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Environmental Sciences Division

ACTIVE SITES ENVIRONMENTAL MONITORING PROGRAM
PROGRAM PLAN

Rev. 2

C. M. Morrissey, D. S. Hicks, and T. L. Ashwood
Environmental Sciences Division

G. R. Cunningham
Waste Management and Remedial Action Division

Environmental Sciences Division
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PROGRAM PLAN

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C. M. Morrissey

C. M. Morrissey, Project Manager
Environmental Sciences Division

2/28/94

Date

G. R. Cunningham

G. R. Cunningham, Program Manager
Waste Management and Remedial Action Division

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Date

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ABBREVIATIONS AND ACRONYMS

ASEMP	Active Sites Environmental Monitoring Program
DOE	Department of Energy
EASC	Emergency Avoidance Solidification Campaign
ER	Environmental Restoration
ESD	Environmental Sciences Division
FRP	fiberglass reinforced plastic
HDTF	Hillcut Disposal Test Facility
IWMF	Interim Waste Management Facility
IRL	internal reporting level
LLW	low-level waste
LWSP	Liquid Waste Solidification Project
MVST	Melton Valley Storage Tanks
NPDES	National Pollutant Discharge Elimination System
ORNL	Oak Ridge National Laboratory
QA	quality assurance
RCRA	Resource Conservation and Recovery Act
RSWO	Radioactive Solid Waste Operations
SWO	Solid Waste Operations
SWSA	Solid Waste Storage Area
TRU	transuranic
WMRAD	Waste Management and Remedial Action Division

EXECUTIVE SUMMARY

The Active Sites Environmental Monitoring Program (ASEMP), initiated in 1989, provides early detection and performance monitoring of active low-level-waste (LLW) and transuranic (TRU)-waste facilities at Oak Ridge National Laboratory (ORNL) in accordance with U.S. Department of Energy (DOE) Order 5820.2A. The Environmental Sciences Division implements the program for Waste Management and Remedial Action Division (WMRAD). Several changes have recently occurred in regard to the sites that are currently used for waste storage and disposal. These changes require a second set of revisions to the ASEMP program plan. This document incorporates those revisions.

Active LLW facilities in Solid Waste Storage Area (SWSA) 6 include the Interim Waste Management Facility (IWMF), a storage site for the low-level Liquid Waste Solidification Project (LWSP II) campaign, and TRU-waste storage buildings.

The IWMF consists of aboveground, high-strength concrete pads on which concrete vaults containing metal boxes of grouted LLW are placed. Eventually, an engineered multilayered cap will cover these pads and vaults. The LWSP II site in SWSA 6 was a staging area for tumulus and IWMF loading activities. Buildings 7878 and 7842 in SWSA 6 are being prepared for storage of contact-handled TRU waste in 55-gal, stainless-steel drums. In addition, this program plan includes the monitoring of the Hillcut Disposal Test Facility (HDTF) in SWSA 6, even though this facility was completed before the date of the DOE order.

In SWSA 5 North, the TRU facilities include below-grade engineered caves, high-range wells, unlined trenches, and storage buildings.

The LWSP/Emergency Avoidance Solidification Campaign (EASC) site, Area 7856 in Melton Valley, houses solidified Melton Valley Storage Tank (MVST) supernatant in steel-lined concrete storage casks. ASEMP will continue monitoring this site until the casks are shipped off-site.

Monitoring activities at all sites covered by the ASEMP are based on the current conceptual model of the hydrology in the waste storage areas as well as site-specific characteristics, and are driven by the facility design.

In all areas, water is the primary vector for

stormflow within the upper 1-2 m of soil or as groundwater in the shallow aquifer.

The IWMF and the LWSP/EASC storage areas are aboveground facilities. The IWMF pads provide the first line of containment for any waste material that might escape from the concrete vaults. Water running off the pads is sampled and analyzed for gross radionuclide parameters. Should the concrete pads leak, the gravel base below the pads would accumulate the contaminated water, which would drain away from the pads and be sampled. In order to prevent stormflow and shallow groundwater from accumulating in the underpad drainage area, an upgradient French drain routes the stormflow and shallow groundwater away from the facility. The outfall from this French drain is periodically sampled. The need for monitoring the shallow groundwater below the facility is thus obviated.

To monitor the individual LWSP/EASC casks for leakage of liquid from the waste form, ASEMP personnel sample any water that accumulates in the liquid collection area of the concrete storage casks. Soil around the periphery of the sites is sampled and analyzed for radionuclide contamination.

HDTF, which is very similar to a tumulus-type facility that is already buried, is monitored through the collection and sampling of water that accumulates on the concrete pad and in the gravel base.

In SWSA 5 North, transport through the shallow aquifer, especially along preferred pathways, may be more important than shallow stormflow. Thus, in this area, monitoring activities focus on groundwater monitoring wells, seeps, and samples from small tributaries that drain the area. Water that accumulates in sumps that drain individual disposal facilities in SWSA 5 North is also sampled and analyzed for any indication of radioactive contamination.

All samples from SWSA 6 are screened for alpha and beta activity and counted for gamma-emitting isotopes. In addition to these analytes, samples of groundwater from selected wells in SWSA 5 North are analyzed for specific TRU elements.

This program plan presents the organization and procedures for monitoring the active sites. The program plan also provides internal reporting levels to guide the evaluation of monitoring results.

1. INTRODUCTION

The Active Sites Environmental Monitoring Program (ASEMP) was initiated in 1989. The Radioactive Solid Waste Operations (RSWO) Department in the Waste Management and Remedial Action Division (WMRAD) at Oak Ridge National Laboratory (ORNL) funds the program and the Environmental Sciences Division (ESD) implements it. Results of the first 4 years of monitoring activities are documented in several semiannual and annual reports (Wickliff et al. 1991a,b; Ashwood et al. 1991a,b; Morrissey et al. 1993; Yager 1991).

This document presents changes to the first revision of the program plan (Ashwood et al. 1992) that have become necessary primarily because of changes in the sites used for waste storage and disposal.

The introduction to this report provides information on the background and scope (Sect 1.1), project organization (Sect 1.2), and concerns about quality assurance (QA) and health and safety (Sects. 1.3 and 1.4). Section 2 describes the technical basis for the program. Section 3 includes specific monitoring activities for each facility. Reporting and milestones are addressed in Sect. 4. Detailed monitoring procedures are included in an appendix.

1.1 REGULATORY BACKGROUND AND SCOPE

Chapter III of U.S Department of Energy (DOE) Order 5820.2A (U.S. DOE 1988) sets forth requirements for the environmental monitoring of operational low-level-waste (LLW) disposal facilities. Two statements from this order are included here because they set the framework for the ASEMP activities in Solid Waste Storage Area (SWSA) 6.

The environmental monitoring program shall be designed to measure: (a) operational effluent releases; (b) migration of radionuclides; (c) disposal unit subsidence; and (d) changes in disposal facility and disposal site parameters which may affect long-term site performance.
[Sect. 3.k.2]

The monitoring program shall be capable of detecting changing trends in performance sufficiently in advance to allow application of any necessary corrective action prior to exceeding performance objectives. The monitoring program shall be able to ascertain whether or not effluents from each . . . disposal facility or disposal site meet the requirements of applicable

EH Orders. [Sect. 3.k.4]

Performance monitoring associated with LLW facilities is required under Chap. III, Sect. 3.b(3) of the order.

Where practical, monitoring measurements to evaluate actual and prospective performance should be made at locations as required, within and outside each facility and disposal site. Monitoring should also be used to validate or modify the models used in performance assessments.

Transuranic (TRU) waste storage areas such as SWSA 5 North are covered in Chap. II of the order. Environmental monitoring is required as follows for temporary and interim storage:

Transuranic wastes in storage areas shall be monitored periodically to ensure that the wastes are not releasing their radioactive and/or hazardous constituents. [Sect. 3.e(4)]

An environmental monitoring system shall be provided to detect any release and migration of major radioactive and hazardous components. Background levels of primary radioactive and hazardous waste components shall be determined. [Sect. 3.g(2)(c)]

The scope of this program includes all ORNL waste disposal sites that were active on or after the date of the order (September 1988) and that are under the operational control of the RSWO Department in WMRAD. Other areas may still be "active", but the Environmental Restoration (ER) program controls them. These ER-controlled areas will be monitored as part of the Waste Area Grouping 6 environmental monitoring program.

In SWSA 6, the ASEMP-monitored active sites include the low-level Liquid Waste Solidification Project (LWSP) II site, the Interim Waste Management Facility (IWMF), the Hillcut Disposal Test Facility (HDTF), and the Building 7878 sump (Fig. A.1). HDTF is included in ASEMP, even though it was not used for waste disposal on or after the date of the DOE Order.

The suspect waste landfill, biological trenches, LLW silos, high-range wells, fissile wells, and asbestos silos in SWSA 6 are now under the control of the ER Division and are not monitored as a part of this program.

This plan also addresses monitoring activities in SWSA 5 North and at the original EASC/LWSP storage site, Area 7856, in Melton Valley near the new hydrofracture facility (Fig. A.2). Active TRU-waste facilities in SWSA 5 North include aboveground and belowground buildings and auger holes similar to the high-range wells in SWSA 6. ASEMP will monitor sumps that drain buildings 7855, 7826, and 7834 in SWSA 5 North for any water that enters these waste storage areas. A series of wells within and adjacent to SWSA 5 North will be used to monitor groundwater in and around the area. Streams and seeps in the SWSA 5 North area are also sampled (Fig. A.3). Individual storage casks at the Emergency Avoidance Solidification Campaign (EASC)/LWSP sites are monitored for leakage, and the soil in and around the area is periodically sampled and analyzed for radionuclide contamination.

Compliance monitoring required under the Resource Conservation and Recovery Act (RCRA) or for National Pollutant Discharge Elimination System (NPDES) permits is not included in this program. Although information can be shared among the ASEMP and other monitoring programs, the QA requirements and monitoring approaches are so different that data from ASEMP cannot be used for environmental compliance monitoring.

1.2 ORGANIZATION

Four individuals from ESD implement ASEMP, and the ASEMP program manager in WMRAD oversees the entire program (Fig. A.4). Close coordination is maintained with Solid Waste Operations (SWO) personnel in each SWSA, and information is shared as needed with ER activities. Monthly and annual reports (Sect. 5) are issued to all interested individuals within ORNL, including representatives of waste management operations, environmental monitoring, and ER organizations.

1.3 QUALITY ASSURANCE

This program is conducted in accordance with a QA program that is consistent with DOE Order 5700.6C. A separate QA plan has been prepared and will be updated as necessary.

Specific procedures have been established for each monitoring activity, uncontrolled copies of which are included in Appendix C. All project personnel have received appropriate training in these procedures as well as training required to enter the SWSAs.

1.4 HEALTH AND SAFETY

A Project Safety Summary approved by the ESD safety officer covers each monitoring activity. All project personnel have received at least 24 h of training required for entry into the SWSAs as well as annual updates. All project personnel are on the ORNL bioassay program.

2. TECHNICAL BASIS

This section describes the basic hydrologic concepts that guide the monitoring activities and the manner in which these concepts are applied at each facility. Data quality objectives and action levels are also discussed.

2.1 CONCEPTUAL MODEL

The primary vehicle of contaminant transport in SWSA 5 North and SWSA 6 is water. Both areas receive ~130 cm of rainfall per year (Moore 1989). Both light and heavy rainfalls occur throughout the year. Slightly more than half of this rainfall returns to the atmosphere through evapotranspiration (Moore 1989). Thus, ~60 cm of rainfall per year is available to transport contaminants.

Moore (1988, 1989) suggests that most of the subsurface flow in the ORNL area occurs laterally in a shallow stormflow zone (≤ 2 m deep). This zone typically has a hydraulic conductivity much greater than deeper zones and is active when infiltrating precipitation exceeds the soil moisture deficit (Moore 1988, 1989). Water in the stormflow zone moves rapidly to surface-water drainages. As a result of this rapid lateral movement to the surface drainages, only a small fraction of the precipitation is available to recharge the shallow aquifer.

Because water is the primary transport vehicle, the conceptual model of contaminant transport for each facility relies on fundamental hydrologic concepts and the specific characteristics of the facility. Monitoring activities are designed on a facility-specific basis and reflect the conceptual model.

2.1.1 LLW Disposal Facilities in SWSA 6

2.1.1.1 Interim Waste Management Facility

IWMF is patterned after the earlier tumulus-type facilities. Concrete pads support concrete vaults containing LLW in a grout mixture. During loading operations the pads are uncovered and open to direct precipitation. After IWMF is completely loaded with waste-containing vaults, an engineered cap that minimizes infiltration of rainwater will cover the pads. Eventually, IWMF will consist of 12 concrete pads loaded with 330 vaults each.

Because IWMF is aboveground, the primary vector for contaminant transport is rainwater falling on the vaults and pads. The conceptual model for IWMF differs from that of the earlier tumulus facilities only in that a French drain exists between IWMF and the hill to the north. This French drain prevents groundwater from entering the gravel base under the pads. The IWMF gravel base drains through a monitoring station to the surface stream. The French drain would also intercept some portion of the water that infiltrates the ground beneath the gravel base. Any remaining water of any water passing through the gravel base would infiltrate to the shallow aquifer.

2.1.1.2 Hillcut Disposal Test Facility

HDTF is a demonstration project that was started in 1981 but discontinued the following year before any wastes were emplaced (see Fig. A.1 for location). In 1985 the project was reactivated as part of the Low-Level Waste Disposal Development and Demonstration project. HDTF provided a method for disposing of high-activity LLW because no suitable greater-confinement burial method was available at the time. The HDTF demonstration also provided a means to evaluate the use of hillslope cuts as possible sites for future engineered disposal facilities. The objective of the demonstration was to assess the degree of hydrologic isolation afforded by this type of design.

HDTF is similar to the tumulus-type facilities and consists of a concrete pad (4.6 m x 4.6 m) constructed in a cut from the side slope of a hill (Fig. A.5). The pad was installed above the expected high water table in the area. Twenty-seven concrete boxes (1.1 m x 1.1 m x 1.4 m) of high-activity LLW were placed on the pad and covered with soil. The lids of the boxes were sealed with a bitumen mastic, and the boxes were banded. A runoff collection system was installed to drain both the pad and the gravel area surrounding the pad. Runoff from the pad and runoff from

the gravel drain are collected separately in two above-grade 500-gal tanks. Two monitoring wells are installed at HDTF. One monitoring well is on the pad; another is in the gravel drain (Fig. A.5).

Water can reach the buried waste vaults through infiltrating precipitation or shallow stormflow. If the water table rises after heavy rains, the gravel base below the pad should intercept water from the shallow aquifer, thereby serving as a wick to drain the water away from the pad.

2.1.2 TRU Waste Storage Facilities in SWSA 5 North

Active TRU-waste management facilities in SWSA 5 North include aboveground buildings, buildings that are belowground on three sides, and auger holes similar to the high-range wells in SWSA 6. The buildings have sumps that collect any water that enters the waste storage areas.

Prior to the date of the DOE 5820.2A order, TRU wastes were also emplaced in unlined trenches in SWSA 5 North. Within the trenches, TRU wastes are contained in concrete casks and wooden and metal boxes (Stewart et al. 1989). There is evidence that the shallow aquifer extends above the bottom of at least some of the trenches during high water table conditions (Wickliff et al. 1991b). Furthermore, TRU contamination leached from wastes in the trenches has been measured in a downgradient well (Ashwood et al. 1990b; Wickliff et al. 1991a,b; Ashwood et al. 1991a,b) and in seeps along the bank of White Oak Creek (Ashwood et al. 1991a,b). Thus, transport from the trenches occurs through the shallow aquifer and along discrete pathways.

2.1.3 EASC/LWSP Cask Storage Facility

The EASC/LWSP campaign was undertaken to solidify the supernatant from the Melton Valley storage tanks. The supernatant was mixed with cement and other solidifying agents and allowed to cure in steel cylindrical containers measuring 1.8 m in diameter and height and weighing ~12 metric tons.

For radiation shielding purposes, each steel container was loaded inside a storage cask before the waste was solidified. The waste forms were then transported to the EASC/LWSP cask storage site in Melton Valley behind the new hydrofracture facility, where they were placed inside concrete storage casks.

The first EASC/LWSP cask storage site, Area 7856, is south of Building 7860, the new hydrofracture facility (Fig.

A.2). The site is an engineered, compacted, crushed-stone storage pad surrounded on all sides by fences and drainage ditches. The casks are arranged on the pad as shown in Fig. A.6. There are 60 EASC casks and 59 LWSP casks on the pad. Four of the casks (two each from the EASC and LWSP campaigns) contain surrogate waste forms which are similar to the actual waste forms but do not contain radioactive constituents.

Each storage cask contains an integral fiberglass reinforced plastic (FRP) liner with lid. The FRP lid is not presently sealed to the FRP liner. Sampling lines were cast in place through the wall of the storage cask into the annular space between the waste form and the FRP-lined concrete storage cask. One tube extends to the bottom of the annular space and collects any liquid that may occur inside the cask. The other tube extends to within a few inches of the top of the annular space and can be used to collect gas samples (Fig. A.7).

2.2 DATA QUALITY OBJECTIVES

As previously stated, data from ASEMP are not used in compliance with any federal environmental regulations. Therefore, U.S. Environmental Protection Agency guidelines for data quality objectives do not apply to this program. SWO personnel use data from ASEMP to manage their operations in accordance with DOE Order 5820.2A and to assess the performance of LLW disposal facilities.

Monitoring activities must ensure that any contaminant transport from the active LLW and TRU facilities is detected in time to allow SWO personnel to take appropriate corrective action. Sample collection must represent affected media to ensure that contaminant pathways are not missed, and analytical techniques must be sensitive enough to detect contamination at levels above background. Furthermore, sufficient geochemical and hydrologic data must be available to evaluate the potential risks from any detected leaks.

2.3 INTERNAL REPORTING LEVELS

Many of the radioisotopes that are present in LLW (e.g., ^3H , ^{90}Sr , and ^{137}Cs) also exist in the environment as a result of radioactive fallout. These isotopes (except ^3H) and naturally occurring isotopes (e.g., ^{40}K , Ra, Rn, Th, and U) also contribute to the activity measured in gross alpha and gross beta analyses. Leak detection at LLW and TRU

facilities depends upon the ability to identify contamination above the background concentrations of naturally occurring and fallout-derived radioisotopes. Thus, a determination of the range of background concentrations was conducted (Ashwood and Ashwood 1991). On the basis of this study, internal reporting levels (IRLs) (Table B.1) have been established that typically provide 90% confidence that 90-95% of the measured background concentrations will fall below the IRL. Thus, any samples where the measured concentration exceeds an IRL are highly likely to indicate contamination from the monitored facility.

No gross alpha IRL has been established for SWSA 5 North because experience with groundwater sampling in this area shows that gross alpha measurements are not sensitive enough to detect trace levels of TRU isotopes. Instead, measurements of ^{241}Am or ^{244}Cm that are statistically greater than the detection limit are considered to have exceeded the IRL.

Any samples that exceed an IRL are reported to the WMRAD program manager for ASEMP as soon as the ESD project manager receives them. Depending upon the location of the sample, the analyte involved, and the magnitude of the exceedance, a decision is then made regarding an appropriate follow-up action.

3. METHODOLOGY

This section describes the monitoring activities associated with each active LLW and TRU facility. These activities are based on the conceptual model for the facility as described in Sect. 2.1 and the data quality objectives in Sect. 2.2. Each subsection includes a summary of the salient results from the first 4 years of monitoring. Unless otherwise noted, the results are based on the semiannual and annual reports (Wickliff et al. 1991a,b; Ashwood et al. 1991a,b; Morrissey et al. 1993). Procedures for each of the monitoring activities described herein are included in Appendix C.

3.1 SWSA 6 FACILITIES

3.1.1 Interim Waste Management Facility

IWMF became operational in December 1991. To date, only two pads are used, but 12 pads will eventually be

constructed. Groundwater flow in the area is to the southeast toward the surface stream and to the south toward White Oak Lake. Hydraulic conductivity is relatively low ($\sim 10^{-6}$ cm/s), and no radioactive or trace metal contamination occurs in the shallow aquifer in this area (Wickliff et al. 1991a).

3.1.1.1 Pad Runoff

Runoff from the active pad (i.e., the pad on which waste vaults are actively being loaded) flows through polyvinyl chloride piping and into a sump, designated the stormwater sump, at the monitoring station. Runoff from the inactive (i.e., fully loaded) pad(s) drains to a separate sump, called the infiltration sump, at the monitoring station. The volume of each sump is ~ 7500 L (2000 gal). From the sumps, the water is allowed to flow through a flume and discharge to a nearby surface stream.

Runoff water from IWMF shows the same elevated pH trends that were previously observed during Tumulus I and II operations (Ashwood et al. 1991a,b; Wickliff et al. 1991a,b). A CO_2 gas neutralization system operates as a "best management practice" to maintain the IWMF effluent below the NPDES-permitted pH value of 9.0 at the discharge point. This neutralization system is electronically controlled and is activated in response to a combination of flow from the pads and elevated runoff pH.

Electronically controlled Isco, Inc. automatic samplers are used to collect samples of pad runoff. Each sample is analyzed for the constituents indicated in Table B.2.

3.1.1.2 Underpad Drainage

Any water that accumulates in the underpad gravel base drain is routed to the monitoring station and is collected in an ~ 3800 -L (1000-gal) sump at the monitoring station. From the sump, underpad drainage is discharged through the flume.

To date, very little water has drained from the underpad. This indicates that the upgradient French drain routes shallow groundwater around the facility. The valve controlling flow from the underpad discharge line into the underpad sump is kept closed during normal operations. When ASEMP personnel visit the site to collect pad runoff samples, this valve is opened to check for underpad drainage. If water does drain from this line, it will be collected, and samples will be taken and analyzed as indicated in Table B.2.

3.1.1.3 French Drain

The IWMF French drain discharges east of the IWMF facility near the surface stream. Water from this drain is not expected to be contaminated. However, a sample will be collected quarterly as an indicator of background shallow groundwater chemistry and analyzed as indicated in Table B.2.

3.1.1.4 Groundwater

Environmental compliance personnel annually sample several RCRA groundwater quality monitoring wells to monitor groundwater downgradient of the IWMF. These wells will serve as indicators of possible contaminant release to groundwater from IWMF. Since the upgradient French drain is designed to keep shallow groundwater out of the IWMF area, it is not considered necessary to install new monitoring wells in the area.

3.1.3 Hillcut Disposal Test Facility

The contents of three of the vaults placed on the HDTF pad cannot be identified; therefore, these vaults cannot be certified to be free of RCRA material. The water that drains from the pad and underpad will therefore be collected in tanks and transferred to the Process Waste Treatment Plant for proper disposal.

The volume of water in the tank that collects pad runoff will be measured and recorded weekly. When water in this tank reaches ~70% of tank volume, a sample is collected and tank contents are transferred to one of two holding tanks while awaiting disposal.

Because very little water drains from the underpad, this water is collected in a holding tank, and the volume of runoff is not routinely measured. A sample of this underpad water is also collected when the tank is ~70% full.

These samples are analyzed for gross alpha, gross beta, and gamma activity. When the analytical results are received, the SWSA 6 foreman will be notified. The foreman will see that the water is taken to the appropriate waste treatment plant. If radioactivity levels are above the IRLs, the ASEMP program manager will be notified.

Wells that reach the buried pad and the gravel base will be monitored weekly for water levels. Samples will be obtained whenever the water levels indicate that water is over the top of the curb around the pad. Samples will be

analyzed for gross alpha, gross beta, and gamma activity.

To date, no contamination has been found in water draining from either the pad or the gravel base. The well that reaches the gravel base is almost always dry. The well that reaches the buried pad frequently shows ~1 cm of water standing on the pad.

3.2 SWSA 5 NORTH FACILITIES

When the SWSA 5 foreman reports that water has accumulated in the sumps that drain buildings 7855, 7826, and 7834, ASEMP personnel will sample them. Samples will be analyzed for gross alpha, gross beta, and gamma activity. Samples that show activity may also be analyzed for metals, anions, and total organic carbon. Should contaminants be found in any of the sumps, the ASEMP program manager will be notified, and the water will be collected and taken to the appropriate waste treatment facility. Uncontaminated water will be discharged to the ground in SWSA 5 North.

3.2.1 Groundwater Wells

The 500 series wells identified in Fig. A.3 are sampled annually. Samples are analyzed as shown in Table B.3. Water levels are recorded in each well at the time of sampling.

To date, only well 516 has contained TRU contamination. This well is hydrologically downgradient from the burial trenches (Fig. A.3) and has contained gross alpha activity (primarily from ^{244}Cm and ^{241}Am) since monitoring activities began. No trace metal or organic contamination has been detected in well 516.

3.2.2 Seeps and Streams

Seeps and streams (Fig. A.3) are sampled annually and analyzed as indicated in Table B.3.

Monitoring data indicate that two seeps in the bank of White Oak Creek (WOC 213 and WOC 255) contain measurable concentrations of ^{244}Cm and ^{241}Am . No other seeps or stream samples have contained TRU isotopes.

3.3 EASC/LWSP CASK STORAGE FACILITIES

Liquid samples are collected from the LWSP/EASC casks, if liquid has collected in the sampling ports, and are

analyzed for radioactivity (gross alpha, gross beta, and gamma), sodium, nitrate, and chloride. Liquid samples from the casks at the original LWSP/EASC site are collected annually. Liquid samples will be collected quarterly from the new casks at the SWSA 6 LWSP II site for the first year. After the LWSP II casks have been at the SWSA 6 site for 1 year, they are sampled annually. The Liquid Waste Operations Group conducts all liquid sampling of the casks in accordance with Procedure R501.20, "EASC/LWSP Storage Cask Sampling".

Soil samples are collected twice per year from five sampling locations at the EASC/LWSP cask storage area (Fig. A.8). Sample site 3 was chosen to detect transport from off-site into the cask area, sample sites 1 and 5 were selected to determine transport to off-site areas, and sample sites 2 and 4 were chosen to detect a combination of on-site and off-site transport (Furnari and Yager 1991). The samples are analyzed for gross alpha, gross beta, and gamma radiation.

Soil samples will also be collected from five sites around the LWSP II site in SWSA 6.

Both the original EASC/LWSP cask storage facility near the new hydrofracture facility and the LWSP II site in SWSA 6 will be inspected at least once per month. An evaluation is made for evidence of erosion, vegetation growth, fence structural integrity (original site only), and obstruction of drainage. Each storage cask is visually inspected for excessive settlement, cracking, leakage, and any other evidence of structural distress.

Surrogate waste forms are removed from their storage casks and inspected for corrosion of the metal containers every other year. The storage casks are visually inspected for damage to the FRP liner and exposed internal concrete surfaces. The RSWO Department performs these inspections in accordance with the RSWO Department Procedure R501.20, "EASC/LWSP Storage Cask Sampling".

4. REPORTING AND MILESTONES

4.1 MONTHLY PROGRESS REPORTS

A description of the activities and results for each month will be sent electronically to the WMRAD program manager for ASEMP and other interested personnel. Activities conducted each month, together with any analyses

received, will be summarized in a letter report, which will be issued by the fifth working day of the following month.

4.2 ANNUAL REPORTS

A detailed report with the results of all ASEMP activities will be issued annually. A draft copy of the report will be issued by the 15th working day of October following the close of the reporting period. After WMRAD and ESD staff review it, the report will be issued as an ORNL/M report.

4.3 EXCEPTION REPORTS/ACTION PLANS

Samples that exceed an established IRL or otherwise indicate a problem will be reported to the WMRAD program manager for the ASEMP by the most immediate method (usually electronic mail or a telephone call). Depending upon the nature of the problem, an action plan may be prepared describing those actions to further investigate and remedy the problem, including any follow-up documentation.

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APPENDIX A
FIGURES

Fig. A.1. Active low-level-waste disposal sites and other major facilities in Solid Waste Storage Area 6.

A-4

Fig. A.2. Location of original Emergency Avoidance Solidification Campaign/Liquid Waste Solidification Project cask storage area 7856 in Melton Valley.

ORNL-DWG 91-15062 R1

Figure A.3. Transuranic waste storage and sampling locations in Solid Waste Storage Area 5 North.

Fig. A.4. Active Sites Environmental Monitoring Program organization.

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Fig. A.5. Schematic of Hillcut Disposal Test Facility.

Fig. A.6. Arrangement of casks and location of soil sampling sites at the original Emergency Avoidance Solidification Campaign/Liquid Waste Solidification Project cask storage site.

Fig. A.7. Emergency Avoidance Solidification Campaign/Liquid Waste Storage Project waste storage casks.

APPENDIX B

TABLES

Table B.1. Internal Reporting Levels for the Active Sites Environmental Monitoring Program samples from Solid Waste Storage Area 5 North and Solid Waste Storage Area 6.

Area	Analyte	IRL	(Bq/L)
SWSA 5 North	Gross beta		2.0
	⁶⁰ Co		1.5
	¹³⁷ Cs		1.0
	²⁴¹ Am		> 0
	²⁴⁴ Cm		> 0
SWSA 6	Gross alpha		1.0
	Gross beta		5.0
	⁶⁰ Co		1.5
	¹³⁷ Cs		2.5

Table B.2. Sample frequency and analytes for the Interim Waste Management Facility and the Hillcut Disposal Test Facility in Solid Waste Storage Area 6.

Sample	Frequency	Analytes ^a
IWMF pad water	Episodic ^b	Gross α , gross β , γ scan
IWMF underpad water	Episodic ^b	Gross α , gross β , γ scan
IWMF French drain	Quarterly	Gross α , gross β , γ scan, ^3H
HDTF pad water	Episodic ^b	Gross α , gross β , γ scan
HDTF underpad water	Episodic ^b	Gross α , gross β , γ scan

^a gross α = gross α screening analysis; gross β = gross β screening analysis; γ scan = complete spectrum of γ emitting isotopes. All radionuclide analyses, except tritium, are counted for sufficient time to reduce counting errors to <0.5 Bq/L.

^b Episodic means immediately following each rain event that results in the accumulation of water in the IWMF pad runoff sumps or underpad drain sump. For HDTF, sampling will be done as needed for disposal of water in the holding tanks.

Table B.3. Sample frequency and analytes for groundwater and surface water in Solid Waste Storage Area 5 North.

Sample	Frequency	Analytes ^a
Groundwater	Annually	Gross α , gross β , γ scan, ²⁴¹ Am, ²⁴⁴ Cm, ³ H, cations, anions, total organic carbon
Surface streams	Annually	Gross α , gross β , γ scan, ²⁴¹ Am, ²⁴⁴ Cm
Seeps	Annually	Gross α , gross β , γ scan, ²⁴¹ Am, ²⁴⁴ Cm, cations, anions, TOC
Building sumps	Episodic ^b	Gross α , gross β , γ scan

^a gross α = gross α screening analysis; gross β = gross β screening analysis; γ scan = complete spectrum of γ emitting isotopes. All radionuclide analyses, except tritium, are counted for sufficient time to reduce counting errors to <0.5 Bq/L.

^b Episodic means immediately following each rain event that results in the accumulation of at least 1 L of water in the sumps.

Table B.4. Sample frequency and analytes for the Liquid Waste Solidification Project/Emergency Avoidance Solidification Campaign cask storage areas.

Sample	Frequency	Analytes ^a
Casks >1 year old	Annually	Gross alpha, gross beta, gamma scan, sodium, nitrate, chloride
Casks <1 year old	Quarterly	Gross alpha, gross beta, gamma scan, sodium, nitrate, chloride
Any cask showing elevated radionuclide activity	Quarterly	Gross alpha, gross beta, gamma scan, sodium, nitrate, chloride
Soil	Semiannually	Gross alpha, gross beta, gamma scan

^a gross alpha = gross alpha screening analysis; gross beta = gross beta screening analysis; gamma scan = complete spectrum of gamma emitting isotopes. All radionuclide analyses are counted for sufficient time to reduce counting errors to <0.5 Bq/L. Sodium is determined by inductively coupled plasma scan; nitrate and chloride by ion chromatography.

APPENDIX C
PROGRAM SPECIFIC PROCEDURES

IWMF SITE VISIT CHECKSHEET

Initials: _____ Date: _____ Time: _____

weather conditions: _____

Have you been trained in the current revision of this sampling procedure? Y N

CO₂ tank: pressure in tank _____ psi change tank? Y N

sump transducer: logger reading _____ in. calibrate? Y N

pH probes: stormwater sump pH _____ infiltration sump pH _____ outlet pH _____
calibrate pH probes? Y N

remove DSM for downloading? Y N

Stormwater sump ISCO sampler: Stormwater sump sample number: _____
 sample bottle number _____ pulses to next sample _____
 program halted? Y N remove samples? Y N
 number of bottles removed _____ restart program? Y N
 bottle number/pulses _____
 number of composite samples prepared for analysis _____
 types of analyses for which samples collected:
 gross α , gross β , and γ scan? Y N archive? Y N tritium? Y N
 other _____

Infiltration sump ISCO sampler: Infiltration sump sample number: _____
 ISCO @ sample bottle number _____ pulses to next sample _____
 program halted? Y N remove samples? Y N
 number of bottles removed _____ restart program? Y N
 bottle number/pulses _____
 number of composite samples prepared for analysis _____
 types of analyses for which samples collected:
 gross α , gross β , and γ scan? Y N archive? Y N tritium? Y N
 other _____

Underpad sump: Underpad valve opened? Y N
 estimated volume of water drained _____
 sample collected? Y N sample ID: _____
 types of analyses for which samples collected:
 gross α , gross β , and γ scan? Y N archive? Y N tritium? Y N
 other _____

French drain:
 sample collected? Y N sample ID: _____
 types of analyses for which samples collected:
 gross α , gross β , and γ scan? Y N archive? Y N tritium? Y N
 other _____

problems and comments: _____

actions taken to resolve problems: _____

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**SWSA 5 NORTH
SITE VISIT CHECKSHEET**

Initials: _____

Date: _____

Time: _____

weather conditions: _____

Have you been trained in the current revision of this
sampling procedure? Y N

Sumps sampled:

describe sample color, etc.

7826-1: Y N _____

7826-2: Y N _____

7834-1: Y N _____

7834-2: Y N _____

7834-3: Y N _____

7834-4: Y N _____

7855-1: Y N _____

7855-2: Y N _____

problems and comments: _____

actions taken to resolve problems: _____

Procedure ID:	TUM-04
Revision No.:	3
Date of Revision:	15 July 1993
Date Implemented:	15 July 1993

PROCEDURE FOR COLLECTING SAMPLES OF INTERIM WASTE MANAGEMENT FACILITY PAD AND UNDERPAD RUNOFF

Prepared by: C.M. Morrissey
Geosciences Section
Environmental Engineering Group

1.0 PURPOSE

This procedure documents the methods for collecting samples of water draining Interim Waste Management Facility (IWMF) disposal pads using the ISCO automated samplers. The procedure also documents the manual collection of samples from the IWMF underpad drains. The purpose of the procedure is to provide consistent samples of water so that results may be compared between pads and over time. The procedure also provides a check on the effectiveness of the IWMF French drain system in preventing the accumulation of water in the tertiary containment barrier (i.e., the underpad drainage system). The procedure will also serve to train new project personnel.

2.0 SCOPE

The procedure addresses collection of water samples, preparation of the samples, and submission of the samples for analyses.

3.0 EQUIPMENT

These materials are stored in the tumulus monitoring shed, in the adjacent storage shed, or at the IWMF monitoring area.

1. Five 1-L glass or plastic collection bottles for gross alpha, gross beta, and gamma scan.
2. One large (10 L or larger) plastic carboy.
3. Gloves.
4. Distilled water.
5. Acids: 50% HNO_3 .
6. Pipette and pipette tips.
7. Labels for sample collection bottles.
8. Site visit checksheet (SVC) and ball point pen.
9. Safety glasses.
10. One ten-gallon bucket or other similar container.

4.0 PROCEDURES

These samples are collected after each rainfall that is sufficient to provide at least 3 full ISCO sample bottles in each sampler.

1. Remove cover from ISCO sampler and record on SVC current sample bottle number and pulses to next sample from the LCD display.
2. If at least three sample bottles have been collected, remove all bottles containing any sample from the ISCO.
3. Label collection bottles as follows:
 - a. Sample ID - for example, for samples from the

stormwater sump (i.e., the active pad) IWMF-012 (sample), IWMF-012A (archive), IWMF-013 (blank); for samples from the infiltration sump (inactive pads) IWMF-2-002, etc. Note that even numbers are for sample and odd numbers are for blank. One sample of distilled water will serve as a blank for both sets of sump samples.

- b. Name of collector.
 - c. Date and time of collection.
 - d. Analysis requested.
4. Combine all ISCO sample bottles into the large plastic carboy.
 5. Pour 1 L of distilled water into a 1-L collection bottle for a gross α , gross β , γ scan blank.
 6. Acidify samples as follows: 1 mL of 50% HNO_3 into gross α , gross β , and γ scan sample, archive and blank.
 7. Rinse ISCO sample bottles with distilled water and return to the sampler.
 8. Resume ISCO program and cover sampler.
 9. Repeat procedure for other ISCO sampler.
 10. Place the ten-gallon container in the underpad sump under the drain line and open valve U-1 that drains the underpads.
 11. If sufficient water drains from the underpad line to fill the bucket, collect a sample for gross α , gross β , and γ analyses as above.
 12. Complete an Analytical Services Request (ASR) form and take samples to the sample receiving room in Building 4500S. On the ASR form, note that these samples are for the ASEMP and that the samples for radionuclide analyses are to be counted for sufficient time to provide counting errors of <0.5 Bq/L on all radionuclide analyses except tritium. Note that ^{40}K data

is desired if the activity is calculated from an actual ^{40}K peak. The acidified archived samples are stored in the tumulus monitoring shed and retained until the analytical data have been received. The unacidified tritium archive is stored in the refrigerator located in the monitoring shed until the analytical data have been received.

12. Notify Solid Waste Operations if any changes are made to the valving configuration at the facility.

5. PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

	<u>Name</u>	<u>Organization</u>	<u>Trained by</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____

6. APPROVALS

ASEMP program manager: _____

Solid Waste Operations: _____

Procedure ID:	TUM-06
Revision No.:	3
Date of Revision:	1 December 1993
Date Implemented:	1 December 1993

PROCEDURE FOR OPERATION OF INTERIM WASTE MANAGEMENT FACILITY PAD RUNOFF pH CONTROL SYSTEM

Prepared by: C.M. Morrissey
Geosciences Section

1.0 PURPOSE

This procedure documents the methods for the operation and maintenance of a carbon dioxide based system designed to control the pH of Interim Waste Management Facility (IWMF) pad runoff waters. The purpose of the procedure is to insure proper operation of the pH control system so that pad runoff water pH remains below the National Pollutant Discharge Elimination System permitted level of 9.0. The procedure will also serve to train new project personnel.

2.0 SCOPE

The procedure addresses the operation and maintenance of the pH control system.

3.0 EQUIPMENT

1. Campbell Scientific data logger data logger and data storage module (DSM).

2. Site visit checksheet (SVC) and ball point pen.
3. pH buffers 7.0 and 10.0.
4. Small screwdriver.
5. Gloves.
6. Desiccant packs.

4.0 PROCEDURES

A check of the system should be performed weekly.

1. Check pressure in carbon dioxide tank; if less than 50 psi change to a new tank.
2. Open logger box and read and record on SVC the pHs and sump water level. Enter *6A0 and use the A key to advance to position 4 for the water level, position 8 for the outlet pH, position 9 for the stormwater sump pH, and position 10 for the infiltration sump pH. Enter *5 when finished.
3. On the first workday of each month remove the DSM and download data. DSM may be taken back to the office computer for downloading. The logger will continue to collect data that will be written to the DSM when it is returned to the logger.
4. Estimate water level in the stormwater sump; if very different from the logger output then recalibrate pressure transducer (see below).
5. Carefully remove sump and outfall pH probes and check for algal growth and other accumulations on the probes. Clean gently with a soft cloth or tissue if necessary.
6. Check desiccant in pressure transducer connection box; if mostly pink then replace with fresh desiccant.
7. Replace desiccant in logger box weekly.

8. Calibration of pH probes.
 - a. Immerse probe in pH 7.0 buffer and record logger reading.
 - b. Immerse probe in pH 10.0 buffer and record reading.
 - c. If either reading is >10% above or below expected value then inform ESD I&C personnel. They will electronically calibrate.
9. Calibration of pressure transducer.
 - a. Remove transducer from sump and immerse in at least two feet deep of water.
 - b. Read and record data logger output. If reading is >20% different from the expected value, contact ESD I&C for recalibration.
10. Notify Solid Waste Operations if any changes are made to the valving configuration at the facility.

5. PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

	<u>Name</u>	<u>Organization</u>	<u>Trained by</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____

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6. APPROVALS

ASEMP program manager:

Solid Waste Operations:

Procedure ID:	TUM-07
Revision No.:	1
Date of Revision:	15 July 1993
Date Implemented:	15 July 1993

PROCEDURE FOR COLLECTING SAMPLES FROM THE IWMF FRENCH DRAIN OUTFALL

Prepared by: C.M. Morrissey
Geosciences Section
Environmental Engineering Group

1.0 PURPOSE

This procedure documents the methods for collecting samples of water discharging from the IWMF French drain. The purpose of the procedure is to collect representative samples of groundwater upgradient of the IWMF disposal pads. The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure addresses collection of water samples, preparation of the samples, and submission of the samples for analysis.

3.0 EQUIPMENT

These materials are stored in the Tumulus monitoring shed or in the adjacent storage shed.

1. Three 1-L glass or plastic bottles for gross α , gross β , and gamma scan.
2. Two glass or plastic bottles at least 100 mL for

tritium.

3. One 1-L wide mouth bottle for pH and specific conductance measurements.
4. A pH probe and meter and a specific conductance probe and meter.
5. Gloves.
6. Stainless steel wide-mouth sampler and funnel.
7. Deionized water.
8. Acids: 50% HNO_3 .
9. Pipette and pipette tips for dispensing 0.5 mL.
10. Labels for sample bottles.
11. Site visit checksheet and ball point pen.
12. Safety glasses.

4.0 PROCEDURES

Samples are collected periodically (at least once a quarter); preferably after a recent sustained rainfall.

1. Label sample bottles as follows:
 - a. Sample ID: FD-012 (sample), FD-012A (archive), FD-013 (blank). Note that even numbers are for sample and odd numbers are for blank.
 - b. Name of collector.
 - c. Date and time of collection.
 - d. Analysis requested.
2. Using the stainless steel sampler and funnel, collect enough water from the pipe to rinse the sampler and funnel.

3. Collect more water with the sampler and add to appropriate bottles. Samples collected are as follows:
 - a. 1 L for gross alpha, gross beta, and a gamma scan to be submitted to Analytical Chemistry Division (ACD);
 - b. 1 L for the same parameters stored to be stored as an archive;
 - c. 100 mL for tritium analysis by ACD;
 - d. 100 mL for a tritium archive;
 - e. 1 L for pH and specific conductance measurements.
4. Collect a blank sample for gross radionuclide parameters by first rinsing the stainless steel sampler with deionized water located in the monitoring shed and then refilling with deionized water. Collect 1 L for analysis by ACD for gross radionuclide parameters.
5. Place calibrated pH probe in water collected in the 1-L wide mouth jar. Allow reading to stabilize and record on the site visit checksheet.
6. Place specific conductance probe in the same water used for pH measurement. Allow reading to stabilize and record on site visit checksheet.
7. Individual samples must be acidified as follows immediately after all samples are collected:
 - a. 1 mL of 50% nitric acid is added to each 1 L sample and archive for gross radiochemical analysis;
8. Complete an Analytical Services Request (ASR) form and take samples to the sample receiving room in Building 4500S. On the ASR form, note that these samples are for the ASEMP and that the samples for radionuclide analyses are to be counted for sufficient time to provide counting errors of <0.5 Bq/L on all radionuclide analyses except tritium. Request that ^{40}K be reported but only if the data is from an actual ^{40}K

peak. The acidified archived samples are stored in the
 Tumbler monitoring shed and retained until the
 analytical data have been received. The unacidified
 tritium archive is stored in the refrigerator located
 in the monitoring shed until the analytical data have
 been received.

5. PERSONNEL

The following personnel have been trained and are qualified
 to carry out this procedure:

Name	Organization	Trained by
------	--------------	------------

1. _____
2. _____
3. _____
4. _____
5. _____

6. APPROVALS

ASEMP program manager: _____

Solid Waste Operations: _____

Procedure ID:	TUM-08
Revision No.:	1
Date of Revision:	15 July 1993
Date Implemented:	15 July 1993

PROCEDURE FOR COLLECTING SOIL SAMPLES FROM THE EASC/LWSP and LWSP II CASK STORAGE AREAS

Prepared by: C. M. Morrissey
Geosciences Section
Environmental Engineering Group

1.0 PURPOSE

This procedure documents the methods for collecting samples of soil from the sediments in the overland flow channels around the EASC/LWSP cask storage areas. The purpose of the procedure is to collect representative samples of soil from areas surrounding the cask storage areas in order to detect radioactive contamination that might result from leaking casks or other waste storage activities. The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure addresses collection of soil samples, preparation of the samples, and submission of the samples for analysis.

3.0 EQUIPMENT

These materials are stored in the Tumulus monitoring shed or the adjacent storage shed.

1. Wide-mouth glass jars of 250 mL capacity.

2. Ball-point pen and sample labels.
3. A carboy, equipped with drain valve, of deionized water for equipment cleaning.
4. Stainless steel scoop.
5. Gloves.
6. Safety glasses.
7. Drying oven.
8. Number 5 sieve.
9. Mortar and pestle.
10. Analytical request forms.

4.0 PROCEDURES

These samples are collected and prepared quarterly by ASEMP personnel and submitted to ORNL's Analytical Chemistry Division for radiochemical analysis. Samples are to be taken from each soil monitoring location. In addition, two duplicate samples shall be taken from one soil monitoring location.

Sample collection:

1. Label each glass jar with an appropriate sample ID number, date and time of collection, name of collector, and analyses requested. All labels shall include Sample ID number, date and time of collection, name of collector and analysis parameters requested. Sample ID's are as "EASC/LWSP-site-moyr-Lid", where site is either the storage site near the hydrofracture facility (HYDRO) or the site in SWSA 6 (SWSA6); mo is the numeric month; yr is the last two digits of the year; id is the sampling location number (e.g. "L2" for location #2 within the particular site). A duplicate sample is indicated by with a "D" at the end of the sample number.

2. Using a clean stainless steel scoop, collect a sample of soil/sediment from an approximately six inch square area to a depth of about $\frac{1}{2}$ inch at each of the sampling locations. Collect approximately 400 grams.
3. Place each sample in an the appropriate sample jar.
4. Clean the stainless steel scoop with deionized water between each sample collection.
5. Contact Health Physics (HP) to have samples checked for radiological contamination and "Green-tagged" if non-contaminated.

Sample preparation:

1. Remove tops from sample jars and dry samples at a temperature of 105° C for a period of 24 hours.
2. Remove samples from oven and pass sediment sample material through a No. 5 Seive (crush with mortar & pestle if necessary).
3. Decontaminate the mortar and pestle (or other tools and materials that may contact more than one sample) with deionized water before each sample preparation.
4. Return sieved samples to appropriate jars.
5. Submit samples to Analytical Chemistry Division and request analyses for gross alpha (α), gross beta (β), and gamma (γ) activity. Request that ^{40}K be reported only if the data is from a true ^{40}K peak.

5. PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

	<u>Name</u>	<u>Organization</u>	<u>Trained by</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____

6. APPROVALS

ASEMP program manager:

Solid Waste Operations:

Procedure ID:	HDTF-01
Revision No.:	2
Date of Revision:	1 October 1993
Date Implemented:	1 October 1993

FIELD SERVICE PROCEDURE FOR THE HILLCUT DISPOSAL TEST FACILITY

Prepared by : S. M. Gregory
Revised by: D. S. Hicks
Geosciences Section
Surface Water Hydrology Group

1.0 PURPOSE

This procedure documents the routine service procedures for the Hillcut Disposal Test Facility site at SWSA6. It will also serve as a guide for a fill-in site servicer or new project personnel. The procedure is used to minimize risk to the health and safety of project personnel and to guard against release of contaminants to the environment. The procedure will also serve to train new project personnel.

2.0 SCOPE

The procedure includes those activities that involve routine servicing of the HDTF, winterizing the facility, sampling and emptying the tanks, and recording the data.

3.0 EQUIPMENT

3.1 Weekly Service

1. Water level measuring device for wells.

2. Ball point pen.
3. Data sheet.
4. Approx. 5-gal. bucket.

3.2 Sampling and Transferring Water

1. 2-in. diameter flexible hoses (kept on site).
2. One clean, 1-L widemouthed sample bottle per tank being sampled.
3. One Analytical Services Request form.
4. Ball point pen and black permanent marker.
5. Nitric acid.
6. Rubber gloves
7. Approx. 5-gal. bucket.
8. Catch pan.

4.0 PROCEDURES

4.1 Weekly Service

1. Measure the depth to water in the two wells on top of the hill. The wells are identified by well numbers, 1 and 2, marked on the riser with a black permanent marker.
 - a. Well 1 is the on-pad well.
 - b. Well 2 is the off-pad well.
- c. Remove the well caps and measure the depth to water in the wells.
- d. Record the measurements in the field logbook. Check the current measurements against the

previous weeks' measurements to see if they look reasonable. If they don't, make the measurements again.

- e. Replace the well caps before leaving the well area.
2. Proceed to the tank area.
 - a. Begin by making a visual inspection of the tank area. Look for any leaks in the tanks or piping.
 - b. Confirm that the white plastic stopcock at the end of the measuring assembly is closed.
 - c. Confirm that the cap is installed on the fitting for the 2-in. transfer hose. This is located between the 2-in. ball valve and the stand pipe on the measurement assembly.
 - d. Tank 1 drains the pad. Tank 2, originally meant to catch drainage from the trench around the pad, is bypassed such that any water draining from the trench goes directly to the storage tank. Tank 1 will almost always have water in it. Water in tank 1 is measured by opening the 2-in. ball valves. This allows water from the tank to flow into a clear, vertical, plastic standpipe. Here the water level can be viewed beside the scale attached to the stand pipe. Open the ball valve from the tank and allow the water level to equilibrate.
 - f. Close the 2-in. ball valves.
 - g. Place the bucket, found at the site, under the white plastic stopcock at the end of the tank level measuring apparatus. Open the stopcock to drain the water in the stand pipe into the bucket.
 - h. Confirm that the drain valve at the bottom of the holding tank is closed. Empty the contents of the bucket into the holding tank. It is especially important to drain the stand pipe during cold weather to prevent freeze damage to the piping.

4.2 Winterizing the Site

1. In November, have Plant and Equipment staff deliver bales of straw to the site and stack them around the tanks and around the piping up to the valves and measuring standpipes. This helps to reduce the chance of freeze damage.

4.3 Sampling the Tanks and Transferring the Contents to Holding Tanks

1. When tank 1 reaches approximately two-thirds full, it should be sampled and the contents transferred to a holding tank. The tank fills fastest in the spring, so you may want to sample and transfer before a tank reaches two-thirds full if a lot of rain is forecast.
2. Before transferring the water from tank 1 to the holding tank, a sample must be collected.
3. To sample tank 1, open the 2-in. ball valve.
4. After the water level stabilizes in the stand pipe, record the level in the tank, as described in step 2 of section 4.1.
5. Label the sample bottle with a black permanent marker. The label should have a sample number, and should say "groundwater" and "pH <2". The sample number should look like this: #-YYMMDD-1 for the standard analysis. The # is for the number of the tank that was sampled. The YYMMDD is the year, month, and day the sample was collected. The number "1" at the end indicates that it is the standard analysis: gross alpha, gross beta, and gamma scan. Example: 1-990130-1 for tank one, sample date 30 January 30 1999, standard analysis.
6. Put on a pair of rubber gloves as a precaution. Wear them for the whole sampling and transferring process.
7. Fill the sample bottle with tank water using the plastic stopcock at the end of the tank measuring apparatus.

8. Close the 2-in. ball valve.
9. Place the bucket under the stopcock. Open the stopcock to drain the contents of the measuring assembly into the bucket.
10. Close the stopcock.
11. Place the catch pan under the hose connection located between the 2-in. ball valve and the riser pipe.
12. Remove the cap from the hose connection, making sure that any water remaining in the measuring assembly is caught by the catch pan.
13. The 2-in. transfer hose is left at the site, stretched from tank 1 to the holding tank. Connect the transfer hose to the fitting at tank 1.
14. Confirm that the drain valve at the bottom of the holding tank is closed.
15. Empty the contents of the catch pan and the bucket into the holding tank through the port at the top of the tank.
16. Install the loose end of the transfer hose into the holding tank through the port at the top.
17. After confirming that the stop cock was closed in step 10, open the 2-in. ball valve. The water will begin transferring to the holding tank by gravity drain.
18. After the transfer is complete, place the catch pan back under the hose connection at the tank 1 measuring apparatus.
19. Close the 2-in. ball valve.
20. Disconnect the hose connection from the measuring apparatus, making sure that any water left in the apparatus is caught by the catch pan. There shouldn't be any water left here; this is just a precaution.

21. Replace the cap to the hose connection on the tank measuring apparatus.
22. Raise the end of the hose at the tank 1 end to make sure that all water drains from the hose to the holding tank. This is especially important during freezing weather.
23. Remove the loose end of the hose from the holding tank.
24. If any water remains in the catch pan, pour it into the holding tank.
25. Install the plug in the port at the top of the holding tank.
26. If you brought nitric acid with you, add enough to the sample to bring the pH down to pH 2. If you need to, take the sample back to the lab to perform this step. Check the sample with pH paper to confirm that the pH is at or below 2.
27. Fill out an Analytical Services Request form for the sample and take it to the sample receiving room in Building 4500S. For the standard analysis, request a gamma scan, gross alpha, and gross beta analyses. On the request form, fill in the deadline blank to make sure that you get the results back before the next time the measuring tanks need to be transferred. A week from the submit date is typical but may need to be shortened during very rainy periods, and may be lengthened during typically dry summer months.
28. In the event that the results are late in being received and more water needs to be transferred, there is a second holding tank at the site. If it becomes necessary to use this second tank, call Analytical Chemistry Division to expedite the sample analysis, and alert the project manager immediately.

4.4 Emptying the Holding Tanks

1. Results from the sample analysis should be given to the project manager, who will contact the SWSA 5 foreman. The SWSA 5 foreman will assure that the water is pumped

from the tanks and transported to the ORNL Process Waste Treatment Plant.

5.0 RESULTS AND RECORDS

All data are to be recorded in the field logbook or on the HDTF Site Visit Checksheet. In addition, a copy of all Analytical Services Request forms should be kept in a separate notebook. Analytical results are to be given to the project manager.

6.0 PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

	<u>Name</u>	<u>Organization</u>	<u>Trained by</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____

7.0 APPROVALS

ASEMP project manager: _____

WMRAD program manager: _____

Procedure ID:	SWSA5N-01
Revision No.:	1
Date of Revision:	4 November 1991
Date Implemented:	4 November 1991

PROCEDURE FOR GROUNDWATER SAMPLING IN SWSA 5 NORTH

Prepared by:
D. S. Hicks
Geosciences Section
and
T. L. Ashwood
Environmental Biotechnology Section

1.0 PURPOSE

This procedure documents the methods for collecting samples from groundwater wells in SWSA 5 North. The purpose of the procedure is to provide consistent samples of water so that results may be compared between wells and over time. The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure addresses measurement of water levels, collection of water samples, preparation of the samples, and submission of the samples for analyses.

3.0 EQUIPMENT

See specific equipment requirements in procedure subsections 4.1.1, 4.2.1.1, and 4.2.2.1.

4.0 PROCEDURES

4.1 Water Level Measurements

4.1.1 Equipment

1. Electronic water level indicator with measurements in feet (e.g., M scope).
2. Field logbook.
3. Black permanent pen.
4. Protective clothing—see Project Safety Summary.
5. Radiation monitors:
 - a. Pocket visual dosimeter.
 - b. GM detector.

4.1.2 Procedures

The following steps should be conducted at each well prior to sampling or at any other time that water level measurements are needed.

1. Record well number, date, time, and any other pertinent information in field logbook.
2. Locate reference mark at top of well casing.
3. Lower probe of water level indicator into well. When the alarm sounds, stop lowering the probe. Pull up on the probe until alarm no longer sounds; then lower the probe again slowly, stopping at the instant the alarm sounds.
4. Using the mark on top of the casing as the reference point, determine the depth on the tape to the nearest 0.01 ft. Repeat the procedure to verify measurement. Record the measurement as depth to water in field logbook.
5. Rinse the probe and any portion of the tape that contacted well water with deionized water. The rinse water should be placed

in the purge water drums at each well.

4.2 Groundwater Sampling

Groundwater samples will be collected annually for radionuclide analysis (gross alpha, gross beta, and a gamma scan). In addition, a sample for tritium analysis will be collected from each of the wells. Prior to sample collection, wells will be purged to ensure that the sample is representative of the groundwater.

4.2.1 Well Purging

4.2.1.1 Equipment

1. Pump and associated equipment:
 - a. Portable Waterra pump for all wells except 516.
 - b. Gasoline powered compressor and controller for dedicated bladder pump in well 516.
2. Extension tubing for each well. This tubing is marked for each well and may be reused.
3. Screwdriver (flat), hose clamps, and fittings to connect tubing to Hydrolab and to extension tubing.
4. Hydrolab II.
5. Stop watch.
6. Container of known volume.
7. Calculator.
8. Field logbook.
9. Black permanent pen.
10. Protective clothing—see Project Safety Summary.
11. Radiation monitors:
 - a. Pocket visual dosimeter.

b. GM detector.

11. Appropriate containers for waste.
12. Drum(s) for purge water. These drums should be on site at each well. If they are not, call Solid Waste Operations to have drums delivered.

4.2.1.2 Procedures

1. Measure groundwater level as indicated in Sect. 4.1, and calculate the volume of water in the well by using the formula on the Groundwater Monitoring Summary Sheet. Table 1 provides a list of well depths, diameters, and typical depths to water and well volumes. Compare your calculated well volume with the typical volume. If there is a large discrepancy, review your calculation and/or your depth to water measurement.
2. Connect the Waterra pump to the dedicated hose in well, and connect well tubing to extension tubing. Connect extension tubing to drum. For well 516, connect the controller to the compressor and dedicated tubing in the well and connect extension tubing to Hydrolab.
3. Begin pumping and record the time of initiation on the Groundwater Monitoring Summary Sheet. Determine rate of evacuation by timing the filling of the container of known volume. Record the pumping rate on the Groundwater Monitoring Summary Sheet. Empty the container into the purge water drum.
4. Note the appearance of the water (color, cloudy, clear, etc.), and record the data on the Groundwater Monitoring Summary Sheet.

Table. 1. Groundwater monitoring information for SWSA 5 North

Well	Well	Total well depth	Depth to water	Approx. well
no.	diam.	from MP*	in 11/90	volume in 11/90
	(in.)	(ft)	(ft)	(gal)

Wells that should be pumped dry

514	6	30.4	20.81	14
517	6	32.4	14.35	27
518	6	31.6	17.92	20
519	6	25.6	13.53	18
521	4	87.6	25.63	40
522	6	69.2	44.97	36
523	3	11.2	5.43	2
524	3	12.0	3.84	3
525	6	29.4	16.24	19
716	2	100.7	6.52	15

Wells that should be pumped for 1-3 volumes

513	6	20.6	8.5	18
516	4	26.8	15.42	7
520	6	24.6	1.57	34
708	2	18.0	4.12	2
715	2	41.0	14.9	4

Water level measurement only

562	2	150.0	45.73
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* MP = measurement point.

5. Continue pumping until the well is dry, until three well volumes have been removed, or until field parameters have stabilized as follows.
 - a. For wells 514, 517, 518, 519, 521, 522, 523, 524, 525, and 716, pump wells until they are dry.
 - b. For wells 513, 516, 520, and 708, pump three well volumes or pump at least one well volume and then pump until temperature, pH, and specific conductance have stabilized (temperature $\pm 0.5^\circ \text{C}$, pH ± 0.1 unit, specific conductance $\pm 5\%$).
6. All purge water is to be collected and drummed. The water will be kept until analytical results are available. If the analytical results indicate that the water contains radionuclides above the ASEMP action levels, contact Solid Waste Operations for disposal of the water; otherwise the drums may be emptied on site.

4.2.2 Sample Collection

4.2.2.1 Equipment

1. Pump and associated equipment:
 - a. Portable Waterra pump for all wells except 516.
 - b. Gasoline-powered compressor and controller for dedicated bladder pump in well 516.
2. Extension tubing for each well. This tubing is marked for each well and may be reused.
3. Screwdriver (flat), hose clamps, and fittings to connect tubing to Hydrolab and to extension tubing.
4. Hydrolab II.
5. In-line filters.
6. Appropriate sample containers:
 - a. 1-L bottles for gross alpha, gross beta, and gamma scan.

- b. 125-mL bottles for tritium.
- 7. Black permanent markers for labeling.
- 8. Paper towels.
- 9. Waste bags.
- 10. Plastic bags for samples.

4.2.2.2 Procedures

Sampling should be done as soon as possible after the well has been evacuated. Allow 1 day for recovery of those wells that were pumped to dryness.

1. If not already connected, connect pump as described in Sect. 4.2.1.2. Connect extension tubing to the Hydrolab and to the in-line filter making sure that water flow will be in the direction indicated by the arrow on the filter. Direct the discharge of the filter to the purge water drum.
2. Adjust the pump to provide a steady stream of water from the filter discharge.
3. Before collecting samples, measure the pH, specific conductance, and temperature of the well water. Record the information in field logbook.
4. From each well collect one sample in a 1-L bottle (for gross alpha and beta analyses, and gamma scan) and one sample in the 125-mL bottle (for tritium analysis).
5. Label each bottle carefully and clearly with the well number, date, time, and preservative (see step 8). Enter information in the field logbook.
6. Sample bottles should be placed in plastic bags and screened with GM detector before returning to Building 1505.
7. Rinse the Hydrolab and extension tubing with deionized water. Collect rinse water in purge water drum.
8. After returning to the lab, add 1 mL of 50% HNO₃ to samples in 1-L bottles. Do not add acid to the tritium samples.

9. Complete Analytical Services Request form and take samples to sample receiving room in Building 4500S. On the Analytical Services Request form, note that these samples are for the ASEMP and that the samples are to be counted for sufficient time to provide counting errors of <0.5 Bq/L on all analyses except tritium.

5.0 RESULTS AND RECORDS

As noted in Sect. 4.0, all data are to be recorded in the field logbook or on the Groundwater Monitoring Summary Sheet. After completion, each Groundwater Monitoring Summary Sheet is to be glued into the field logbook on a separate page. In addition, a copy of all Analytical Services Request forms should be glued into the field logbook. Analytical results are to be given to the principal investigator.

6.0 PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

	<u>Name</u>	<u>Organization</u>	<u>Trained by</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____

7.0 APPROVALS

ASEMP project manager: _____

WMRAD program manager: _____

GROUNDWATER MONITORING SUMMARY SHEET

Well Number: _____

Date: _____

Well Casing Volume Determination

A. Depth of well: _____ ft B. Measured depth to water: _____ ft

C. Height of water column (A-B): _____ ft D. Casing diameter: _____ in

Volume = C x (1.47 for 6-in. Casing diameter) = _____ gal
 (0.65 for 4-in. Casing diameter)
 (0.37 for 3-in. Casing diameter)
 (0.16 for 2-in. Casing diameter)

Well Evacuation

Initiation time: _____ Rate: _____ gal/min (1 gal = 3.785 L)

Measurement	Value 1	Value 2	Value 3	Value 4	Value 5
Date:	_____	_____	_____	_____	_____
Time:	_____	_____	_____	_____	_____
pH:	_____	_____	_____	_____	_____
Temperature:	_____	_____	_____	_____	_____
Specific conductance:	_____	_____	_____	_____	_____
Gallons evacuated:	_____	_____	_____	_____	_____
Well volumes purged:	_____	_____	_____	_____	_____

Sample Collection

Date: _____

Time: _____

Comments and Observations

Appearance of water at initiation: _____

Appearance of water at completion: _____

Comments: _____

Procedure ID:	SWSA5N-02
Revision No.:	0
Date of Revision:	
Date Implemented:	4 November 1991

PROCEDURE FOR SURFACE WATER SAMPLING IN SWSA 5 NORTH

Prepared by:
T. L. Ashwood
Environmental Biotechnology Section
and
D. S. Hicks
Geosciences Section

1.0 PURPOSE

This procedure documents the methods for collecting samples from seeps and streams around SWSA 5 North. The purpose of the procedure is to provide consistent samples of water so that results may be compared among wells and over time. The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure addresses collection of water samples, preparation of the samples, and submission of the samples for analyses.

3.0 EQUIPMENT

1. Field logbook.
2. Black permanent marker.
3. Protective clothing—see Project Safety Summary.

4. Chest waders for bank seeps or rubber boots for stream samples.
5. Radiation monitors:
 - a. Pocket visual dosimeter.
 - b. GM detector.
6. 1-L and 250-mL sample bottles.
7. Metal spatulas.
8. Paper towels.
9. Waste bags.
10. Plastic bags for samples.

4.0 PROCEDURES

Sample locations are indicated on the map of the area in the program plan, and these locations are marked in the field by flags. If flags are missing, contact either D. S. Hicks or A. L. Thomas for exact locations. Bank seeps may be located by measuring in a downstream direction from the south bank of the North Tributary. Seeps are identified by their distance, in meters, downstream from this point.

1. If water is present at the stream locations, dip a 1-L bottle into the water and fill as far as possible, being careful not to stir up sediment. Finish filling 1-L bottle by dipping 250-mL bottle into water and pouring contents into 1-L bottle.
2. If water is present at bank seeps, push a metal spatula into the bank at the seep to provide a spout for the water. After the water has cleared, hold 250-mL bottle under the spout until full.
3. If water is present at other seeps, fill a 1-L sample bottle by repeatedly submerging a 250-mL bottle in the seep and pouring the contents into the 1-L bottle. Be careful to minimize the amount of sediment suspended by this process.

4. Wipe off excess moisture from the outside of the sample bottles in the field. Scan the bottles with the GM detector before taking them into Building 1505. If the bottles read more than 50 counts per minute above background, contact Health Physics. Dispose of the paper towels in the waste bags as solid low-level waste.
5. After returning to the lab in Building 1505, filter each sample through 0.45- μ m filters and into clean sample bottles. Mark the filters with the number of the sample, and place the filters in a 15-cc petri dish. Submit this dish to the ESD counting room for an overnight gamma scan.
6. Complete Analytical Services Request form, and take samples to sample receiving room in Building 4500S. On the Analytical Services Request form, note that these samples are for the ASEMP and that the samples are to be counted for sufficient time to provide counting errors of <0.5 Bq/L on all analyses except tritium.

5.0 RESULTS AND RECORDS

The date, location, time, and any unusual conditions are to be recorded in the field logbook for each sample. For each sample, the volume of sample filtered and the number of filters required are to be recorded in the field logbook. Copies of the Analytical Services Request are to be glued into the field logbook. Results from the ESD counting room and from Analytical Chemistry Division are to be given immediately to the project principal investigator.

6.0 PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

Name	Organization	Trained by
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- 1.
- 2.
- 3.
- 4.
- 5.

7.0 APPROVALS

ASEMP project manager:

WMRAD program manager:

INTERNAL DISTRIBUTION

1-5. T. L. Ashwood	30. D. E. Reichle
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59. R. C. Harriss, Institute for the Study of Earth, Oceans, and Space, Science and Engineering Research Building, University of New Hampshire, Durham, NH 03824
60. G. Y. Jordy, Director, Office of Program Analysis, Office of Energy Research, ER-30, G-226, U.S. Department of Energy, Washington, DC 20545
61. A. Patrinos, Director, Environmental Sciences Division, Office of Health and Environmental Research, ER-74, U.S. Department of Energy, Washington, DC 20585
62. L. L. Radcliffe, Director, Waste Management and Technology Development Division, U.S. Department of Energy, Oak Ridge Operations Office, P.O. Box 2001, Oak Ridge, TN 37831-8620
63. L. C. M. Roddye, Program Manager, Waste Management and Technology Development Division, U.S. Department of Energy, Oak Ridge Operations Office, P.O. Box 2001, Oak Ridge, TN 37831-8620
64. F. J. Wobber, Environmental Sciences Division, Office of Health and Environmental Research, ER-74, U.S. Department of Energy, Washington, DC 20585
65. Office of Assistant Manager for Energy Research and Development, U.S. Department of Energy Oak Ridge Operations, P.O. Box 2001, Oak Ridge, TN 37831-8600
- 66-67. Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831

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