcontractors at Rocky Flats Environmental Technology Site (RFETS) to handle field decontamination water and field wash water.

## 2. SCOPE

This procedure applies to all Water Operations workers handling decontamination water including: groundwater, surface water and decontamination facility personnel. Proper handling, storage and treatment of decontamination generated water is required to minimize the potential spread of contamination to other areas and personnel.

This document is a total rewrite and replaces 5-21000-OPS-FO.07, Rev. 2, Handling of Decontamination Water and Wash Water.

## 3. DEFINITIONS

**Approved Detergent** - Liquinox or other laboratory grade phosphate free detergent.

**Decontamination Water** - Water with an approved detergent or clean water used for cleaning and rinsing equipment, personnel, samples or vehicles in work areas characterized as potentially contaminated or in areas where field monitoring detected readings above background. Also, all water used to clean subsurface soil equipment (drilling equipment, Geoprobe vehicles) will be considered decontamination water, regardless of work area characterization.

**Wash Water** - Approved detergent water or clean water used to clean equipment, personnel, samples, or vehicles used at work areas characterized as not potentially contaminated and where NO field monitoring readings above background were detected.

**Potentially Contaminated** - Areas characterized as potentially contaminated or areas where field monitoring detected readings above background.

**NOT Potentially Contaminated** - Areas characterized as not potentially contaminated and where NO field monitoring readings above background were detected.

4. **REQUIREMENTS**

All personnel working with decontamination water and wash water will have the proper training. Training requirements will be verified by the RFETS Project Manager.

Training may include:

- OSHA 40 Hour Hazardous Waste Operations
- Radiation Worker Level II
- Any other training required by RFETS Project Management

5. **INSTRUCTIONS**

The work area will be characterized by RFETS prior to starting any field activity. Work area characterization will be based on historical chemical and radiological results of soil and groundwater samples. Radiological field monitoring surveys conducted by Health and Safety Specialists (HSSs) or Radiological Control Technicians (RCTs) will also be used to characterize an area. Types of contamination encountered may include:

- Non-Radioactive RCRA regulated hazardous substances
- Low Level radioactive contaminated substances
- Mixed Waste (Low level radioactive combined with RCRA hazardous substances)

Equipment needed to handle decontamination water or wash water may include the following:

- Enclosed Truck or trailer for holding liquid waste containers
- Personal splash protection
- Pump (hand or peristaltic)
- Drums or liquid waste containers
- Drum handling equipment (if required)

**Decontamination Water and Wash Water**

Decontamination water and wash water will be held in liquid material containers. Every container will be inspected for holes, leaks and adequate seals before each use. Each container must have a secure fitting lid, which will not leak if overturned. Container lids will be securely in place prior to movement. Containers will be appropriately labeled. All containers will be placed in an enclosed truck or trailer for transport. Container transport will follow the applicable procedures outlined in 1-T91-TRAFFIC-100,

Transportation Manual and 1-T93-TRAFFIC-110, On-site Transportation of Hazardous and Radioactive Materials Manual.

If required an HSS or RCT will conduct Radiological surveys on equipment, samples, containers, personnel or vehicles before leaving the work area. Radiological surveys will be conducted in accordance with the Radiological Safety Practices Manual.

**Water Disposition**

Filled containers will be taken to a Decontamination Facility (B966 or B903A) or to B891 Consolidated Water Treatment Facility (CWTF) for treatment. The location for water disposition will be based on historical knowledge and sediment levels. The CWTF will accept water based on criteria outlined in RF/ER-96-0018, Consolidated Water Treatment Facility Sampling and Analysis Plan.

When the containers are empty and the job is completed the containers will be decontaminated according to 5-21000-OPS-FO.03, General Equipment Decontamination.

**References**

5-21000-OPS-FO.03, General Equipment Decontamination

5-21000-OPS-FO.04, Heavy Equipment Decontamination

RMRS/OPS-PRO.141, Protected Area Decontamination Facility Operations

OPS-PRO.008, Main Decontamination Facility Normal Operations-FO.17

1-T91-TRAFFIC-100, Transportation Manual

1-T93-TRAFFIC-110, On-site Transportation of Hazardous and Radioactive Materials Manual

RF/ER-96-0018, Consolidated Water Treatment Facility Sampling and Analysis Plan

Radiological Safety Practices Manual

# ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE PRO-1457-UL

## USE OF LOGBOOKS

Responsible K-H Organization: Environmental Restoration Program Effective Date: 11/1/01

Approved By: MANAGER/ER PROGRAM / 10/04/01  
Title Date

Lane Butler / [Signature]  
Print Name Approval Signature

Annette Primrose  
Print Name of Responsible Manager (N/A if RM is Approval Authority)

The Responsible Manager Has Determined The Following Organizations' Review Is Required. Review Documentation Is Contained In the Document History File:

Environmental Media Management

| IMPORTANT NOTES           |                               |
|---------------------------|-------------------------------|
| Periodic Review Frequency | Documents Superseded (if any) |
| 4                         | 2-S47-ER-ADM-05.14            |

REVIEWED FOR CLASSIFICATION/UCNI

By: [Signature] (If Required) 4/1/01

Date: 10/9/01

CONTROLLED DOCUMENT  
(if numbered in red ink/black circle indicates information only)

Copy Number 7

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## 1. PURPOSE

The purpose of this procedure is to provide instructions for using and controlling logbooks for environmental restoration and other field activities at the Rocky Flats Environmental Technology Site (Site).

## 2. SCOPE

This procedure applies to Site employees and subcontractors who are engaged in environmental restoration and other field activities across the Site. This procedure addresses the applicability, use, and close out of field logbooks.

## 3. OVERVIEW AND APPLICABILITY

This procedure provides information related to the use of field logbooks. It applies to all field activities regardless of whether alternate types of documentation, e.g., task- or project-specific forms exist. If such forms do exist and are required by the work controlling document under which the field activities are performed, and these forms provide sufficient documentation of activities, events, and observations, then duplication of this information in the field logbook is not required. In these cases, only chronology of events and other relevant notes would be recorded in the field logbook.

## 4. DEFINITIONS

Field Logbook-The primary record of field activities intended to provide sufficient data and observations to enable project personnel to reconstruct events that occurred.

ER (Environmental Restoration) Project File Center (PFC) - The ER program-specific central repository for project letters, documents, field forms, field logbooks, etc.

ER PFC Document Control Log - A log maintained and controlled by the ER PFC for use in issuing control numbers for field logbooks.

Records Management - Controls disposition of original records and receives records for archiving.

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## 5. RESPONSIBILITIES

### 5.1 Responsible Manager

- Ensure that at least one logbook is maintained for each project. Where multiple projects are under the supervision of one field project manager, the field project manager can maintain one logbook for multiple projects.
- Ensure that a unique number from the ER PFC Document Control Log (or from another Site document control program) is assigned to the field logbook.
- Ensure each individual who will be entering information in a logbook is appropriately trained. Training will include reading this SOP.
- Ensure that the field logbooks receive a peer review near the beginning of the project, at the end of the project, and at quarterly intervals during the project.
- Ensure that completed field logbooks are submitted and properly archived in the ER PFC (or other Site archive).
- Ensure that recorded data are entered in the ER database, if applicable.

### 5.2 Field Logbook User

- Ensure that the field logbook is bound and that pages are numbered sequentially.
- Ensure that entries made in the field logbook are in accordance with this SOP, and are complete, concise, legible, and contain all applicable data, activities, references to procedures and forms, and observations necessary to reconstruct the activity being recorded.

### 5.3 Field Logbook Peer Reviewer

- Perform an independent review to ensure that the entries made in the field logbook satisfy the requirements of this SOP, and are complete, concise, and contain applicable data, activities, and references to procedures and forms.

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## 6. INSTRUCTIONS

The following steps are applicable to all logbooks used in the field.

### 6.1 Field Logbook

#### Responsible Manager

- [1] Issue Field Logbook.

#### Field Logbook User

- [2] Obtain a unique number from the ER PFC Document Control Log, or from another programmatic source, as appropriate.
- [3] Print the project name and the unique control number clearly on the title page of the field logbook.
- [4] Clearly print the name of the individual(s) responsible for the field logbook. When the work starts, begin the daily record keeping in the field logbook.
- [5] Record the unique control number and date at the top of each page, and sequentially number each page, if not already paginated.
- [6] Ensure that all applicable information is documented in the field logbook as outlined in Appendix 1, Examples of Entries for Field Logbook.

*Note: Use non-smearable, waterproof black or blue ink. Do not use pencils to make logbook entries.*

- [7] Protect the field logbook against damage, deterioration, or loss. Depending upon work location, the logbook may require radiological evaluation prior to release from the work area.
- [8] WHEN work is completed for the day,  
THEN:
  - [A] Line out the remaining lines of the page that have NO entry.
  - [B] Include the comment "End of Day."
  - [C] Sign and date the page.
- [9] WHEN errors are found in an entry in the field logbook,  
THEN:
  - [A] Draw a single line through the incorrect entry.

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[B] Initial and date the lined-out entry.

[C] Record the correct entry.

*NOTE 1: Only the person who made a logbook entry, or the peer reviewer, is authorized to correct the entry.*

*NOTE 2: The original entry is to be readable through the lined-out entry.*

*NOTE 3: All logbook entries SHALL be made as the activities being documented in the logbook are being performed. Recording logbook entries, at the end of the day or later, is not acceptable on a routine basis. In cases where this may be necessary because of work circumstances; the author SHALL preface these entries with a note in the logbook stating that entries were made at the end of the day (or whenever they were made), and the reason this was necessary.*

*Note 4: All logbook entries shall be made in chronological order, using standard, Military time notation.*

#### Field Logbook Peer Reviewer

[10] Review the field logbook to ensure that the following activities were properly completed:

- Field logbook paginated
- Black or blue ink used for log keeping
- Includes expected entries, per Appendix 1
- Control number entered on top of each page
- "End of Day" entries are properly recorded
- All corrections lined out, initialed, and dated
- Peer reviews performed at the frequency assigned by the Responsible Manager.

*Note: Use non-smearable, waterproof black or blue ink. Do not use pencils to make logbook peer review entries.*

[11] If minor errors are found and the corrections are obvious, and the person who made the entries is not available to make the correction, then:

[A] Draw a single line through the incorrect entry.

[B] Initial and date the lined-out entry.

[C] Record the correct entry.

[12] Record results of the peer review at the end of the logbook entries that were reviewed. Clearly indicate which logbook entries were reviewed.

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- [13] Initial and date the entry regarding the peer review.

## 6.2 Field Logbook Closeout

### Field Logbook User

- [1] Make an entry in the field logbook indicating that the field logbook has been completed.
- [2] If activities being documented in the filled logbook are to be continued in another logbook, identify that logbook by Control Number.
- [3] Submit the completed field logbook to the Peer Reviewer for review.

### Field Logbook Peer Reviewer

- [4] Review the field logbook, and document the review according to the instructions provided in Section 6.1.

## 7. RECORDS

Field logbooks are quality records. Submit all quality records to the ER PFC for filing, or to another appropriate records management group for non-ER work.

## 8. REFERENCE SECTION

1-V41-RM-001, Records Management Guidance for Record Sources

3-H10-SOP-126, Records Control Program

## 9. APPENDICES

Appendix 1, Examples of Entries for Field Logbook

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## APPENDIX 1

### Examples of Entries for Field Logbook

Record sufficient information to reconstruct the events of the day. This will include the following information as applicable:

1. Detailed account of field activities including facts, events, occurrences, injuries, accidents, accomplishments, and special conditions.
2. Activity location.
3. Field personnel or team members, including supporting organization personnel (e.g., RCTs) (if not available elsewhere).
4. Procedure number and revision number, IWCP or RWP if applicable.
5. List of equipment used for the day's activities by name, model number, serial number, or other identifier, if not already listed on a separate form.
6. Field instrument calibration data if not recorded elsewhere.
7. Weather conditions, wind, precipitation, air temperature, etc.
8. Chronological record of activities in standard, unrounded military time.
9. Arrival times, departure times, purposes, and names of visitors to project work site.
10. Conditions or incidents that may affect project tasks or results (record time, date, nature of condition or incident, and location of condition or incident).
11. Any deviations from the plan used for the project.
12. Telephone conversations with pertinent details and agreements.
13. Excavation depth and width (a drawing is usually very helpful), if applicable.
14. Daily work start and stop times.
15. Downtime (record time, date, and reason).
16. Any other observations and information that may be pertinent or of interest.

For characterization activities, include the following additional information as appropriate:

17. Specific sampling information including location and depth of sample
18. Types and numbers of samples collected
19. Collection method
20. Time and date of sample collection

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- 21. Type and preparation of sample bottles if not recorded elsewhere
- 22. Preservation of samples if not recorded elsewhere
- 23. Field measurement data (if applicable)

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## **SOP - INVESTIGATION DERIVED WASTE**

**This standard operating procedure (SOP) shall be replaced with any official RFETS investigation-derived waste (IDW) SOP if applicable.**

This section describes the management program for IDW generated during the Present Landfill (PLF) monitoring period. Field tasks that will generate waste include monitoring well purging and decontamination of equipment. Disposable equipment and personal protective equipment (PPE) are classified as miscellaneous IDW.

To avoid potential environmental impacts, all wastes derived from field activities will be properly managed. The following protocol for management of these IDW is in accordance with CDPHE's document "Draft Interim Final Policy and Guidance on Management of IDW at RCRA Facilities." The primary purpose for record keeping is to facilitate management and tracking of IDW and other containerized waste. A hardcopy record will be used to track waste from the point of waste generation, to the storage location, and through final waste disposition. When a container is filled, information about the waste is included on a container management record. If the waste container is relocated, a container transport record must be completed to identify the new location of the container. A container inspection form is used to document waste management practices such as storage, spill remediation, and container and label maintenance. If the waste is transported for treatment or disposal, a container disposal form will be completed to provide details of the waste disposition.

### **Investigation-Derived Waste Collection**

All wastewater from decontamination procedures and monitoring well purging will be containerized in Department of Transportation (DOT)-specified 55-gallon drums labeled "Investigation-Derived Waste." Contaminated PPE, plastic sheeting, disposable bailers, rope, and other sampling-derived wastes will be containerized in separate DOT-specified 55-gallon drums also labeled "Investigation-Derived Waste." Wastewater from well purging from locations without previous analytical data must be placed in new metal drums. Wastewater from these activities from locations with existing analytical data that show minimal elevated concentrations may be placed in decontaminated polyethylene drums.

Drums containing PPE or wastewater will be permanently marked with the following information: type of material (PPE or water); site number and location; monitoring well identification (number and depth); and date. The drum identification number will allow correlation with other data such as exact locations where material was generated and analytical results.

In general, groundwater analytical data from the monitoring wells will be used for waste determination. A waste determination will be made within 30 days. Weekly inspections of the IDW will be performed. The IDW storage areas will be fenced or secured. If the IDW cannot be fenced or secured at the individual monitoring wells, the IDW will be transported to a 90-day storage area or a permitted storage area and the transportation will be documented.

**Investigation-Derived Waste Drum Labeling**

The contractor will fill the drums/containers as the IDW is generated for the specific tasks. The IDW from separate monitoring wells must be kept segregated by site and will not be placed in the same drums/containers. The IDW will be segregated by category (liquid or miscellaneous) and specific IDW type as listed in the table below. The IDW will also be segregated by sampling event to eliminate the need to open drums/containers that have been previously sealed. Therefore, IDW generated at different sites and/or times will be containerized separately.

| <b>IDW Categories and Types</b> |   |
|---------------------------------|---|
| <b>General IDW Categories</b>   | <b>Specific IDW Types</b>   |
| Liquid IDW                      | Development and Purge Water<br>Decontamination Fluids                     |
| Miscellaneous IDW               | Disposable Personal Protection Equipment<br>Disposable Sampling Equipment |
| IDW Spills                      | Development and Purge Water<br>Decontamination Fluids                     |

A label with the following information will be placed on each of the drums/containers until the analytical results are evaluated to determine if the IDW is a hazardous or nonhazardous waste:

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“This container on hold pending analysis”; contents “Investigation-Derived Waste”; drum ID; date; origin of materials; address “RFETS”; and contact. In addition, a permanent marker (grease pen or paint pen) will be used to further label the drum with the following information: unique drum identification number, contents, and accumulation start date. If the analytical results indicate the IDW is a hazardous waste, the drums/containers will be relocated to a 90-day hazardous waste storage area. Hazardous waste determinations, drum relabeling, and disposal will be performed by the hazardous waste storage area operator.

### **Investigation-Derived Waste Storage**

IDW waste storage will occur at the monitoring well locations and at the RCRA 90-day storage area, if necessary. Material determined to be hazardous will be transported to the 90-day storage area will be shipped off-site to an appropriate treatment/disposal facility within 90 days of the waste determination. Nonhazardous material may remain at the monitoring well location and will be transported off-site within 90 days of waste determination for treatment and/or disposal.

### **Monitoring Well Staging Area**

Monitoring well staging areas will be designated during sampling activities based on the following criteria:

- Amount of material to be staged,
- Transport considerations from field activities,
- Topography and surface water runoff considerations,
- Secondary containment,
- Physical segregation of different waste types,
- Access to drums and containers, and
- Security.

Loading and unloading of containers will be conducted with a forklift, drum hoist, or other appropriate equipment. The material will be segregated within the staging/storage area by IDW category (i.e., liquid or miscellaneous) and will be accessible for inspections, bulking activities, or shipment for treatment/disposal. Obviously hazardous waste will be taken immediately to the 90-day storage area and disposed as a hazardous waste. The waste to be removed from the site for final disposition will be appropriately documented and manifested to ensure compliance with

all regulations, both solid and hazardous waste. All transport and relocation of containers will be documented in a container transport record form. This form must also provide for IDW transport from a staging area to a different staging area or to the 90-day storage area.

The contractor is responsible for conducting weekly inspections of the drums/containers located at the monitoring well staging areas. The inspections will be documented on a container inspection form. This form prompts the inspector to document the staging area, the number of containers located at the staging area, drum identification, and damage evaluation of the drum and drum label, and to determine if there is evidence of a spill or leak and what corrective actions should be taken if damage or a spill/leak has occurred. If an IDW spill or leak occurs, the contractor will notify RFCA parties immediately.

#### **Ninety-Day Storage Area**

Drums containing hazardous waste will be stored in the RCRA 90-day storage area. IDW stored in the 90-day storage area will be inspected weekly (CCR Subpart I 265.174) to determine the status of the drums/containers. The transportation of waste to the RCRA 90-day storage area will be documented using a container transport form.

#### **Investigation-Derived Waste Disposal**

Final disposition of IDW is dependent on a number of factors, including the type of IDW, hazardous waste determination, quantity of IDW, constituents, and concentrations detected in the IDW, costs, and regulatory compliance. The results of groundwater sampling will be used to determine disposal options for well purge water, decontamination water, and miscellaneous IDW (i.e., PPE or sampling equipment). Decontamination fluids will be characterized by groundwater analytical results, as appropriate. A sample of the decontamination water may be required to evaluate disposal options. The wastewater will be disposed of at an off-post treatment storage and disposal facility. Additional analysis may be required to characterize any of the IDW streams, and additional requirements will be detailed in the site-specific work plans.

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