

Removal and Stockpiling of Contaminated Soil and Removal of Underground Storage Tanks, EM-2 and EM-3 Operable Units, Hanford 1100 Area, Wash- ington

June 1995



United States
Department of Energy
P.O. Box 550
Richland, Washington

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REMEDIAL ACTION WORK PLAN

DELIVERY ORDER NO. 019

REMOVAL AND STOCKPILING OF CONTAMINATED SOILS AND
REMOVAL OF UNDERGROUND STORAGE TANKS,
EM-2 AND EM-3 OPERABLE UNITS
HANFORD 1100 AREA, RICHLAND, WASHINGTON

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LIST OF ABBREVIATIONS AND ACRONYMS

ARARs	Applicable or Relevant and Appropriate Requirements
CDM Federal	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CWM	Chemical Waste Management, Inc.
DOE	U.S. Department of Energy
DQCR	Daily Quality Control Report
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
FTL	Field Team Leader
HLA	Harding Lawson Associates
HPT	Health Physics Technician
IDW	Investigation-Derived Wastes
LFI/FFS	Limited Field Investigation/Focused Feasibility Study
mg/kg	Milligrams(s) per kilogram
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MTCA	Model Toxics Control Act
NPL	National Priorities List
OU	Operable Unit
PCB	Polychlorinated Biphenyl
PPM	Parts per Million
QA	Quality Assurance
QAPjP	Quality Assurance Project Plan
QC	Quality Control
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SOP	Standard Operating Procedure

LIST OF ABBREVIATIONS AND ACRONYMS (CONTINUED)

SOW	Statement of Work
SSHP	Site Safety and Health Plan
SVOC	Semi-Volatile Organic Compound
TEG	Transglobal Environmental Geosciences Northwest, Inc.
TPH	Total Petroleum Hydrocarbons
USACE	U.S. Army Corps of Engineers
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WAC	Washington Administrative Code
WP	Work Plan
WTPH	Washington State Method - Total Petroleum Hydrocarbons

1.0 INTRODUCTION

CDM Federal Programs Corporation (CDM Federal) has prepared this Remedial Action Work Plan for Removal and Stockpiling of Contaminated Soil and Removal of Underground Storage Tanks, Hanford 1100 Area, EM-2 and EM-3, Hanford Reservation, Richland, Washington, (Work Plan) for the U.S. Army Corps of Engineers Walla Walla District (USACE) under Contract No. DACW68-94-D-0001. Activities described in this Work Plan are being conducted as part of the remedial action for the EM-2 and EM-3 Operable Units (OUs) of the 1100 Area National Priorities List (NPL) Site. This Work Plan was developed in accordance with the USACE Statement of Work (SOW) dated April 5, 1995 as modified on May 15, 1995.

This Work Plan is organized into five sections. Introduction and site background are presented in Section 1.0. Previous investigation results are summarized in Section 2.0. The specific approach to site remediation is outlined in Section 3.0. Section 4.0 comprises the Field Sampling Plan (FSP) for this project. The FSP includes a discussion of excavating and sampling procedures, underground storage tank (UST) sampling and removal, analytical methods, equipment decontamination, Quality Assurance/Quality Control (QA/QC), and investigation-derived waste (IDW) procedures. Section 5.0 contains references cited.

Appendices to this Work Plan include a Quality Assurance Project Plan (QAPjP) (CDM Federal 1995c), a CDM Federal Site Safety and Health Plan (SSHP)(CDM Federal 1995d), a SSHP prepared by Chemical Waste Management (CWM) , and a CDM Federal Standard Operating Procedure (SOP) modification. A description of the purpose and content of the QAPjP and the SSHPs is presented later in Section 1.4.

1.1 BACKGROUND

The 1100 Area was placed on the NPL in July 1989. The 1100 Area has been divided into four OUs based on geographic area and common waste sources. The four OUs are identified as 1100-EM-1 (EM-1), 1100-EM-2 (EM-2), 1100-EM-3 (EM-3), and 1100-IU-1 (IU-1). The location of the Hanford Site and the 1100 Area are depicted on Figure 1-1. During the course of performing Remedial Investigation/Feasibility Study (RI/FS) activities at the 1100 Area, the highest priority was placed on EM-1, which underwent a full-scale RI/FS to determine the nature and extent of contamination and to identify the preferred remedial alternatives. The EM-2 and EM-3 OUs underwent a limited field investigation and focused feasibility study (LFI/FFS) to determine the nature and extent of contamination and to identify the preferred remedial alternatives at those sites. This work plan addresses the planned remedial actions at EM-2 and EM-3.

The EM-2 OU encompasses an area on the southeast side of the Hanford Site and north of the town of Richland. Operable Unit EM-3 is about 600 meters (m) or 1,000 feet (ft), northeast of EM-2. The main structure of EM-2 is the 1171 Building, which is a vehicle service, maintenance, and repair facility. EM-3 contains approximately 20 permanent structures. Operations at EM-2 and EM-3 have included the use of solvents, fuels, oils, and polychlorinated biphenyls (PCBs).

During the LFI/FFS, one area within EM-2 and two areas within EM-3 were determined to contain contaminants at levels that may pose potential long-term risks to human health. The area of concern within EM-2 is an area of discolored soil, the Tar Flow Area. The areas of concern within EM-3 are one area of discolored soil, the Suspect Spill Area, and the 1240 French Drain, which is adjacent to a PCB collection area. At a third EM-3 site, the LFI/FFS identified two abandoned USTs (1262 Solvent Tanks) that may contain residual materials that pose potential health risks. The location of the EM-2 and EM-3 areas are depicted in Figure 1-2.

USACE contracted Montgomery Watson to conduct the investigation of the EM-2 and EM-3. Montgomery Watson subcontracted Golder Associates Inc. to conduct the field investigation, onsite laboratory analyses, and reporting. The following sections are based on the *Draft Field Investigation Report for the 1100-EM-2 and 1100-EM-3 Operable Units* (USACE 1994c).

1.1.1 TAR FLOW AREA

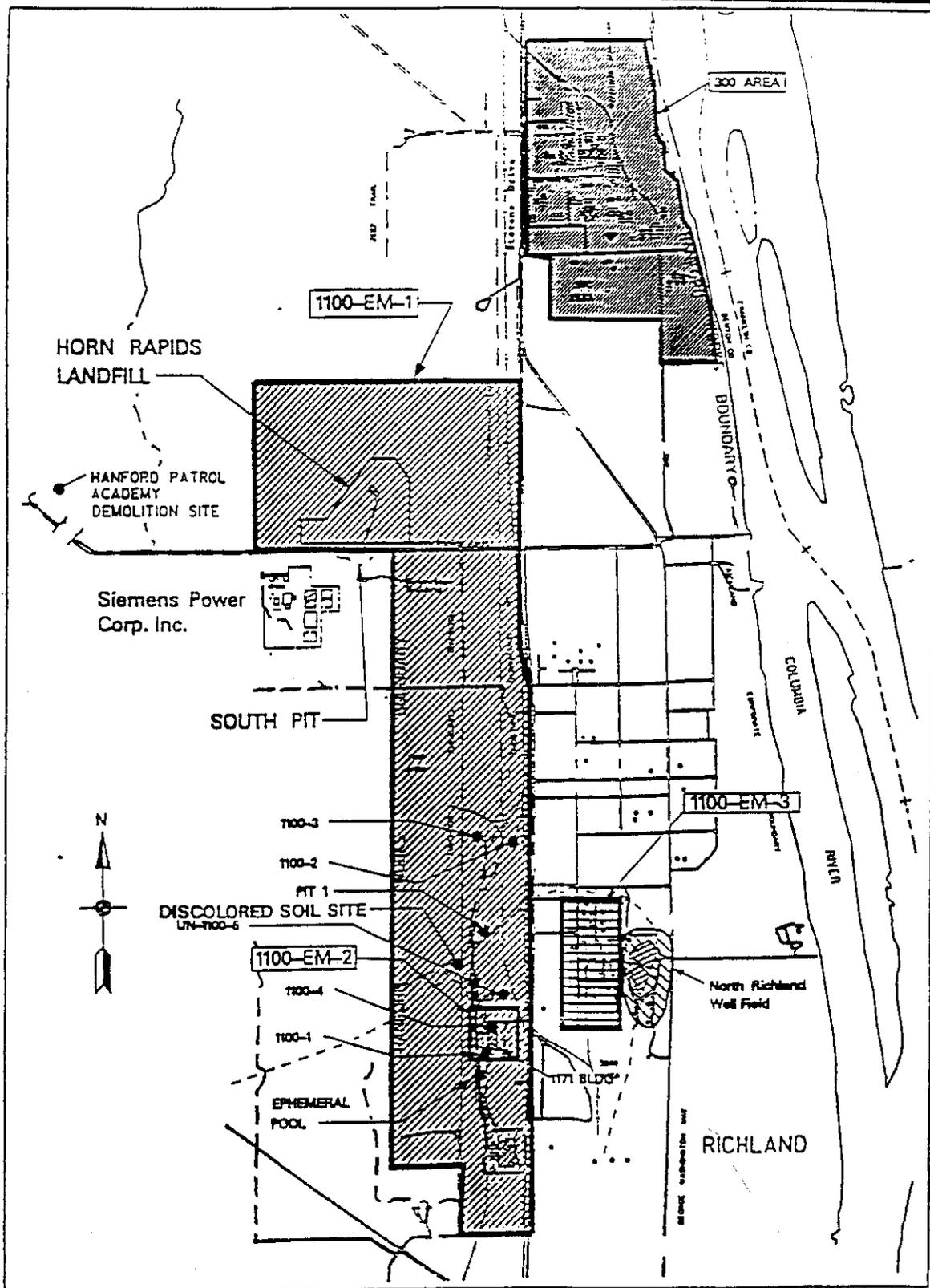
The Tar Flow Area is approximately 318 m (1,050 ft) north of the northwest corner of Building 1171 (Figure 1-3). Previous investigations identified a soft, tar-like material visible on the ground surface covering an irregular area of about 61 m x 20 m (200 ft x 65 ft). The source of the tar-like material is unknown. Samples collected from surface soils at this site contained two contaminants, total petroleum hydrocarbons (TPH) and lead. The maximum concentrations of TPH and lead were 80,000 milligrams per kilogram (mg/kg) and 404 mg/kg, respectively. The remedial objective for this site is to excavate and stockpile all soil with TPH and lead concentrations exceeding 200 mg/kg and 250 mg/kg, respectively. Approximately 385 cubic meters (500 cubic yards) of soil may be contaminated. This Work Plan addresses the excavation, sampling, and stockpiling of these materials.

1.1.2 1240 SUSPECT SPILL AREA

The Suspect Spill Area is a 12 m x 12 m (40 ft x 40 ft) area of visibly stained soil at the south end of Building 1240 (Figure 1-4). Previous investigations have identified lead contamination from an unknown spill. The maximum concentration of lead was 44,200 mg/kg. The remedial objective for this site is to excavate and stockpile all soil with a lead concentration exceeding 250 mg/kg. Approximately 92 cubic meters (120 cubic yards) of soil may be contaminated. This Work Plan addresses the excavation, sampling, and stockpiling of this material.

1.1.3 1240 FRENCH DRAIN

The 1240 French Drain is a 1 m (3 ft) by 0.5 m (1.7 ft) man-made drain on the west side of Building 1240 (Figure 1-4). The drain is encased in concrete and reportedly drains into the surrounding soil. Previous investigations have identified TPH, lead, and chromium contamination in the soil inside the drain. The maximum concentrations of TPH, lead, and chromium were 80,000 mg/kg, 619 mg/kg, and 949 mg/kg, respectively. The remedial objective for this site is to excavate and stockpile all soil with TPH, lead, and chromium concentrations



1100 AREA

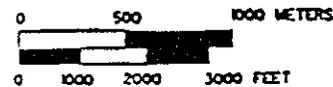


Outline and Designation of Operable Units

1100-3



Subunit Location and Designation



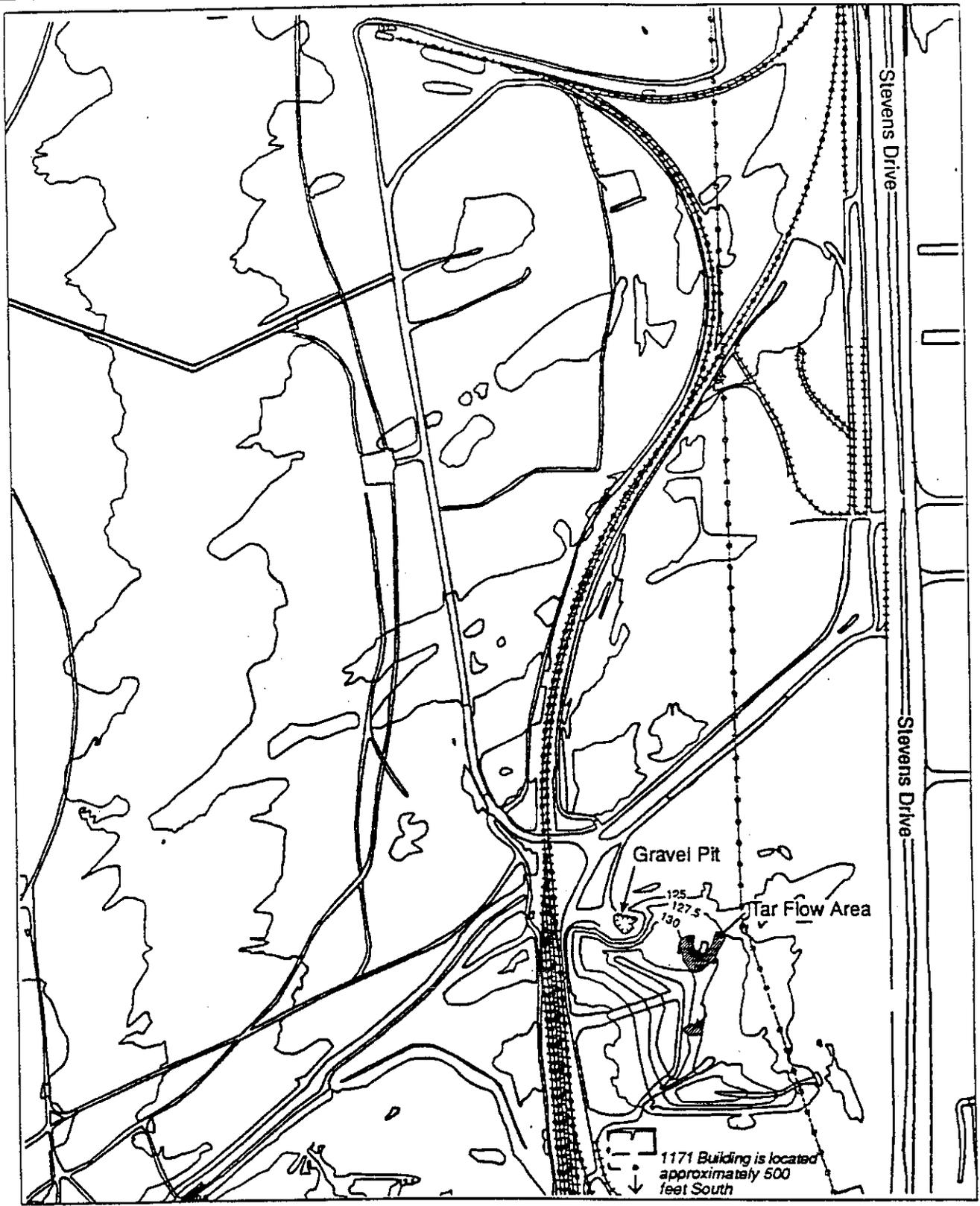
05/9

LOCATION OF THE 1100 AREA OPERABLE UNITS (MODIFIED FROM DOE 1993)

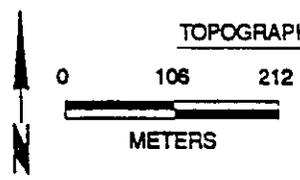


CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

Figure I-2



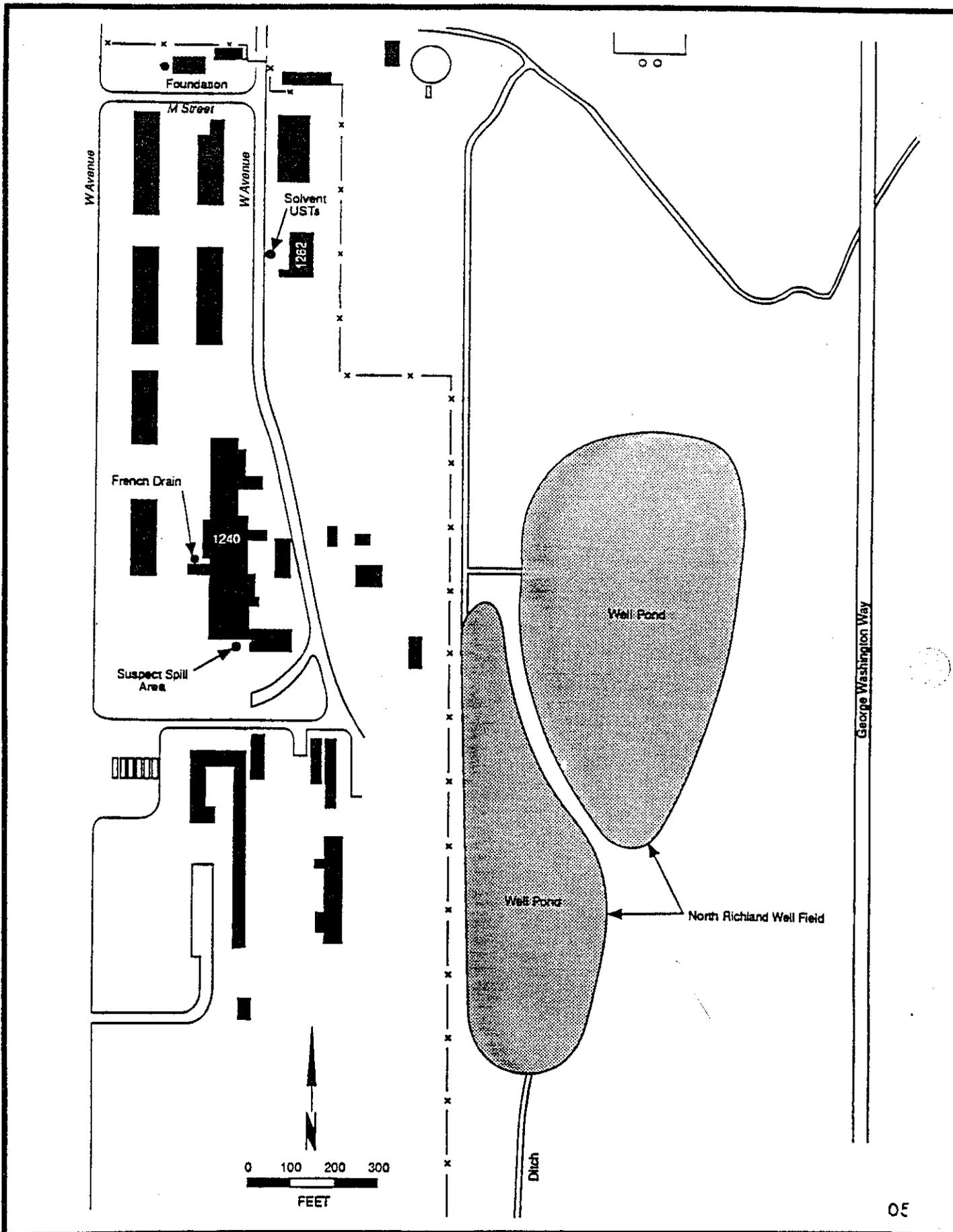
Explanation	
	Gravel Road
	Electrical Power Lines
	Railroad Tracks



TOPOGRAPHIC BASE: Digitized 1992 USACE Hanford Flyover Data.

05/95

LOCATION OF THE TAR FLOW AREA AT
 THE EM-2 OPERABLE UNIT
 (MODIFIED FROM USACE 1994c)



LOCATION OF THE 1240 FRENCH DRAIN
 1240 SUSPECT SPILL AREA, AND 1262 SOLVENT
 TANKS AT THE 1100 EM-3 OPERABLE UNIT
 (MODIFIED FROM USACE 1994c)

exceeding 200 mg/kg, 250 mg/kg, and 400 mg/kg, respectively. Approximately 0.5 cubic meter (<0.5 cubic yard) of soil within the drain is contaminated. An additional volume of soil outside of the drain, assumed to be less than 19 cubic meters (25 cubic yards), may also be contaminated. This Work Plan addresses the excavation, sampling, and stockpiling of these materials.

1.1.4 1262 SOLVENT TANKS

The 1262 Solvent Tanks are two USTs located on the west side of Building 1262 (Figure 1-4). Previous investigations identified the two USTs as being underneath the west curb, approximately 8 m (26 ft) west of Building 1262. Each tank is believed to be 1,125 gallons in capacity, and to have contained dry-cleaning solvents. No sampling of the tank contents has occurred. The remedial objective for this site is to open the tanks and sample the contents, if any. Following this, any contents will be drummed, and the tanks cleaned, removed, and disposed offsite. Any contaminated soil around or beneath the tanks will be excavated and stockpiled after the tanks are removed. This Work Plan addresses the sampling and containerization of the tank contents, the cleaning and removal of the tanks, and any necessary soil excavation and stockpiling.

1.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This soil excavation, stockpiling, and removal of USTs will be conducted in accordance with the following Applicable or Relevant and Appropriate Requirements (ARARs):

- The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
- Code of Federal Regulations (CFR) Title 40, Parts 262-263, (40 CFR 262-263)
- The State of Washington Model Toxics Control Act of 1989, Amended 1991, (MTCA, Chapters 173-340 Washington Administrative Code [WAC])
- CFR Title 40, Part 280, Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (40 CFR 280)
- Washington State Department of Ecology, Guidance for the Remediation of Releases from Underground Storage Tanks
- National Historic Preservation Act (16 CFR 470, *et seq.*)
- The State of Washington Dangerous Waste Regulations, revised March 7, 1991, (Chapters 173-303 WAC)
- Threatened and Endangered Species Act (40 CFR 402)

1.3 OBJECTIVES AND SCOPE

The objectives of the projects governed by this Work Plan are to excavate and stockpile soils contaminated with hazardous materials that have been shown to present potential long-term risks to human health; and to assess the contents of and remove two USTs. These objectives will be accomplished through the excavation of suspected contaminated soils, concurrent determination of the vertical and lateral extent of contamination above the cleanup criteria, and segregation of confirmed contaminated materials for treatment and/or disposal. The contents of the USTs will be sampled, removed, and drummed, followed by the removal and disposal of the tanks offsite. Any contaminated soil around and beneath the USTs will be excavated and segregated for treatment and/or disposal. Following excavation, screening sampling will be performed to verify that remaining soils are below the remediation criteria specified in the DOE Hanford 1100 Area Record of Decision (ROD) (EPA 1993). The onsite laboratory results will be verified by offsite laboratory analyses.

The scope of this project includes the removal and stockpiling of soils from one EM-2 site and two EM-3 sites where previous investigations (USACE 1994c) have demonstrated the presence of contaminants exceeding remediation criteria. At a third EM-3 site, two USTs near Building 1262 will be sampled, drained, removed, and disposed offsite, and contaminated soil will be removed and stockpiled. Soils containing contaminants in excess of the remediation criteria will be stockpiled on and covered with minimum 10-millimeter (mil) plastic sheeting pending transportation and disposal by others.

1.4 PROJECT ACTIVITIES AND DELIVERABLES

The technical approach for EM-2 and EM-3 was developed from the USACE SOW, and includes the preparation of planning documents, implementation of the field program, preparation of data reports, and QA activities. The following sections summarize these activities. Table 1-1 presents a schedule of activities and deliverables.

1.4.1 PLANNING DOCUMENTS

The planning documents for the removal and stockpiling of contaminated soil, as well as the sampling and removal of two USTs, include a Work Plan (with FSP), QAPjP (CDM Federal 1995c), and two SSHPs (CDM Federal 1995d, CWM 1995). A summary of the information presented in each of the documents is presented in the following paragraphs.

1.4.1.1 Work Plan

This Work Plan includes a description of the site location, background of the site and extent of the problem, and the overall project objectives. The Work Plan describes the technical approach to accomplishment of project goals, and references the *Remediation Design and Remedial*

TABLE 1-1

SCHEDULE OF ACTIVITIES AND DELIVERABLES

DESCRIPTION	DATE
Submit Draft Work Plan	26 May 1995
Regulatory Review/Comments Due	7 June 1995
Submit Revised Work Plan	13 June 1995
<p data-bbox="212 761 841 857">Begin Field Work (work will proceed according to the following steps):</p> <ol data-bbox="212 857 841 1453" style="list-style-type: none"> <li data-bbox="212 857 841 963">1) Excavate and sample the USTs at the the 1262 Solvent Tanks site <li data-bbox="212 963 841 1070">2) Excavate and sample soil at the Tar Flow Area <li data-bbox="212 1070 841 1176">3) Excavate and sample soil at the 1240 Suspect Spill Area <li data-bbox="212 1176 841 1283">4) Excavate and sample soil at the 1240 French Drain <li data-bbox="212 1283 841 1453">5) Complete UST removal and remediation at the 1262 Solvent Tanks 	15 June 1995
Complete Field Work	7 July 1995
Submit Draft Close-Out Report	11 August 1995
Review Comments Due	8 September 1995
Submit Final Close-Out Report	30 September 1995

Action Plan for the 1100 Area, Hanford Site (USACE 1994a). This document outlines the overall approach to the remedial design for the operable units within the 1100 Area of the Hanford Site.

1.4.1.2 Quality Assurance Project Plan

The QAPjP (CDM Federal 1995c) describes CDM Federal's QA/QC objectives and protocols. Specifically, the QAPjP includes project organization and responsibilities; document control procedures; quality assurance objectives for measurement data; a summary of proposed sampling activities and procedures; sample custody requirements; equipment operation, maintenance, calibration, and standardization procedures; analytical procedures; data quality management guidelines and goals; required QA/QC samples; and QA oversight activities.

1.4.1.3 Site Safety and Health Plans

Two SSHPs were prepared for this Work Plan, a CDM Federal SSHP (CDM Federal 1995d), located in Appendix B, and a CWM SSHP (CWM 1995), located in Appendix C. The CDM Federal SSHP includes the following:

- Description of known hazards and risks associated with the site and with each activity conducted
- Organization and personnel responsible for site safety
- Delineation of work areas, levels of personal protection, procedure for site access, and decontamination procedures for personnel
- Health and safety work precautions, accident prevention, first-aid, and emergency response procedures

The CWM SSHP describes the specific hazards and risks associated with sampling and removal of the USTs.

1.4.2 FIELD ACTIVITIES

CDM Federal will provide trained personnel for the field program including: a Field Team Leader (FTL) for site management, a hazardous waste specialist for sampling, a chemist to perform onsite analysis of soil samples, and heavy equipment operators and laborers. Training requirements for field staff are outlined in the SSHP (CDM Federal 1995d). The FTL for work at the 1262 Solvent Tanks will be licensed by the State of Washington as a Site Assessor, UST Decommissioner and UST Supervisor. The details of the field program are presented in Sections 3.0 and 4.0. The following is a list of the field tasks to be accomplished:

- Mobilization of field program

- Excavation and stockpiling of suspected contaminated materials
- Soil sampling
- Onsite analysis of samples
- Uncovering and sampling any residual materials in the two USTs
- Removing and containerizing residual materials inside the USTs
- Cleaning and removal of the USTs
- Transporting and disposing of the USTs offsite
- Packing and shipping of samples for offsite laboratory analysis
- Demobilization of field program

1.4.3 CDM FEDERAL DELIVERABLES

The reports to be generated as a part of this project include Daily Quality Control Reports (DQCRs), and Draft and Final Close-Out Reports. For the 1262 Solvent Tanks, a Washington Department of Ecology Site Check/Site Assessment Checklist will be prepared.

1.4.3.1 Daily Quality Control Reports

DQCRs will be generated daily during field activities and submitted by the CDM Federal FTL to the USACE FTL at the beginning of the following business day. The DQCRs will include a description of the subcontractors and equipment onsite; work performed (including samples collected and shipped); QC activities; health and safety levels and activities; problems encountered and corrective actions taken; and the anticipated activities for the next day. A copy of the DQCR form is included in Appendix D of the 1100-EM-1 Work Plan (CDM Federal 1995a).

1.4.3.2 Draft and Final Close-Out Reports

Upon completion of the field work and receipt of all analytical results, CDM Federal will prepare the Draft Close-Out Report, which will be submitted to the USACE approximately 35 days after demobilization from the field. The Draft Close-Out Report will include the following information:

- A brief narrative, which summarizes the site location, background, and objectives of the project.
- Discussion of the field activities performed, including sampling techniques.
- A description of the numbers and types of samples collected, including the dates of collection. Included with this will be a table which lists the sample numbers and any corresponding laboratory numbers required to identify analytical results for each sample. The table will also describe which samples are designated field QA/QC samples.

- A map showing the areal limits of excavated areas, location of all samples collected, and limits of geophysical surveys. The location information presented on this map will not be surveyed to confirm exact locations, but will be plotted in the field with respect to site features.
- A description of the remedial activities at the 1262 Solvent Tanks. This will include the condition of the tanks, the quantity of residual materials, the removal and drumming of residual materials, and the number of 55-gallon drums of residual material. Additional information will include a description of cleaning the tanks, removing the tanks from their current location in the ground, and disposal of the tanks offsite.
- An inventory of contaminated soils removed from the EM-2 site and three EM-3 sites.
- A brief discussion of all sample analysis results.
- The analytical sample data package from the laboratory will include detection limits for all analytes, dilution factors, and appropriate data flags; laboratory QC results including instrument blank, method blank, surrogate spike, matrix spike, laboratory duplicate and/or matrix spike duplicate pair samples; and completed chain-of-custody forms showing sample shipment and sample preservation.

Following receipt of comments from USACE and other agencies, CDM Federal will revise the draft report and submit a Final Close-Out Report.

1.4.4 QUALITY ASSURANCE

All work performed on this project will be in accordance with CDM Federal QA requirements as described in the QAPjP (CDM Federal 1995c) and in the CDM Federal QA Manual, Revision 6, March 31, 1995 (CDM Federal 1995b). All USACE and CDM Federal QA/QC requirements applicable to remedial actions implemented by CDM Federal at the Hanford North Slope sites and 1100-EM-1 will also apply to the work described herein. No additional QA/QC requirements will be imposed for work at the 1100-EM-2 and EM-3 OU sites.

This Work Plan has been reviewed for QA/QC requirements by George DeLullo, CDM Federal QA Specialist who will maintain QA oversight for the duration of the project. The following deliverables produced during this investigation will be subject to technical and QA review by CDM Federal technical and QA specialists:

- Draft and Final Remedial Action Work Plan (including QAPjP)
- Draft and Final Close-Out Report

In accordance with CDM Federal's audit policy, a certain percentage of projects may be subject to an internal QA system audit conducted by the CDM Federal QA staff. This project has been scheduled for an office audit. The audit will include a review of project documentation on file at CDM Federal's Golden, Colorado office to ensure compliance with applicable QA/QC requirements. A written audit report will be distributed to the CDM Federal project manager and appropriate management personnel. Any necessary corrective actions will be documented as part of the audit process.

The Project Manager will be responsible for maintaining the project files in CDM Federal's Golden, Colorado office. A working copy of the files will also be maintained in the Richland, Washington CDM Federal office. Additional information regarding QA requirements for this characterization and remediation project are presented in the QAPjP (CDM Federal 1995c).

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2.0 SUMMARY OF PREVIOUS INVESTIGATIONS

This section presents a brief summary of the findings of previous investigations which are germane to the removal and stockpiling of contaminated soils at the Tar Flow Area, the 1240 Suspect Spill Area, and the 1240 French Drain, and to the removal of the 1262 Solvent Tanks. Data from these investigations will be used in the field to identify those areas where contaminated soils must be excavated. Additionally, two USTs at the 1262 Solvent Tanks will be sampled, cleaned, and removed. The *Draft Field Investigation Report for the 1100-EM-2 and 1100-EM-3 Operable Units* (USACE 1994c) served as the source for the information presented in this section and provides a more detailed description of the methods and results of the investigations. The investigation results for the four sites are presented separately.

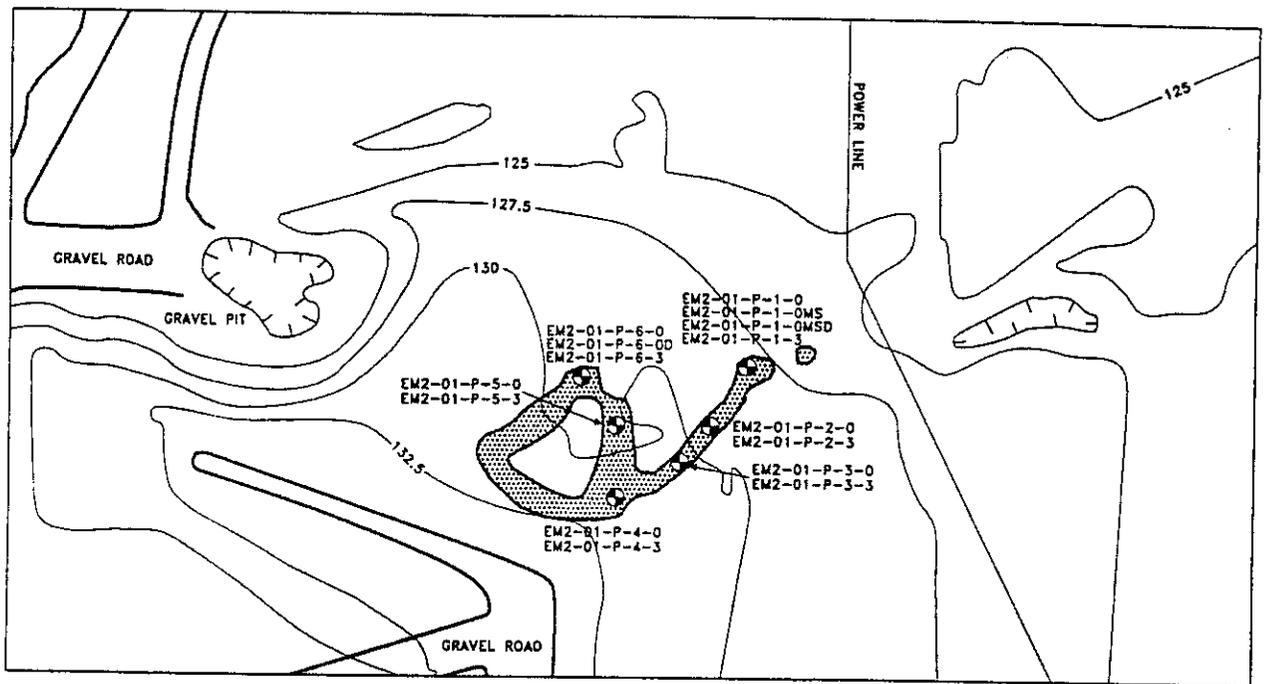
Contaminant investigations at the one EM-2 OU site and the three EM-3 OU sites involved one or more of the following techniques: geophysical surveys, surface (0 to 0.15 m [0 to .5 ft]) and subsurface soil sampling.

2.1 TAR FLOW AREA

The Tar Flow Area consists of an area covered by a soft, tar-like substance about 318 m (1,050 ft) north of the northwest corner of Building 1171. The source and origin of the tar-like substance is unknown. Two analytes were determined to be present in surface soils of the Tar Flow Area at concentrations exceeding the goals stated in the ROD (EPA 1993). These contaminants and their maximum detected concentrations include the following: TPH at 80,000 mg/kg, and lead at 404 mg/kg. The contamination is associated with the soft, tar-like substance visible on the ground surface. Based on borings done as part of the pre-remedial characterization activities, this tar-like substance extends to a depth of approximately 5 cm (2 in). The tar-like substance covers an irregular area of approximately 61 m x 20 m (200 ft x 65 ft). The approximate areal extent of soil requiring excavation is shown on Figure 2-1. The cleanup criteria established in the 1100 Area ROD (EPA 1993) for TPH and lead is 200 mg/kg and 250 mg/kg, respectively. The approximate volume of contaminated soil to be removed is 385 cubic meters (500 cubic yards).

2.2 1240 SUSPECT SPILL AREA

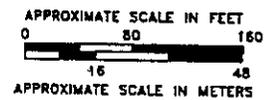
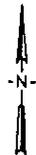
The Suspect Spill Area consists of an area of visibly stained soil at the north end of Building 1240 (Fig. 2-2). The soil staining was the result of a spill of a pliable adhesive mixed with metal fragments and floor sweepings. One contaminant, lead, was determined to be present in surface soils of the Suspect Spill Area at a concentration exceeding the ROD goals. The maximum detected concentration was 44,200 mg/kg. The surface soil contamination appears to be limited to the top 15 cm (6 in) of soil. Figure 2-2 depicts the approximate areal extent of soil requiring excavation. The cleanup criteria established in the 1100 Area ROD (EPA 1993) is 250 mg/kg for lead. The approximate volume of soil to be removed is 92 cubic meters (120 cubic yards).



LEGEND :

- ⊙ Previous soil sampling location, designation, and depth
- ▨ Approximate extent of contamination

127.5 — Contour line, contour interval is 2.5 m



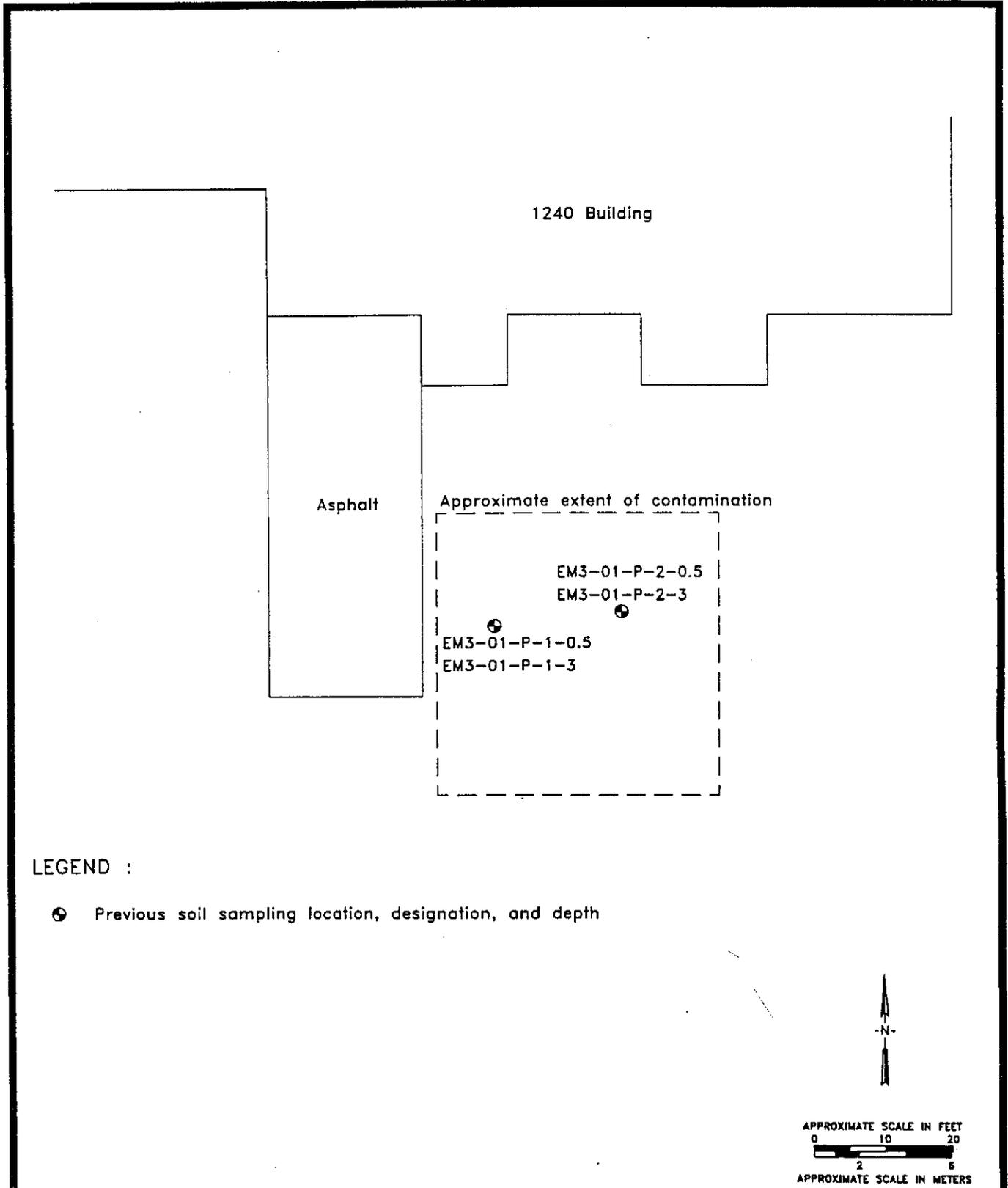
APPROXIMATE EXTENT OF CONTAMINATION
AT THE TAR FLOW SITE
(MODIFIED FROM USACE 1994c)



CDM FEDERAL PROGRAMS CORPORATION HANFORD RESERVATION, WASHINGTON
a subsidiary of Camp Dresser & McKee Inc.

FIGURE No. 2-1

TARFLOW/9MA995/61019



154-4/7APRS/905

APPROXIMATE EXTENT OF CONTAMINATION AT THE
1240 SUSPECT SPILL SITE
(MODIFIED FROM USACE 1994c)

CDM FEDERAL PROGRAMS CORPORATION
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HANFORD RESERVATION, WASHINGTON

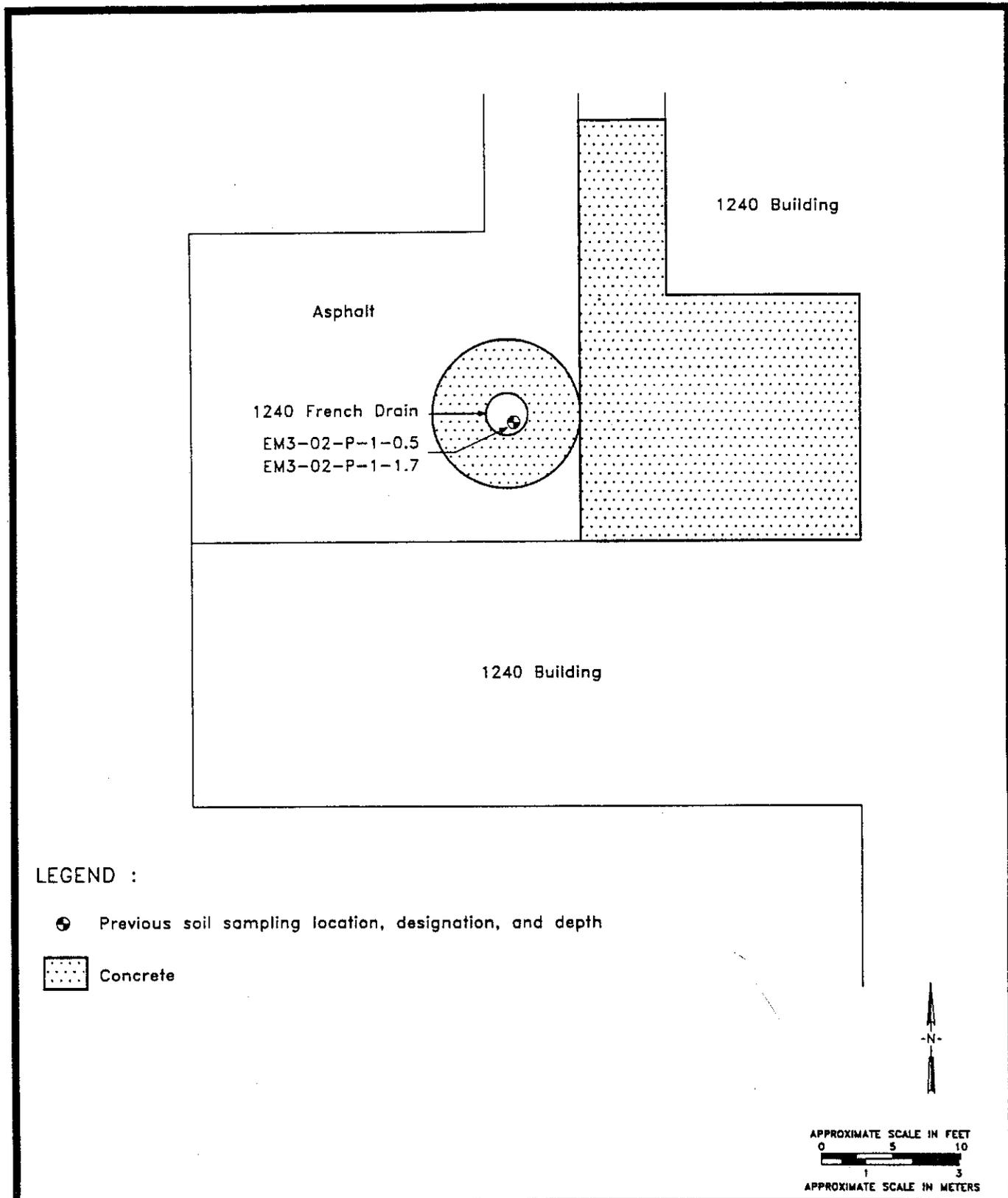
FIGURE No. 2-2

2.3 1240 FRENCH DRAIN

The 1240 French Drain is located on the west side of Building 1240 (Figure 2-3). There is no documented evidence of spills into the drain that might have discharged into the surrounding soils; however, a PCB collection area was located close to the drain. Three analytes were determined to be present in soils at the 1240 French Drain at concentrations exceeding ROD goals. These contaminants and their maximum detected concentrations include the following: TPH (80,000 mg/kg), lead (619 mg/kg), and chromium (949 mg/kg). Analyses for PCBs were done onsite using EnSys Inc. PCB RISC® Immunoassay Field Test kits. The kits indicated that PCB concentrations in the drain were greater than 1 mg/kg, but less than 10 mg/kg. This exceeded the ROD cleanup goal of 1 mg/kg. However, offsite laboratory analysis of the samples for PCBs determined that PCBs in the drain were less than 1 mg/kg. The cleanup criteria established in the 1100 Area ROD (EPA 1993) for TPH and lead are 200 mg/kg and 250 mg/kg, respectively. The cleanup criterion for chromium, under the State of Washington MTCA Method B formula value, is 400 mg/kg. Soil samples were collected at 15 centimeter (cm) (0.5 ft) and 0.5 m (1.7 ft) below ground surface, with contamination detected at both depths within the drain. Based on a drain depth of 0.5 m (1.7 ft), the approximate volume of contaminated soil to be removed is 0.5 cubic meters (<0.5 cubic yards). The extent of contamination beyond the drain is unknown, but has been conservatively estimated to be less than 19 cubic meters (25 cubic yards).

2.4 1262 SOLVENT TANKS

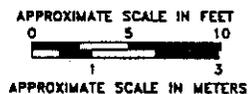
Existing facility engineering drawings indicate the presence of three USTs west of Building 1262. These USTs were associated with a military dry-cleaning facility located in Building 1262. A geophysical survey was conducted as part of the pre-remedial characterization activities at the 1262 Solvent Tanks. Geophysical data from the location of one of these tanks, the "extractor tank," suggest that this tank has been removed (Figure 2-4). Two tank-like objects were identified beneath the west curb using ground penetrating radar and magnetometer surveys. Three pipes were also detected as part of the geophysical investigation. These pipes originate at the suspected tanks and run into Building 1262. No sampling occurred during the pre-remedial characterization activities at the tanks.



LEGEND :

⊕ Previous soil sampling location, designation, and depth

▤ Concrete



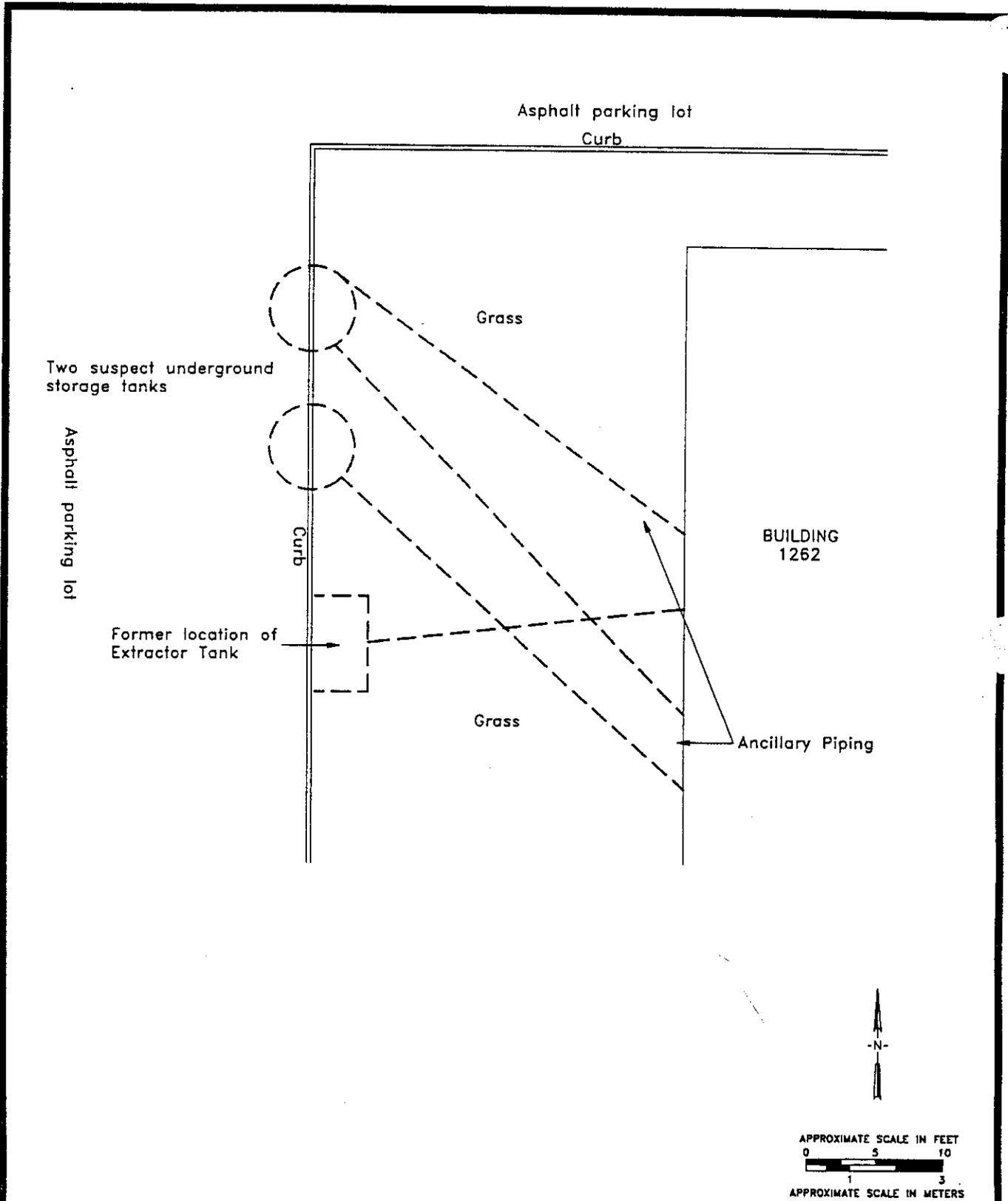
PREVIOUS SAMPLING LOCATIONS AT THE
1240 FRENCH DRAIN
(MODIFIED FROM USACE 1994c)

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

HANFORD RESERVATION, WASHINGTON

FIGURE No. 2-3

FDRAIN/9MAV95/61019



SVTANKS/9MAT95/61019



**RESULTS OF GEOPHYSICAL INVESTIGATION
AT THE BUILDING 1262 USTs
(MODIFIED FROM USACE 1994c)**

CDM FEDERAL PROGRAMS CORPORATION HANFORD RESERVATION, WASHINGTON
a subsidiary of Camp Dresser & McKee Inc.

FIGURE No. 2-4

3.0 WORK PLAN RATIONALE

Design of the site remediation and sampling approach is driven by contaminant types and distribution, and site conditions. The sampling and removal of the tanks are driven by the type and amount of residual material, the condition of the tanks, site conditions, and the goals and objectives of the project. These aspects of the EM-2 and EM-3 sites were presented in previous sections. This section describes the approach to be implemented to achieve project goals and objectives.

3.1 REMOVAL AND SEGREGATION OF CONTAMINATED SOILS

Prior to the excavation of contaminated soils from the Tar Flow Area, 1240 Suspect Spill Area, and 1240 French Drain, the locations of previously documented contaminated soils will be staked in the field by USACE. Excavation will be by trackhoe to minimize the entry of earth-moving equipment into contaminated areas. Contaminated soils will be excavated and segregated based on the results of previous investigations, visual evidence of contamination witnessed in the field, and the results of field screening analyses in an onsite laboratory. A Health Physics Technician (HPT) from Westinghouse Hanford Company will be present for initial excavation at each of the EM-2 sites (1240 Suspect Spill Site, 1240 French Drain, and 1262 Solvent Tanks). The HPT will screen soil and debris to determine if radioactive materials are present at concentrations exceeding background. Radiation action levels are given in the SSHP (Appendix B). At the 1262 Solvent Tanks, any contaminated soil beneath or around the tanks will also be excavated by trackhoe.

All suspect contaminated materials will be placed on minimum 10-mil plastic sheeting and will be covered with plastic sheeting at the end of each day. At the 1240 French Drain site, the entire french drain will be excavated and the concrete rubble placed on minimum 10-mil plastic sheeting and covered with plastic sheeting at the end of each day. Demarcation of hazardous material staging areas will be accomplished with temporary construction fencing at all of the EM-2 and EM-3 sites. Excavations at the Tar Flow Area, 1240 Suspect Spill Area, and 1240 French Drain sites are expected to be less than 1.25 m (4 ft) deep and will not require any special fencing or other warning markings. During excavation, water will be used as necessary to minimize the generation of fugitive dust. All contaminated soil and debris stockpiles will be secured pending determination of appropriate disposal alternatives.

3.2 SAMPLING AND REMOVAL OF 1262 SOLVENT TANKS

The USTs are believed to have contained solvent or waste solvent from dry-cleaning operations during Hanford's military era. The sampling and removal of the USTs will be conducted in two phases. The first phase will consist of uncovering the USTs and determining their condition. Any residual materials inside the tanks will be sampled and characterized, and the total quantity of material determined. The second phase will consist of pumping and drumming any residual material, cleaning the tanks, and removing and disposing of the tanks offsite.

Soils from the UST excavation will be evaluated using direct-reading instruments and will be analyzed in an onsite laboratory. Any contaminated soil beneath or around the USTs will be excavated as discussed in Section 3.1. Excavation will be by trackhoe, and all contaminated soil will be placed on minimum 10-mil plastic sheeting and covered at the end of each day. Soil sampling and analysis at the USTs will follow the steps discussed in Section 3.3 below. If the excavation exceeds 1.25 m (4 ft) in depth, soil sampling will be done out of the trackhoe bucket. Screening soil samples will be analyzed in an onsite laboratory until all contamination is below the cleanup levels calculated using the State of Washington MTCA Method B formula values. At this point, confirmatory soil samples will be collected for offsite analysis.

3.3 SOIL SAMPLING AND ANALYSIS

Once all suspect contaminated materials have been removed from an excavation, based on previous investigation data and visual evidence, samples will be collected from the base and walls of the excavation to confirm the absence of any contaminants above the cleanup levels established in the 1100 Area ROD (EPA 1993) and under MTCA Method B. These samples will be analyzed in an onsite laboratory facility, which will provide rapid turnaround (i.e., less than 2 hours), and EPA QC Level II analytical data requirements. If any sample results indicate the presence of contaminants above cleanup levels, excavation will resume in those areas. Excavation will cease when onsite analyses demonstrate the absence of contaminants above cleanup levels. Finally, confirmation samples will be collected from the excavation for offsite laboratory analyses. Offsite analyses will meet EPA QC Level III data requirements (with 10 percent meeting the EPA QC Level IV equivalent data requirements). Additional detail regarding the onsite and offsite analyses is provided in Section 4.0 of this document and in the QAPjP (Appendix A).

3.4 WASTE CHARACTERIZATION SAMPLE COLLECTION

At the completion of soil removal and stockpiling activities, two waste characterization samples will be collected from the stockpiled soil at each of the EM-2 and EM-3 sites for landfill or incinerator characterization. These samples will be collected as composites of several aliquot from the stockpiled soil at each site. Sample locations will be selected to yield analytical data representative of the wastes to be treated or disposed.

3.5 SITE RESTORATION

After excavation and sampling are complete, backfilling with pit run gravel will take place at all of the EM-3 sites. No backfilling, seeding, or reclamation will be performed under this delivery order at the EM-2 Tar Flow Area. Requirements for final restoration of the excavated area at the Tar Flow Area will be determined by USACE and the U.S. Department of Energy (DOE).

At the EM-3 sites, backfill will be introduced in 0.3 m (1 ft) lifts, water will be added, and the backfill will then be compacted to the original grade. Due to the location of the 1262 Solvent Tanks, additional restoration is required. Approximately 7.5 m (25 ft) of concrete curb, 23.2 m²

(250 ft²) of asphalt parking lot, and 23.2 m² (250 ft²) of topsoil and sod will be used to return the site to original condition. The replacement of irrigation lines and sprinklers may also be necessary.

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4.0 FIELD SAMPLING PLAN

The FSP presents a description of the activities or tasks, and the procedures that will be employed to accomplish project objectives in a safe and efficient manner. Additionally, the FSP and the QAPjP(CDM Federal 1995c) ensure that results, products, and data generated will be of acceptable quality to achieve project objectives. This section is divided into four main topics. Section 4.1, Preliminary Activities, describes the site operations and surveys which are necessary precursors or adjuncts to excavation of the contaminated soils. Section 4.2, Excavating, Stockpiling, and Sampling Soil, presents procedures to be used during the remediation of contaminated materials. Section 4.3, Tank Removal Operations, presents the procedures to be used in the decommissioning and removal of the USTs at the 1262 Solvent Tanks site. Section 4.4, Field Sampling, outlines the procedures and protocols to be used in sampling and analysis of soil from all four sites at EM-2 and EM-3.

All of the field work will observe the CDM Federal Standard Operating Procedures (SOPs) listed below and located in Appendix E of the 1100 EM-1 Work Plan (CDM Federal 1995a):

- 1-2 Sample Custody
- 1-3 Surface Soil Sampling
- 2-5 Packing and Shipping of Environmental Samples
- 4-1 Field Logbook Content and Control
- 4-5 Field Equipment Decontamination at Non-Radioactive Sites
- 5-1 Control of Measurement and Test Equipment

SOP 4-5 has been modified to allow alternative methods of decontamination for heavy equipment and for sampling equipment to be used during this field work. A copy of the modification to SOP 4-5 is included in Appendix D. The heavy equipment decontamination method is also discussed in Section 4.2.

The procedures presented in this FSP provide additional site-specific detail, which may not be discussed in the SOPs. Where appropriate, the *Remedial Design Field Sampling Plan for the 1100 Area, Hanford Site* (USACE 1994b) and the *Remedial Action Work Plan, Removal and Stockpiling of Contaminated Soil, EM-1 Operable Unit Hanford 1100 Area, Washington*, (CDM Federal 1995a), are referenced for additional information.

4.1 PRELIMINARY ACTIVITIES

The paragraphs below discuss various surveys, clearances, and other activities conducted in support of the EM-2 and EM-3 remedial action.

4.1.1 NEPA COMPLIANCE ACTIVITIES

Prior to initiation of remedial action field activities, requirements of the National Environmental Policy Act of 1969 (NEPA) must be satisfied. DOE has reviewed the *Remediation Design and*

Remedial Action Plan for the 1100 Area, Hanford Site (USACE 1994a) and evaluated the natural and cultural resources of the EM-2 and EM-3 sites. Based on these reviews and evaluations, DOE has issued a Categorical Exclusion to the NEPA Environmental Assessment process for the EM-2 and EM-3 remedial action.

4.1.2 CONSTRUCTION EXCAVATION PERMITS

Appropriate permits and clearances must be obtained as required by Hanford Administrative Practices prior to any excavation at the EM-2 and EM-3 sites. USACE is currently completing the permitting process for the planned remedial actions.

4.1.3 APPROVAL OF THE REMEDIAL ACTION WORK PLAN

This Work Plan (including FSP), as well as the QAPjP (CDM Federal 1995c) and the SSHP (CDM Federal 1995d) must be finalized and approved by USACE, DOE, and the regulatory agencies before cleanup work can commence at the EM-2 and EM-3 sites.

4.2 EXCAVATING, STOCKPILING, AND SAMPLING SOIL

Soil remedial activities will consist of excavating, segregating, and screening suspect contaminated soils from the Tar Flow Area, the 1240 Suspect Spill Area, the 1240 French Drain, and the 1262 Solvent Tanks. Remedial actions beyond those that apply to soil remediation at the 1262 Solvent Tanks site are discussed in Section 4.3. The work sequence will comprise a number of steps before, during, and after soil remediation is complete.

4.2.1 PRE-EXCAVATION ACTIVITIES

Pre-excavation activities will include setting up a screening and confirmatory sample grid, and mobilizing equipment and personnel to the site to accomplish remediation goals. These activities include the following:

- The previous investigation sampling locations will be field staked by USACE.
- Prior to excavation, CDM Federal will set up a grid so the location of screening and confirmatory samples can be recorded and mapped in reference to grid coordinates.
- The grid origin will be a permanent feature such as a corner of a building or will be marked with a steel fence post.
- Two grid axes will be demarcated in the field using a compass and will be at an angle of 90 degrees to each other.

- Screening samples will be designated based on the distance in meters from the grid origin as well as the compass direction from the origin.
- The trackhoe (1 to 2 cubic yard bucket capacity) will be placed in a safe and upwind position. This location will be based on the judgement of the FTL and the operator, and on the site conditions.

4.2.2 REMOVAL, STOCKPILING, AND SCREENING CONTAMINATED SOIL

- Suspect contaminated materials will be excavated, stockpiled, and secured on 10-mil plastic sheeting. The depth and areal extent of initial excavation will be based on visual evidence of contamination and data from previous investigations. Excavated materials will be placed a sufficient distance from the excavation so as not to return contaminated materials to the trench. During initial excavation at each of the EM-2 sites, the WHC HPT will screen soil and debris for elevated levels of radioactivity.
- Once the visually contaminated soil is removed, 5 to 10 screening samples will be collected within the excavation. In addition, 5 to 10 screening samples will be collected from the walls of the excavation. All samples will be grab samples collected at grid coordinates. Each sample will be considered representative of the portion of the sampling grid in which it is centered. Screening samples will be submitted to the onsite laboratory for analysis.
- If screening sample results indicate that contamination is still present in the base and/or walls of the excavation, soil will be removed in even lifts from the grid area surrounding the original sampling location. Soil removal will extend to the approximate midpoint between contaminated screening sample locations and clean screening samples.
- Excavation and screening sample collection will continue in the above-described manner until no evidence of contamination is detected.
- Personnel will not enter any open trench deeper than 1.2 m (4 ft) deep unless it has been properly sloped in accordance with the *USACE Safety and Health Requirements Manual EM 385-1-1* (USACE 1992). Samples will be collected from the trackhoe bucket when the excavation depth exceeds 1.2 m (4 ft.).
- Due to the large areal extent of contaminated soils at the Tar Flow Area, it may be necessary to collect additional screening samples from the base and walls of the excavation, after initial removal of contaminated soils. Screening sample frequency will be increased to ensure the maximum coverage possible given the time required for onsite laboratory analytical turnaround.

- Based on the limited access in the immediate vicinity of the Tar Flow Area, excavated soil will be placed in a dump truck and stockpiled on 10-mil plastic a short distance away at a location accessible to transport trucks.
- At the 1262 Solvent Tanks, any contaminated soil around or beneath the tanks will be excavated and stockpiled after the tanks are removed. A screening and confirmatory sample grid will be established and the soil removal will proceed as discussed in this section.
- Information regarding each excavation will be recorded including site activities, excavation dimensions and samples collected (using grid coordinates), description of features, results of onsite analyses and date excavated.

4.2.3 OFFSITE SAMPLE ANALYSIS, RECLAMATION, AND DECONTAMINATION

The discussion below is a brief summary of the steps that follow the removal of contaminated soil and the completion of onsite soil screening:

- Offsite analytical services (confirmation samples) will be used to verify the results obtained through onsite analyses. Further discussion of confirmation sample collection is presented in Section 4.4.
- Hazardous materials stockpiled onsite will be disposed of by separate arrangement with USACE after waste characterization data are received.
- No backfilling, seeding or reclamation will be performed at the Tar Flow Area. Requirements for final restoration of this site, if any, will be determined by USACE and DOE.
- At the 1240 French Drain and the 1240 Suspect Spill Area, the excavations will be backfilled with gravel and compacted.
- The excavation at the 1262 Solvent Tanks will be backfilled with gravel and compacted, with curbing, asphalt paving, topsoil and sod restored to original condition.
- The trackhoe will be decontaminated following the complete excavation of contaminated materials at each of the sites. Decontamination will consist of removing the majority of the dirt on the bucket with a shovel, followed by brushing and wet swabbing of the bucket. No decontamination wastewater will be generated.

4.3 TANK REMOVAL OPERATIONS

Removal of the two suspected USTs at the 1262 Solvent Tanks site will involve the coordinated services of several CDM Federal subcontractors. The onsite contractors and their general responsibilities are as follows:

Harding Lawson Associates (HLA) - Licensed Site Assessor/UST Decommissioner and FTL responsible for field supervision and site assessment duties as described in WAC Chapters 173-360.

Burdine Enterprises - Excavation, soil stockpiling and securing, tank removal and blocking, site fencing, and loading decommissioned tanks for transportation offsite.

CWM - Tank product/waste sampling and analysis, tank inerting, transfer of tank contents, and cleaning and disposal (recycling) of tanks.

Transglobal Environmental Geosciences Northwest, Inc. (TEG) - Conduct and reporting of onsite analytical services.

A description of the procedures to be used for removal of the USTs is described in the following sections.

4.3.1 ACCESSING TANKS

The project team will follow, to the extent practical, guidelines outlined in the American Petroleum Institute's (API) Recommended Practice 1604 for removal and disposal of used underground storage tanks. As indicated in API 1604, it is preferable that all free liquids be removed from the tank prior to any excavation work at the tank site. This is not practical as there are no fill or vent lines exposed at the ground surface. Further, it will not be possible to evaluate or inert the tank atmosphere prior to excavation activities. Therefore, it is critical that excavation of the tanks proceed cautiously until the tanks have been exposed and initial monitoring of the tank contents and atmosphere can be conducted.

A Burdine Enterprises operator will excavate and expose the top surface area of the tanks through the use of a trackhoe with a straight-edge bucket. Asphalt and sod will be removed and set off to the side for disposal as non-hazardous waste. Subsurface soils will be excavated in approximately 10 cm (4 in) lifts until the tanks, fill lines, or vent lines are exposed. Excavated soils will be placed on an impervious liner and periodically screened with an organic vapor monitor (OVM) for the presence of VOCs. Once the fill lines, vent lines, or top of the tanks have been exposed, the OVM and Combustible Gas Indicator (CGI) will be used to evaluate the atmosphere present in the tanks. If any flammable or explosive vapors are detected, the tank atmosphere will be rendered inert by CWM through the addition of dry ice (solid carbon dioxide) according to procedures described in API 1604. This method involves adding crushed dry ice at a rate of 10 kg per 400 L (3 pounds/100 gallons) of tank capacity into the available tank

openings. After the ice has been distributed, all of the openings, except the vent, will be plugged. The ice will be allowed to vaporize entirely (approximately 1 hour), during which the surrounding area and the tanks will be monitored for flammable vapor concentration. After confirming that the atmosphere of the tank is non-flammable (<10 % lower explosive limit [LEL] and < 8% oxygen) the tops of the tanks will be fully exposed and the excavation sidewalls will be sloped as required by the *USACE Safety and Health Requirements Manual EM 385-1-1* (USACE 1992).

Once the tanks have been exposed, the atmosphere in the tanks will be rechecked to ensure a non-flammable, oxygen deficient atmosphere exists. If monitoring indicates a flammable atmosphere, CWM will re-inert the tanks as described above. Following confirmation of proper tank atmosphere, the tanks will be inspected for the presence of access covers. If they exist, CWM will remove the covers by using a pneumatic or intrinsically safe impact hammer to remove the bolts. If inspection reveals the absence of access covers, small openings of 10 cm (4 in) will be created in the tops of the tanks with a "Nibbler." The Nibbler is a pneumatic tool with tungsten shears capable of cutting steel up to 64 millimeters (mm) (1/4 in) in thickness.

The associated piping will be elevated manually and supported for a sufficient amount of time to allow complete drainage into the tanks or other containers. The drained piping will be separated from the tanks at the union fittings and disassembled for shipment.

The contents of these tanks is assumed to be tetrachloroethylene (PCE), a halogenated hydrocarbon that does not possess flammable characteristics. However, since tank contents (if any) are unknown, they will be considered potentially explosive. During the tank opening, sampling, product removal, and cleaning phases of this project, the work area will be continuously monitored for the presence of flammable gasses and oxygen-deficient atmospheres with a Gastec Model #1314SMPN combination % LEL, parts per million and oxygen meter. Additional information regarding personal protective equipment and safety procedures are outlined in the site-specific safety and health plans included as Appendices B and C.

4.3.2 TANK SAMPLING

Sampling activities will commence after gaining access to the tanks and when environmental monitoring indicates favorable conditions for work within the excavation area.

Historical records indicate the volume of each tank is 1,125 gal. After accessing the tanks, CWM will use a wooden pole calibrated in inches to measure the diameter (D) of each tank and the height (H) of the product in each tank. The length of each tank will be measured or calculated if the entire tank has not been exposed. The volume of the contents of each tank will be calculated in several steps using a hand-held scientific calculator. For each tank, the volume of the contents measured in gallons can be calculated using the following equation:

$$V_{\text{contents}} = (L/231) \times (2\pi R^2 \alpha / 360 - (R - H)R \sin \alpha) \text{ given}$$

Where: $\alpha = \arccos((R - H)/R)$ (calculated in degrees)
L=the length of a tank
R=the radius of a tank=D/2
H=the height of the contents in a tank
231=231 cubic inches per gallon

Note: All lengths are measured in inches, all volumes are measured in gallons.
The tanks are assumed to be horizontal cylinders.

The individual volumes will be added together to calculate the total volume of product in both tanks. The volume of sediments will be estimated using the same equations if the height of the sediments can be measured.

Using a colliwasa/hand pump or equivalent, CWM will extract a sample of product or waste fluid from each tank and place the extracted material in 40 milliliter (ml) amber glass volatile organic analysis (VOA) vials. The vials will be filled to ensure no head space or bubbles are present. A sterilized sieve scoop will be attached to a pole of suitable material and used to collect sediment samples. The collected sediments will be placed in 60 ml (2 ounce) septa jars. The USACE Site Safety Officer will screen the collected samples for radiation above background levels.

Samples will be placed on ice and transported by CWM to the Sound Analytical Service, Inc. laboratory in Tacoma, Washington, for analysis. Laboratory analysis will be for VOCs (F- listed solvent scan) as well as a radiation scan. Analytical data meeting EPA QC Level III will be available within 7 days of sample receipt by the laboratory. Burdine Enterprises staff will cover all soil stockpiles, construct a temporary fence around the stockpiled soil and the excavation, and otherwise secure the site pending the return of the project crew to transfer any product from the USTs. CWM will seal all openings in the tanks except for the vent lines.

4.3.3 PRODUCT TRANSFER PROCEDURES

Following receipt of the analytical results from the product and sediment sampling, the project crew will remobilize to the 1262 Solvent Tanks site to transfer the product or waste to drums, and remove, clean, and dispose of the tanks. All tank cleaning procedures will be conducted as described in API 2015 (Cleaning Petroleum Storage Tanks).

CWM will use a 2-in. peristaltic or a pneumatic diaphragm pump to remove the free product from the tanks. The pump motors and suction hoses will be bonded to the tank to prevent electrostatic ignition hazards. The removed product will be placed in 55-gal drums, sealed, and labeled according to generator knowledge and analytical data. It has been estimated that approximately 12 drums may be required to containerize the tank contents. A more accurate estimate will be calculated during the sample collection effort.

To reduce the potential for possible ground contamination during the product removal phase, the immediate work area will be covered with 6-mil polyethylene plastic and secondary containment will be provided for the drum filling area. Emergency spill containment and removal equipment will be stationed in the support zone. The location and proper use of this equipment will be discussed during the daily site safety meetings.

4.3.4 TANK REMOVAL

Prior to tank removal, the tank atmosphere will be checked to confirm that the concentration of flammable vapors are less than 10% LEL. If the tank atmosphere does not meet this requirement, it will be re-inerted. Once a safe environment has been confirmed, the tanks will be completely exposed, the vent lines removed and the tanks removed from the excavation and securely blocked by Burdine Enterprises.

Soils surrounding each tank will be removed using the trackhoe. Any observed discoloration in the soils around the tank or other sign of contamination will be noted by the site assessor and the soil placed on an impervious liner for further investigation. Representative samples of soils from the tank excavation and from the area around any piping or fittings will be submitted to the onsite laboratory for analysis for volatile organic compounds.

During removal, a lifting strap or the equivalent meeting the requirements of the USACE Safety Manual, EM-385-1-1 (USACE 1992) will be attached to the pad eyes located at either end of the tank and the tank will be lifted out of the excavation using the trackhoe and placed on a 10-mil liner and blocked to prevent movement.

After the removal and blocking process are complete and before the cleaning process starts, each tank will be labeled to warn against accidental entry and will contain the following information:

- Probable previous tank contents
- Tank is not vapor free
- Tank is not suitable for reuse
- Date of removal

4.3.5 TANK CLEANING, TRANSPORTATION, AND DISPOSAL

The atmosphere in each tank will once again be checked before starting the cleaning process. Once the appropriate atmosphere has been confirmed, CWM will cut 2 access hatches, 1 in each end of the tank using the "nibbler" device described above. The remaining liquids and sediments will be removed through the access hatches with hand tools and a vacuum pump, and the interior of the tank rinsed. All fluids and sediments will be containerized and staged with product removed from the tanks.

Once all sediments and liquids are removed, each tank will be given a final rinse with a fresh water source and the rinsate collected. At this phase, the tanks will be ready for transportation

and disposal. The USACE FTL will be presented with a disposal certificate for signature. In signing this certificate, USACE releases ownership of the tanks to the disposal company allowing the tanks to be recycled as scrap steel.

The cleaned and cut tanks will be loaded onto the transportation vehicle by Burdine Enterprises. CWM will secure all loads and issue a standard Bill of Lading for the units being transported. The cleaned tanks will be recycled at Schnitzer Steel in Portland, OR, or at a suitable local recycler. Recycling the scrap steel will be considered disposal. Copies of all documentation will be forwarded to USACE.

4.4 CONFIRMATION AND WASTE CHARACTERIZATION SAMPLING

This section details criteria for sample collection, identification of samples, documentation, sample labeling, packaging and shipping, decontamination, onsite and offsite laboratory analytical procedures, and handling of IDW

4.4.1 SAMPLE COLLECTION

At the direction of USACE, CDM Federal will collect soil samples during excavation. Samples will be collected to confirm the completion of contaminated soil removal and to characterize excavated materials. Rinsate samples will be collected to evaluate the potential for cross-contamination due to incomplete decontamination of sampling equipment. No background or field blank samples will be collected. Table 4-1 summarizes the samples to be collected during field work at the EM-2 and EM-3 sites. The samples will be handled in accordance with approved SOPs. CDM Federal's FTL will be present during all excavation work and sampling.

EM-2 Sampling - A grid will be established at the EM-2 Tar Flow Area prior to the collection of screening samples to allow the field team to specify screening sample locations at known and representative grid points within the excavated area. Excavation will remove all visibly stained soil, followed by the collection of screening samples, as discussed in subsection 4.2.2. Once the contaminated soil has been removed as indicated by the screening samples, approximately 10 confirmatory samples will be collected. The same grid used to locate the screening samples will be used to identify the locations of the confirmatory samples. The screening and confirmatory sample locations will be designated using the distance and compass direction from the grid 0,0 location.

One of the confirmatory samples (10%) collected at the Tar Flow Area will be a discrete grab sample collected from a single grid node randomly selected by the USACE. This sample will be analyzed and data packages prepared to EPA QC Level IV equivalent data requirements. The remaining samples will be composites of aliquots collected at grid nodes in a manner to ensure that the areal extent of the excavation is representatively sampled. These samples will be collected and sent offsite with sample data preparation meeting the EPA QC Level III data requirements. The composites will consist of one aliquot from the node, plus one aliquot each

**TABLE 4-1
ANTICIPATED SAMPLING AND OFFSITE ANALYSES**

Tar Flow Area						
Sample Type	Sample Designation	Sample Containers	QC Level	Matrix	Quantity	Analyses
						SW-846 WTPH-418.1
Confirmation Sample	EM2/01-C-01-000*	1-250 ml glass, 1-250 ml glass	IV	Soil	1	Lead (7421) TPH
Confirmation Sample	EM2/01-C-02-000* through EM2/01-C-10-000*	9-250 ml glass, 9-250 ml glass	III	Soil	9	Lead (7421) TPH
Confirmation Sample (QC)	QA-EM2/01-C-01-000*	1-250 ml glass, 1-250 ml glass	III	Soil	1	Lead (7421) TPH
Equipment Rinse	EB-EM2/01-C-00-000**	1-1L poly, 2-1L glass	III	Water	1	Lead (7421) TPH
Waste Characterization Samples	EM2/01-W-01-0	2-125 ml glass***	III	Soil	2	Volatile organic compounds (8240), Semi-volatile organic compounds (8270), Pesticides/PCBs (8080), TCLP Lead (1311/7421) 8 RCRA Metals (6010 and appropriate 7000 series method)
	EM2/01-W-02-0	1-250 ml glass	III	Soil		
		1-250 ml glass	III	Soil		
		1-250 ml glass	III	Soil		
1240 Suspect Spill Area						
Confirmation Sample	EM3/01-C-01-000*	1-250 ml glass	IV	Soil	1	Lead (7421)
Confirmation Sample	EM3/01-C-02-000* through EM3/01-C-10-000*	9-250 ml glass	III	Soil	9	Lead (7421)
Confirmation Sample (QC)	QA-EM3/01-C-01-000*	1-250 ml glass	III	Soil	1	Lead (7421)
Equipment Rinse	EB-EM3/01-C-00-000**	1-1L poly	III	Water	1	Lead (7421)
Waste Characterization Samples	EM3/01-W-01-0	2-125 ml glass***	III	Soil	2	Volatile organic compounds (8240), Semi-volatile organic compounds (8270), Pesticides/PCBs (8080), TCLP Lead (1311/7421) 8 RCRA Metals (6010 and appropriate 7000 series method)
	EM3/01-W-02-0	1-250 ml glass	III	Soil		
		1-250 ml glass	III	Soil		
		1-250 ml glass	III	Soil		
		EM3/01-W-01-0	1-250 ml glass	III	Soil	1
		1-L glass	III	Soil	1	Gamma Spectroscopy

* (000 - depth, to be determined in field)

** This will be the same sample number and depth as the sample collected immediately before the equipment blank is collected

***Per sample

**TABLE 4-1 (CONTINUED)
ANTICIPATED SAMPLING AND OFFSITE ANALYSES**

1240 French Drain						
Sample Type	Sample Designation	Sample Containers	QC Level	Matrix	Quantity	Analyses
						SW-846 WTPH-418.1
Confirmation Sample	EM3/02-C-01-000*	3-250 ml glass	IV	Soil	1	Lead (7421), Chromium (6010) TPH
Confirmation Sample	EM3/02-C-02-000* through EM3/02-C-10-000*	27-250 ml glass	III	Soil	9	Lead (7421), Chromium (6010) TPH
Confirmation Sample (QC)	QA-EM3/02-C-01-000*	3-250 ml glass	III	Soil	1	Lead (7421), Chromium (6010) TPH
Equipment Rinsate	EB-EM3/02-C-00-000*	2-1L poly, 2-1L glass	III	Water	1	Lead (7421), Chromium (6010) TPH
Waste Characterization Samples	EM3/02-W-01-0	2-125 ml glass***	III	Soil	2	Volatile organic compounds (8240), Semi-volatile organic compounds (8270), Pesticides/PCBs (8080), TCLP Lead (1311/7421) TCLP Chromium (1311/6010) 8 RCRA Metals (6010 and appropriate 7000 series method) Gross Alpha/Beta Gamma Spectroscopy
	EM3/02-W-02-0	1-250 ml glass	III	Soil		
		1-250 ml glass	III	Soil		
		1-250 ml glass	III	Soil		
	EM3/02-W-01-0	1-L glass	III	Soil	1	
		1-l glass	III	Soil	1	
1262 Solvent Tanks						
Confirmation Sample	EM3/06-C-01-000*	2-125 ml glass	IV	Soil	1	VOCs (8240)
Confirmation Sample	EM3/06-C-02-000* through EM3/06-C-10-000*	18-125 ml glass	III	Soil	9	VOCs (8240)
Confirmation Sample (QC)	QA-EM3/06-C-01-000*	2-125 ml glass	III	Soil	1	VOCs (8240)

* (000 - depth, to be determined in field)

** This will be the same sample number and depth as the sample collected immediately before the equipment blank is collected

***Per sample

**TABLE 4-1 (CONTINUED)
ANTICIPATED SAMPLING AND OFFSITE ANALYSES**

1262 Solvent Tanks						
Sample Type	Sample Designation	Sample Containers	QC Level	Matrix	Quantity	Analyses
						SW-846 WTPH-418.1
Equipment Rinsate	EB-EM3/06-C-00-000*	3-40 ml glass	III	Water	1	VOCs (8240)
Waste Characterization Samples	EM3/06-W-01-0	2-125 ml glass***	III	Soil	2	Volatile organic compounds (8240), Semi-volatile organic compounds (8270), Pesticides/PCBs (8080), Total petroleum hydrocarbons (WTPH-418.1-Washington State Method), 8 RCRA Metals (6010 and appropriate 7000 series method)
	EM3/06-W-02-0	1-250 ml glass	III	Soil		
		1-250 ml glass	III	Soil		
		1-250 ml glass	III	Soil		

* (000 - depth, to be determined in field)

** This will be the same sample number and depth as the sample collected immediately before the equipment blank is collected

*** Per sample

from the four nodes that surround the selected node. To ensure that the aliquots come from within the excavated area, the selected nodes cannot be chosen along the outermost grid lines. The composite samples will allow areally representative samples to be collected from the excavated area at the Tar Flow Area, which is the largest of the sites.

EM-3 Sampling - A grid will be established at each of the EM-3 sites prior to the collection of screening samples similar to the one established at the Tar Flow Area. Once the visible contamination has been removed, or in the case of the 1240 French Drain, the drain has been removed, screening samples will be taken at grid coordinates as a preliminary check of the remediation. Upon completion of removal of contaminated soil, a total of 30 confirmatory samples will be collected; 10 from the 1240 French Drain, 10 from the 1240 Suspect Spill Area, and 10 from the 1262 Solvent Tanks. Ten percent of the samples (one from each site) will be discrete grab samples collected from a single grid node randomly selected by the USACE. These samples will be analyzed and data packages prepared to EPA QC Level IV equivalent data requirements.

The remaining samples will also be grab samples collected at grid nodes in a manner to ensure that the areal extent of the excavation is representatively sampled. These samples will be collected and sent offsite with sample data preparation meeting the EPA QC Level III data requirements. These samples may be collected in the same location where the screening samples were collected.

At the 1240 French Drain and 1240 Suspect Spill Area, screening and confirmatory screening samples will be collected from the excavation walls or base at a depth of 15 cm (6 in). At the 1262 Solvent Tanks, samples will be collected from a depth of 15 to 30 cm (6 to 12 in) in the base and walls of the excavation. Except at the 1262 Solvent Tanks, all screening and confirmatory samples will be homogenized using decontaminated stainless steel utensils prior to filling sample containers. At the 1262 Solvent Tanks, samples will be discrete grab samples and will not be homogenized to avoid potential VOC volatilization.

In excavations less than 1.2 m (4 ft) deep, samples will be collected directly from undisturbed soils in the excavation floor. If deeper excavations are required, samples will be collected directly from the trackhoe bucket. As the samples will be collected from the floor and walls of the excavations, sampling procedures will follow CDM Federal SOP 1-3, "Surface Soil Sampling" located in Appendix E in the 1100 EM-1 Work Plan (CDM Federal 1995a).

Eight waste characterization samples—two from each site—will be collected from soil stockpiles and sent offsite for laboratory analysis and sample data package preparation meeting the EPA QC Level III data requirements. Analytical results from the waste characterization samples will be used to determine waste codes for proper transportation and disposal of the contaminated soil stockpiles. Waste characterization samples will be analyzed for VOCs,

SVOCs, Pesticides/PCBs, WTPH, and 8 RCRA metals. Samples will be composited from several aliquots determined to be representative of the soil stockpiles.

4.4.2 ONSITE LABORATORY ANALYSES

The onsite laboratory will be used to guide excavation and give a preliminary indication as to whether the ROD cleanup goals have been achieved after the removal of visible contamination.

- Screening samples will be collected in 125 ml glass jars. Sample preservation for all analysis will be 4° C. Screening sample custody will follow CDM Federal SOP 1-2, located in Appendix E of the 1100 EM-1 Work Plan (CDM Federal 1995a).
- Onsite analyses will be performed for WTPH, VOCs, lead, and chromium. The onsite analyses will meet the EPA QC Level II data requirements.
- Analytical results will be reported verbally to the CDM Federal Team Leader as soon as they are available, typically in less than 2 hours.
- Blind duplicates of screening samples will be submitted to the onsite lab at a rate of one in twenty screening samples.

4.4.3 OFFSITE LABORATORY ANALYSES

Soil samples collected for offsite laboratory analyses will be submitted to three laboratories. All laboratories will be notified ahead of time if Saturday delivery is required.

All soil analyses, with the exception of WTPH and QA samples, will be analyzed by the subcontract laboratory Environmental Science & Engineering, Inc. TPH analyses will be done by subcontract laboratory Sound Analytical Service, Inc. The QA samples will be submitted to the USACE North Pacific Division laboratory. A brief discussion of the offsite analyses is provided below:

- The analyses to be performed and sample data packages provided by the offsite laboratory will meet EPA QC Level III data requirements, except for 10% "CLP-type" analyses which will meet EPA QC Level IV data requirements.
- Analysis of samples from the Tar Flow Area and the 1240 French Drain will be by Washington State Method WTPH-418.1 and EPA SW-846 Method 7421 for WTPH and lead, respectively. In addition, at the 1240 French Drain, EPA SW-846 Method 6010 will be used for chromium analysis.
- At the Suspect Spill Area, EPA-SW 846 Method 7421 will be used for lead analysis.

- Analysis of samples from the 1262 Solvent Tanks will be used to ensure that soil is below the MTCA Method B remediation criterion for the specific solvents detected in the USTs. Analysis for VOCs will be by EPA SW-846 Method 8240.
- One waste characterization sample from the 1240 French Drain and one from the 1240 Suspect Spill Area will be analyzed for gross alpha-beta radiation and for gamma radiation by gamma spectroscopy.
- Container and preservative requirements, and maximum holding times for each matrix and analyte to be sampled are described in Section 6.0 of the *Remedial Design Field Sampling Plan for the 1100 Area, Hanford Site* (USACE 1994b).

4.4.4 SAMPLE IDENTIFICATION

Samples will be identified through the use of a coding system to identify sample locations and type. The coding system will ensure that samples are uniquely identified and provide a tracking procedure to facilitate data retrieval. Details of the sample numbering system are described in Section 4.0 of the *Remedial Design Field Sampling Plan for the 1100 Area Hanford Site* (USACE 1994b). The confirmatory, equipment rinsate, and waste characterization designations are shown in Table 4-1.

4.4.5 SAMPLE LABELING, PACKAGING, AND SHIPPING

Sample labeling, packaging and shipping will follow procedures in CDM Federal SOP 2-5 located in Appendix E in the 1100 EM-1 Work Plan (CDM Federal 1995a). In contrast to procedures discussed in the *Remedial Design Field Sampling Plan* (USACE 1994b), Offsite Property Control Forms will not be required prior to sample shipment. The point-of-contact for issues regarding samples is Paul Karas (509-943-5828) or George DeLullo (303-232-0131).

4.4.6 DOCUMENTATION

Documentation consists of all paperwork used to both track the samples through the analytical process and create a permanent record of field activities associated with the sampling effort. All activities at the site will be documented in a designated field logbook. Logbooks will be used to record the specific field information collected for each activity. All logbooks will be bound, hard-cover books, with sequentially numbered water-resistant pages. Ring binders or similar types of binders do not constitute a bound logbook. Procedures for field logbook use, content, and control are given in CDM Federal SOP 4-1 located in Appendix E of the 1100 EM-1 Work Plan (CDM Federal 1995a).

4.4.7 SAMPLE CUSTODY

Sample custody, including the completion of custody forms, is described in CDM Federal SOP 1-2 located in Appendix E of the 1100 EM-1 Work Plan. An example of a custody form is

included in Appendix D of the 1100 EM-1 Work Plan (CDM Federal 1995a). Each laboratory will follow chain-of-custody procedures outlined in their respective laboratory QA plans.

4.4.8 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

The field QC samples being sent to the offsite laboratories will include blind duplicates and equipment rinsates. QC sample frequency and protocol are discussed above and in the QAPjP (Appendix A). QA samples will be sent to a designated USACE QA laboratory. These QA samples will be collected as field duplicates of environmental samples submitted to CDM Federal's offsite laboratory.

QA and QC samples will be prepared in accordance with the procedures in the QAPjP and will be used as a check of laboratory and field sampling procedures. Matrix spike/matrix spike duplicate (MS/MSD) samples will be analyzed as required by SW-846 Methods. Extra sample volume for MS/MSD samples will be submitted if requested by the offsite laboratory.

4.4.9 OFFSITE LABORATORIES AND ADDRESSES

The addresses and point-of-contact for the various analytical laboratories are listed below.

Primary Subcontract Laboratory:

Environmental Science & Engineering, Inc.
14220 W. Newberry Rd.
Gainesville, FL 32607
POC: Patrick Wilber
(904) 332-3318 or 1-800-874-7872 Fax: (904) 332-0507

Secondary Subcontract Laboratory:

Sound Analytical Service, Inc.
4813 Pacific Highway East
Tacoma, WA 98424
POC: Tom Watson
(206) 922-2310 Fax: (206) 922-5047

USACE QA Laboratory:

U.S. Army Corps of Engineers
North Pacific Division Laboratory
1401 N.W. Graham Avenue
Troutdale, OR 97060-0503
POC: Pam Hertzberg
(503) 665-4166 Fax: (503) 665-0371

4.5 ATTAINMENT CRITERIA

Attainment criteria for the 1100-EM-2 and 1100-EM-3 sites will follow those used for the 1100-EM-1 sites which were developed jointly by EPA and Ecology. MTCA guidance from WAC173-340-740(7)(d) was used as a basis for this criteria. In summary, the sites will be considered to be fully remediated if;

- (i) The upper confidence interval on a true soil concentration is less than the soil cleanup level. Statistical tests would be performed at a Type I error level of 0.05 (95% upper confidence level);
- (ii) No single sample concentration is greater than two times the soil cleanup level; and
- (iii) Less than fifteen percent of the sample concentrations exceed the soil cleanup level.

In the development of these criteria, it was also recognized that the data sets obtained would probably have sample distributions which were "skewed to the left." In other words, there would be a large number of samples where contaminant concentrations were not detected (thus the leftward skew), some samples where contaminant concentrations were between non-detect and the specified cleanup levels, and a small percentage of samples where contaminant levels ranged from the cleanup level to two times the cleanup level. If the sample sets were tested for normality and log-normality and failed, it was agreed that the approximate method of calculating the one-sided upper confidence limit presented in Section 5.2.1.3 of Ecology's *Statistical Guidance for Ecology Site Managers* (Ecology 1992) would be used.

The sample population for data will include the results of samples analyzed by both onsite and offsite laboratories. The analytical methods used by the onsite laboratory are selected to ensure that all data obtained will be reliable. Offsite laboratory analysis will be used to provide confirmation that cleanup levels have been met. Appropriate QA/QC procedures will be employed for onsite analyses to ensure data usability (*e.g., splits with offsite analyses and blind duplicates*).

4.6 EQUIPMENT DECONTAMINATION

All reusable equipment used to collect, handle, or measure samples will be decontaminated before coming into contact with any sample. Decontamination will follow CDM Federal SOP 4-5, as modified for this project. The SOP can be found in Appendix E of the 1100 EM-1 Work Plan. The modification to SOP 4-5 is provided in Appendix D. Decontamination of sampling equipment will occur at portable decontamination stations set up at sampling locations. Decontamination of excavation equipment will occur at contaminated soil stockpiles. All items that will come into contact with potentially contaminated media will be decontaminated prior to use. If decontaminated items (other than the trackhoe bucket and shovels) are not immediately used, they will be covered either with plastic or aluminum foil, depending on the size of the item.

All decontamination episodes, and the procedures used, will be recorded in the field logbook. The general decontamination procedures for the equipment being used are listed below:

- Decontamination of the trackhoe will consist of knocking off the majority of the dirt on the bucket with a shovel, followed by brushing and wet swabbing of the bucket. No decontamination wastewater will be generated. This "dry decontamination" method represents an approved modification from CDM Federal SOP 4-5 (see Appendix D).
- Stainless steel bowls, spoons and other sampling equipment will be cleaned withalconox and tap water, rinsed thoroughly with tap water, and then rinsed with deionized water. The items will be completely air dried prior to use. Items not immediately used will be either wrapped in aluminum foil (small items) or in sheet plastic (larger items). No solvent or acid rinse will be used (see Appendix D).
- Decontamination waste water generated from the decontamination of sampling equipment will be applied to contaminated material soil stockpiles for dust control. No containerization or sampling of the decontamination waste water will be performed.

4.7 INVESTIGATION-DERIVED WASTE PLAN

All potentially hazardous materials shall be stockpiled at a staging area (adjacent to each excavation) consisting of minimum 10-mil plastic sheets measuring approximately 6 m (20 ft) by 30.5 m (100 ft) in size. Incidental investigation-derived wastes (e.g., personal protective equipment) generated during field sampling activities, if not grossly contaminated, will be disposed of as non-regulated wastes. Any grossly contaminated wastes will be placed into drums and left on plastic sheets at each site. Decontamination fluids generated from decontamination of sampling equipment will be returned to the contaminated soil stockpile from which the sampling event originated for the purpose of dust control.

5.0 REFERENCES

- CDM Federal Programs Corporation (CDM Federal). 1995a. Remedial Action Work Plan, Removal and Stockpiling of Contaminated Soil, EM-1 Operable Unit Hanford 1100 Area, Washington, CDM Federal, Richland, Washington. January 20, 1995.
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- U.S. Department of Energy (DOE) 1993. Draft Remedial Investigation/Feasibility Study for the 1100-EM-1 Operable Unit; DOE, Richland, Washington.
- U.S. Environmental Protection Agency (EPA). 1993. Record of Decision, U.S. Department of Energy, Hanford 1100 Area; EPA, Richland, Washington.
- Washington State Department of Ecology (Ecology). 1992. Statistical Guidance for Ecology Site Managers; Olympia, Washington.

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APPENDIX A

QUALITY ASSURANCE PROJECT PLAN
REMOVAL AND STOCKPILING OF CONTAMINATED SOIL
AND REMOVAL OF UNDERGROUND STORAGE TANKS, EM-2 AND EM-3
OPERABLE UNITS, HANFORD 1100 AREA, WASHINGTON

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**MISCELLANEOUS ARCHITECT ENGINEER SERVICES
FOR HAZARDOUS, TOXIC, AND
RADIOLOGICAL WASTE (HTRW) PROJECTS
FOR
U.S. ARMY CORPS OF ENGINEERS
WALLA WALLA DISTRICT**

QUALITY ASSURANCE PROJECT PLAN

DELIVERY ORDER NO. 019

REMOVAL AND STOCKPILING OF CONTAMINATED SOIL AND REMOVAL
OF UNDERGROUND STORAGE TANKS, EM-2 AND EM-3
OPERABLE UNITS
HANFORD 1100 AREA, WASHINGTON

CONTRACT NO. DACW68-94-D-0001

June 14, 1995

Prepared by:

CDM FEDERAL PROGRAM CORPORATION
1010 Jadwin Avenue
Richland, WA 99352

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
Walla Walla District
201 North 3rd Street
Walla Walla, Washington 99362

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MISCELLANEOUS ARCHITECT ENGINEER SERVICES
FOR HAZARDOUS, TOXIC, AND
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WALLA WALL DISTRICT

APPENDIX A

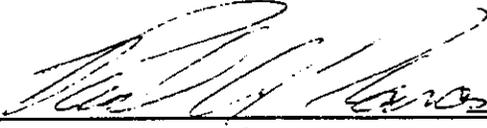
QUALITY ASSURANCE PROJECT PLAN

DELIVERY ORDER NO. 019

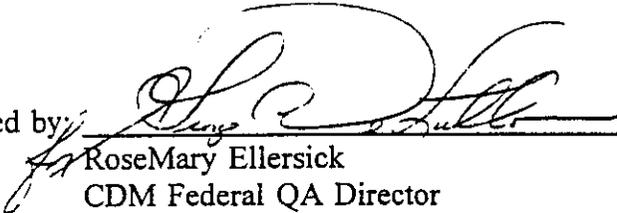
REMOVAL AND STOCKPILING OF CONTAMINATED SOILS
AND REMOVAL OF UNDERGROUND STORAGE TANKS

EM-2 AND EM-3 OPERABLE UNITS
HANFORD 1100 AREA, WASHINGTON

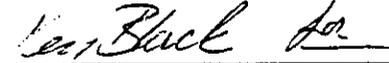
CONTRACT NO. DACW68-94-D-0001

Approved by: 
Paul A. Karas, P.G.
Project Manager

Date: 6/12/95

Approved by: 
RoseMary Ellersick
CDM Federal QA Director

Date: 6/13/95

Approved by: 
Charles J. Schick, P.E.
Program Manager

Date: 6/13/95

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CEQAPP 1.1 REQUIREMENT LOCATOR

Quality Assurance (QA) requirements established in the U.S. Army Corps of Engineers (USACE) Quality Assurance Program Plan (CEQAPP) 1.1 Revision 2 dated June 15, 1993 and in the U.S. Environmental Protection Agency (EPA) Quality Assurance Management Staff (QAMS) interim guidelines and specifications for preparing Quality Assurance Project Plans are relevant to this project. This locator section indicates the appropriate portions of this plan and the supporting documents that address each of the 16 elements described in CEQAPP 1.1 and in QAMS 005/80.

CEQAPP 1.1 AND QAMS 005/80

THIS QUALITY ASSURANCE PROJECT PLAN

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LIST OF ABBREVIATIONS AND ACRONYMS

BEHP	Bis(2-ethylhexyl)phthalate
CDM Federal	CDM Federal Programs Corporation
CLP	Contract Laboratory Program
COC	Chain-of-Custody
CWM	Chemical Waste Management, Inc.
DOE	U.S. Department of Energy
DQCR	Daily Quality Control Report
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
ERA	Expedited Response Action
ESE	Environmental Science and Engineering, Inc.
FSP	Field Sampling Plan
GC	Gas Chromatography
HEIS	Hanford Environmental Information System
HLA	Harding Lawson Associates
LFI/FFS	Limited Field Investigation/Focused Feasibility Study
mg/kg	Milligrams(s) per kilogram
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NPL	National Priorities List
OU	Operable Unit
PARCC	Precision, Accuracy, Representativeness, Comparability and Completeness
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PPE	Personal Protective Equipment
PPM	Parts per Million
QA	Quality Assurance
QAMS	Quality Assurance Management Staff

QAPjP	Quality Assurance Project Plan
QC	Quality Control
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPD	Relative Percent Difference
RPH	Total Petroleum Hydrocarbons
RSD	Relative Standard Deviation
SAS	Sound Analytical Services, Inc.
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
TEG	Transglobal Environmental Geosciences Northwest, Inc.
TPA	Tri-Party Agreement
TPH	Total Petroleum Hydrocarbons
USACE	U.S. Army Corps of Engineers
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WED	West Division (CDM Federal)
WHC	Westinghouse Hanford Company
WP	Work Plan
WTPH	Washington State Method - Total Petroleum Hydrocarbons
µg/kg	microgram(s) per kilogram

1.0 INTRODUCTION

CDM Federal Programs Corporation (CDM Federal) has prepared this Quality Assurance Project Plan (QAPjP), for the U.S. Army Corps of Engineers Walla Walla District (USACE) under Contract No. DACW68-94-D-0001. This QAPjP, in conjunction with the *Work Plan for the Removal and Stockpiling of Contaminated Soils and Removal of Underground Storage Tanks, EM-2 and EM-3 Operable Units (OUs), Hanford 1100 Area, Washington (WP)* dated May 1995 (CDM Federal 1995a) governs activities being conducted during the excavation, screening, and stockpiling of soils and debris and the removal and disposal of underground storage tanks (USTs) at EM-2 and EM-3, Hanford 1100 Area, Washington. These activities are being conducted as part of the remedial action for the EM-2 and EM-3 sites specified by the Record of Decision (ROD) (EPA 1993). This QAPjP will either present or provide references that include the organizational structure and policies, functional activities, and specific quality assurance (QA) and quality control (QC) activities designed to achieve the project goals and objectives. The field sampling activities presented in this QAPjP are described in more detail in the WP, Section 4.0-Field Sampling Plan (FSP). QA/QC activities presented in this QAPjP were developed in accordance with requirements in the USACE Statement of Work (SOW) dated April 5, 1995, and subsequent modifications.

QA is defined as the integrated program designed for assuring reliability of monitoring and measurement data. QA procedures are implemented, as necessary, to ensure that all project work is performed in accordance with professional standards and USACE, U.S. Environmental Protection Agency (EPA), U.S. Department of Energy (DOE), and other applicable governmental requirements and guidelines. QC is defined as the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measuring process. All personnel generating data have the responsibility to implement procedures that assure the precision, accuracy, representativeness, completeness, and comparability of the data. In addition, the data quality levels (i.e., EPA QC Levels I, II, III, etc.) should be consistent with the anticipated uses of the data and the project objectives. This QAPjP has been prepared to ensure that this responsibility is met uniformly throughout the duration of this project.

The following sections of this QAPjP include a discussion of project objectives and site background information; project organization and responsibility; document control; QA objectives for measurement data; proposed sampling activities and procedures; sample custody requirements; equipment operation, maintenance, calibration, and standardization procedures; analytical laboratory procedures; data quality management; QC checks and samples; and QA oversight.

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2.0 PROJECT DESCRIPTION

2.1 BACKGROUND

Background information on EM-2 and EM-3 has been described in detail in the WP (CDM Federal 1995a). The following section provides a summary of this information.

The 1100 Area was placed on the National Priorities List (NPL) in July 1989. The 1100 Area has been divided into four OUs based on geographic area and common waste sources. The four OUs are identified as 1100-EM-1 (EM-1), 1100-EM-2 (EM-2), 1100-EM-3 (EM-3), and 1100-IU-1 (IU-1). The location of the Hanford Site and the 1100 Area are depicted on Figure 1-1 of the WP. During the course of performing Remedial Investigation/Feasibility Study (RI/FS) activities at the 1100 Area, the highest priority was placed on the EM-1 OU which underwent a full-scale RI/FS to determine the nature and extent of contamination and to identify preferred remedial alternatives. EM-2 and EM-3 underwent a limited field investigation and focused feasibility study (LFI/FFS) to determine the nature and extent of contamination and to identify the preferred remedial alternatives.

EM-2 encompasses an area on the southeast side of the Hanford Site and north of the town of Richland. EM-3 is about 600 meters (1000 ft) northeast of EM-2. The main structure of EM-2 is the 1171 Building, which is a vehicle service, maintenance, and repair facility. EM-3 contains approximately 20 permanent structures. Operations at EM-2 and EM-3 have included the use of solvents, fuels, oils, and polychlorinated biphenyls (PCBs).

During the LFI/FFS, one area within EM-2, and two areas within EM-3, were determined to contain contaminants at levels that may pose potential long-term risks to human health. The area of concern within EM-2 was an area of discolored soil, the Tar Flow Area. The areas of concern within EM-3 were one area of discolored soil, the Suspect Spill Area, and the 1240 French Drain, which is adjacent to a PCB collection area. At a third EM-3 site, the LFI/FFS identified two abandoned USTs (1262 Solvent Tanks) that may contain residual materials that pose potential health risks. The locations of each of these areas are depicted on Figures 1-3 and 1-4 of the WP.

2.2 PROJECT OBJECTIVES AND SCOPE

The characterization and remediation activities for EM-2 and EM-3 include preparing planning documents, implementing a field program, and preparing data reports. These proposed activities were developed from the USACE SOW (April 5, 1995 as modified on May 15, 1995). The objectives of the investigation are to accomplish the following:

- Prepare a task-specific WP (including a Field Sampling Plan), Site Safety and Health Plan (SSHP), and this QAPjP.

- Excavate contaminated soils and debris based partially on findings of previous investigations.
- Remove and dispose of two USTs and excavate the associated contaminated soil.
- Collect and analyze screening samples to guide the excavation process.
- Collect and analyze (in an offsite laboratory) samples intended to confirm completion of the removal of contaminated materials.
- Stage and secure contaminated materials onsite.
- Prepare and submit draft and final "Technical" reports.

2.3 PROJECT SCHEDULE

The anticipated project schedule for remediation at the four sites includes a start date of June 15, 1995, for field activities, and a final technical report completion date of September 30, 1995. A more detailed project schedule is presented in the WP.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

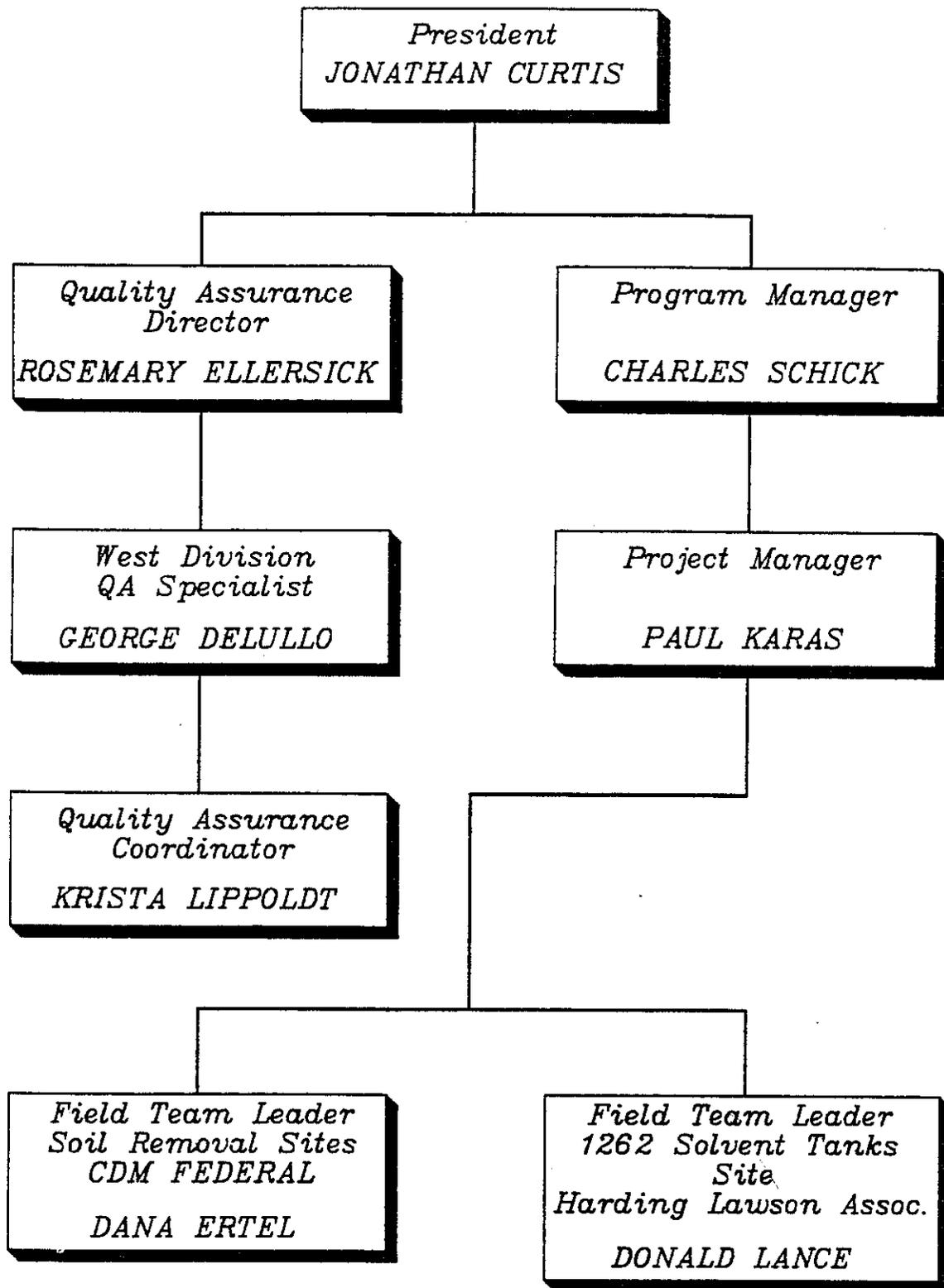
3.1 MANAGEMENT ORGANIZATION

CDM Federal's project management organization for this project is presented on Figure 3-1. Figure 3-2 illustrates the organization and interfaces for the Washington Department of Ecology, EPA, DOE, USACE, CDM Federal, and subcontractors for field activities at EM-2 and EM-3.

On behalf of CDM Federal, Mr. Charles Schick will serve as Program Manager, having ultimate responsibility for all QA matters. The CDM Federal Project Manager, Mr. Paul Karas, is responsible for the day-to-day management and coordination of project activities. His specific responsibilities include:

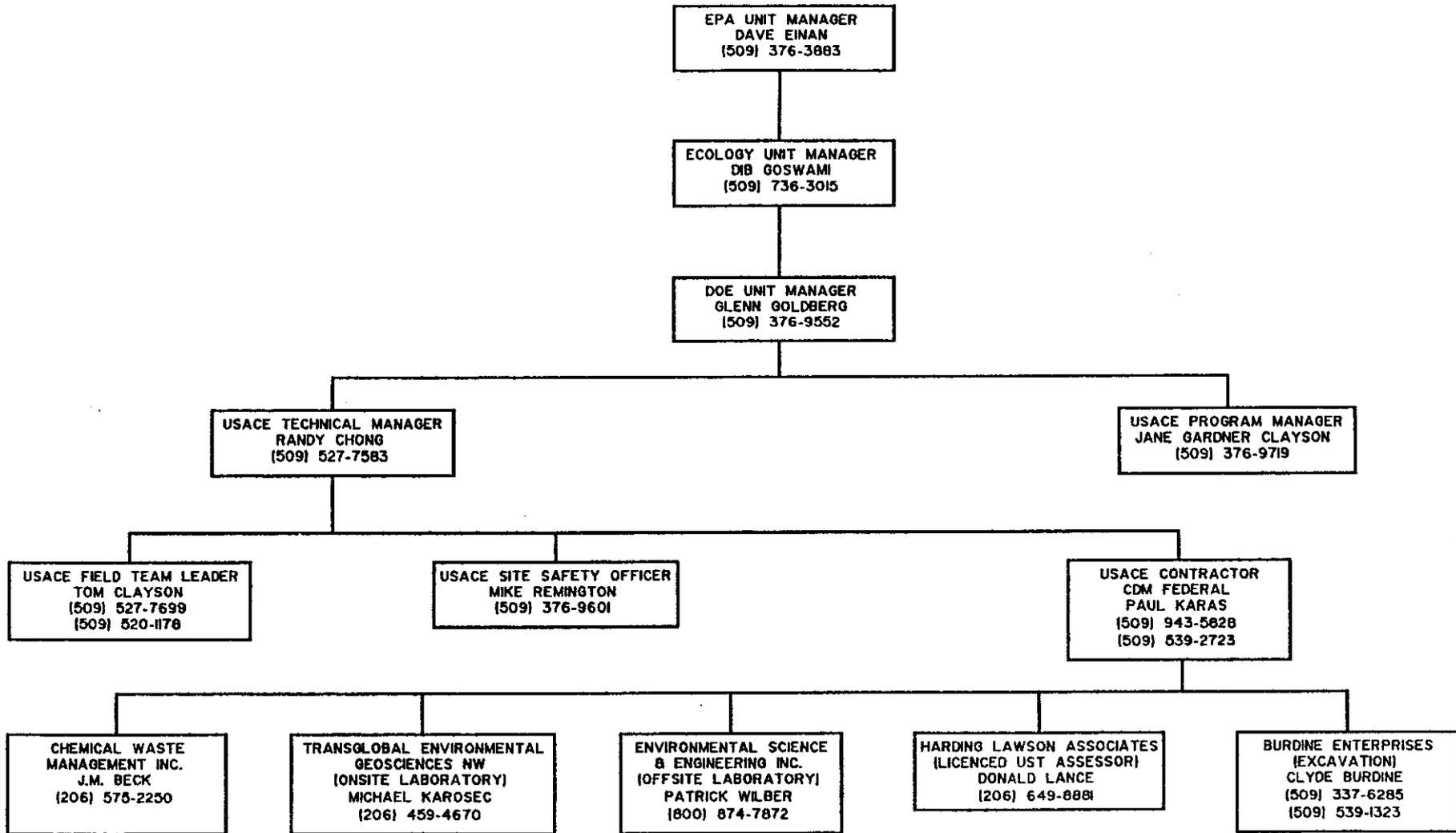
- Overseeing the execution of the project and coordinating and implementing directives from the USACE
- Coordinating with USACE on all planning, field, and data reporting work performed as part of the remediation activities for the 1100 Area sites
- Maintaining a record of all pertinent discussions related to the execution of the remediation activities
- Developing and updating (weekly) a schedule of the remediation activities to include changes and delays to the existing schedule, as well as the rationale for the schedule modifications
- Preparation, review, and approval of deliverables, including this QAPjP, the WP, Addendum to the SSHP, and the Draft and Final Technical Reports
- Implementing QC procedures specified in the WP, this QAPjP, and other project documents
- Managing subcontractor efforts for field support activities, and coordinating laboratory needs for this project
- Identifying and implementing all necessary corrective actions

As Project Manager, Mr. Karas will also serve in the role of Site Manager, as identified in the CDM Federal Standard Operating Procedures (SOPs) included with the WP.



1100 AREA EM2 AND EM3 OPERABLE UNITS
HANDFORD RESERVATION





1100 AREA EM-2 AND EM-3 OPERABLE UNITS
FIELD ACTIVITIES
ORGANIZATION CHART

Other CDM Federal project staff will include the Site Safety and Health Officer and Field Team Leaders.

The Site Safety and Health Officer has the following duties and responsibilities:

- Implementing and enforcing the SSHP
- Conducting site safety checks
- Performing air monitoring in support of site activities
- Enforcing the Site Safety and Health Plan for subcontractor tasks
- Assisting in the training of employees assigned to the site
- Conducting onsite "tailgate" safety meetings
- Enforcing the use of proper personal protective equipment (PPE) for each appropriate work zone and work project
- Designating and enforcing the observance of support, contamination reduction, and exclusion zones
- Performing first aid and notifying appropriate authorities in emergencies
- Performing additional tasks as necessary to ensure the health and safety of assigned project employees and subcontractors

The Field Team Leaders are responsible for overseeing field operations. Specific responsibilities include the following:

- Implementing the field aspects of the WP, this QAPjP, and other project documents
- Ensuring that all necessary information is recorded in the field logbooks
- Communicating with the Project or Program Manager regarding resource and scheduling considerations
- Implementing the QC measures specified in this QAPjP
- Notifying the Project or Program Manager of significant field changes to the WP, this QAPjP, or other project documents on a daily basis

- Notifying the CDM Federal QA Director or Project QA Coordinator immediately of significant problems affecting the quality of data or the ability to meet project objectives
- Notifying the subcontractor laboratory of scheduled sample shipments

Project personnel will be adequately trained and will have the appropriate experience and knowledge for the positions to which they are appointed. All site personnel will have the required health and safety training, including, as a minimum, a 40-hour Hazardous Waste Site Operations Course and an 8-hour Refresher course within the previous year. CDM Federal will provide separately to USACE documentation of required Health and Safety Training and of participation in a medical monitoring program for all staff. Copies of these records will be maintained onsite by the Field Team Leader. The Project Manager will consult with USACE to ensure that all site personnel receive the required Hanford site-specific training. Security badges are not required for work in the EM-2 or EM-3 areas.

3.2 QUALITY ASSURANCE ORGANIZATION

The QA Program is implemented by the CDM Federal corporate QA Director, Ms. RoseMary Ellersick, who is independent of the technical staff and reports directly to the President of CDM Federal on QA matters. The QA Director, thus, has the authority to objectively review projects and identify problems, and the authority to bring corporate resources to bear in solving problems, if necessary. The QA Director is responsible for directing the overall QA program for the project. Mr. George DeLullo is CDM Federal's West Division (WED) QA Specialist and will review all project documents prior to submittal. Ms. Krista Lippoldt will serve as the regional QA Coordinator for this project. She will report to the CDM Federal WED QA Specialist on quality matters affecting this project. The CDM Federal QA organization for this project is shown on Figure 3-1.

The CDM Federal WED QA Specialist and project QA Coordinator are responsible for:

- Maintaining QA oversight for the project
- Reviewing QA sections in project reports
- Reviewing QA/QC procedures applicable to these projects
- Auditing selected field and reporting activities performed by CDM Federal and subcontractors
- Verifying any corrective actions assigned to project activities at the four EM-2 and EM-3 sites

3.3 SUBCONTRACTORS

During the remediation activities, several subcontractors will provide support in the field and at offsite locations. A listing of all subcontractors and their responsibilities is presented below. All subcontractors will report directly to the CDM Federal Project Manager, or during field activities, to the Field Team Leader.

Burdine Enterprises - Excavation Subcontractor: Burdine Enterprises of Waitsburg, WA, will be responsible for heavy equipment operation during the excavation and stockpiling of contaminated soils, placement and compaction of backfill materials, and site restoration as necessary. Burdine Enterprises staff will also apply water during excavation as necessary and cover stockpiles to minimize fugitive dust. At the 1262 Solvent Tanks site, Burdine Enterprises will excavate to uncover the USTs. After the product or wastes are removed, Burdine Enterprises will extract the tanks and retrievable piping, excavate contaminated soils as directed, and restore the site.

Chemical Waste Management, Inc. - Hazardous Waste Services: A field services team from Chemical Waste Management, Inc., (CWM) of Tukwila, WA, will assist in hazardous waste characterization and handling at the 1262 Solvent Tanks site. CWM will conduct the initial assessment and sampling of product or waste present in the USTs, if any. CWM will use a subcontract laboratory, Sound Analytical Service, Inc., (SAS) of Tacoma, WA, to analyze samples of product or waste collected from the tanks. Following receipt of analytical results, CWM will transfer the product or waste fluids and sludge to drums and clean and dispose of the USTs.

Environmental Sciences and Engineering, Inc. - Offsite Analytical Laboratory: Environmental Science and Engineering, Inc., (ESE) of Gainesville, FL, is responsible for the analysis of all confirmatory soil samples and waste characterization samples (except product or waste samples from the 1262 Solvent Tanks USTs). Analysis of soil samples for total petroleum hydrocarbons by Washington State Method (WTPH 418.1) will be conducted by SAS under contract to ESE.

Harding Lawson Associates - Certified UST Decommissioner: Harding Lawson Associates (HLA) of Bellevue, WA, will provide a Washington State certified UST Decommissioner and Site Assessor to serve as FTL for the work at the 1262 Solvent Tanks. Donald Lance, R.G., will serve as FTL for HLA. In this role, Mr. Lance will be responsible for field supervision and direction of excavation, product sampling, product transfer, and UST removal and cleaning. Additional site remediation, as necessary, and site restoration will also be conducted under his supervision. At the conclusion of field activities, Mr. Lance will prepare the Department of Ecology Site Check/Site Assessment Checklist and the draft and final report describing the tank removal and site remediation.

Transglobal Environmental Geosciences Northwest, Inc. - Onsite Analytical Laboratory:

Onsite analytical laboratory services will be furnished by Transglobal Environmental Geosciences Northwest, Inc., (TEG) of Lacey, WA. Mobile laboratory analyses of screening samples from all four EM-2 and EM-3 sites will be conducted on a quick turn-around basis under QC Level II or better.

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4.0 DOCUMENT AND RECORDS CONTROL

Document and Records Control requirements have been established in order to ensure that:

- Documents and revisions are distributed and released in a controlled manner and in accordance with USACE policy and contract requirements.
- Documents and records are kept secure, under custody where necessary, without unauthorized reproduction and/or alteration, to provide for physical accountability.
- Records are properly archived at the end of the project.

The official project files will be maintained in the CDM Federal office in Golden, Colorado. A working copy of the project files will also be maintained in the Richland, Washington office of CDM Federal. Control of document distribution and release will be maintained by the Project Manager throughout the project. A record of distribution (date, individual, affiliation, document title, and revision) will be maintained by the Project Manager. Additional copying and distribution will not be performed without the authorization of USACE and the CDM Federal Project Manager, with the exception of internal distribution copies. Under no circumstances will any documents be released to the public without the approval of the USACE Office of Counsel.

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5.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective for measurement data is to ensure that data of documented quality, acceptable for specified uses, are generated. QA objectives for measurement data are usually expressed in terms of precision, accuracy, representativeness, completeness and comparability. In general, data collected should meet the following criteria:

- Representative of actual site physical and chemical conditions
- Comparable to previous and subsequent data and other studies
- Complete to the extent that necessary conclusions may be reached
- Of known quantitative statistical significance in terms of precision and accuracy, at levels appropriate for each stated data use for the project

The following sections present information related to project-specific sampling data quality objectives, anticipated data uses and associated levels of data quality, and QA objectives.

5.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative criteria used to establish requirements for sample collection and analysis, and are based on the needs and intended uses of the data. The overall intent of DQOs is to ensure that data of the appropriate type and quality are collected to support the decision-making process for a site. DQOs also establish QC limits for activities involving measurement, and they direct the level of QC performed during field activities.

The DQOs have been developed for the removal and stockpiling of contaminated soil, and the removal and disposal of USTs at the four EM-2 and EM-3 sites to ensure that all soil contaminated with chromium, lead, and petroleum products above the specified project action levels has been properly excavated and secured onsite. Sampling DQOs have also been identified for waste characterization analyses to assure transportation and disposal requirements are met. Specific project DQOs are described below.

5.2 APPROPRIATE ANALYTICAL LEVELS

Field and analytical data can be used for a number of purposes ranging from determination of the presence or absence of a potential contaminant to precise quantification of concentrations for comparison to regulatory standards or health-based criteria. To ensure that data will be usable for the intended purposes, analytical levels have been established to define data uses and limitations for field and laboratory data. This section defines analytical levels and indicates the levels appropriate to different data uses for the planned remedial actions.

Data quality has been defined by EPA in terms of five levels of analytical quality control. Sampling will involve the use of EPA quality Levels II, III, and IV, which are described below.

- **Level II:** Data at this level are generally obtained from field laboratories and may be sufficient for characterizing whether bulk contamination is present, determining which samples will be selected for offsite analysis, and placement of additional sampling locations. During this project, Level II data will consist of onsite laboratory data for analysis of chromium, lead, volatile organic compound (VOC), and total petroleum hydrocarbon (TPH) analyses (EPA SW-846 Methods 7190, 7420, and 8021 and Washington State Modified Method 418.1 [WTPH], respectively) in soil samples.
- **Level III:** Comprises all analyses performed at an offsite analytical laboratory. Level III analyses may or may not use Contract Laboratory Program (CLP) procedures, but are minimally required to use EPA-approved methods. They do not usually utilize the strict validation or documentation procedures required of CLP Level IV analysis. During this project, confirmational subsurface soil samples sent to the offsite laboratory will be analyzed for chromium, lead, VOCs, and TPHs utilizing EPA SW-846 Methods 6010, 7421 and 8240 and WTPH, respectively and waste characterization samples will be analyzed for TPHs, 8 RCRA metals, VOCs, semivolatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (pests/PCBs), toxicity characteristic leaching procedure (TCLP) chromium, and TCLP lead utilizing WTPH 418.1 and EPA SW-846 Methods 6010/7000-series, 8240, 8270, 8080, 1311/6010, and 1311/7421, respectively, at EPA QC Level III. Eight RCRA metals include arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), lead (Pb), mercury (Hg), selenium (Se), and silver (Ag). Ba, Cd, Cr, and Ag will be analyzed using SW-846 Method 6010, as utilizing SW-846 Method 7060, Pb utilizing SW-846 Method 7421, Se utilizing SW-846 Method 7740, and Hg utilizing SW-846 Method 7471.
- **Level IV:** CLP routine analytical services generate data of Level IV quality. All analyses are performed at an offsite CLP approved laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation. During this project, 10-percent of all subsurface soils samples analyzed sent to the offsite laboratory will be analyzed and reported using EPA CLP protocols at EPA Quality Level IV.

5.3 OBJECTIVES FOR PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

QA objectives for measurement data are usually expressed in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC). The following sections define each of these terms. Goals for PARCC parameters are discussed in Section 5.3.6.

5.3.1 PRECISION

Precision refers to the level of agreement among repeated measurement of the same characteristics, usually under a given set of conditions. Precision is expressed quantitatively as a measure of variability of a group of measurements compared to their average value. Precision is usually stated in terms of standard deviation or relative percent difference between measurements of the same parameter. For this project, the precision of the analytical and instrument measurement system will be assessed through the collection and analysis of field duplicate samples and the performance of laboratory analytical replicates and matrix spike/matrix spike duplicates.

Precision will be estimated by the analysis of replicate samples and will be expressed (if three or more values are determined) as the standard deviation, which is determined according to the following equation:

$$S = \left[\frac{\sum (X_i - X)^2}{n - 1} \right]^{1/2}$$

where:

- S = standard deviation
- X_i = individual measurement result
- n = number of measurements
- X = arithmetic mean of replicate measurements

Relative standard deviation may also be reported. If so, it will be calculated as follows:

$$RSD = 100 \frac{S}{X}$$

where:

- RSD = Relative standard deviation, expressed in percent
- S = Standard deviation, and

X = Arithmetic mean of
replicate measurement

Precision will be estimated by calculating the relative percent difference (RPD) if only two values are determined using the following equation:

$$RPD = \frac{100 (D_1 - D_2)}{(D_1 + D_2)/2}$$

where:

RPD = relative percent difference
D₁ = the larger of the two observed values
D₂ = the smaller of the two observed values

Precision of radiochemistry data will be determined through assessment of the Replicate Error Ratio (RER) calculated based on a minimum 5% replicate frequency. Calculation of the RER is by the following formula:

$$RER = \frac{|S - R|}{2 \times \sqrt{\sigma_S^2 + \sigma_R^2}} \leq 1.42$$

Where:

S = Sample Result
R = Replicate Result
 σ_S = 1 σ sample uncertainty
 σ_R = 1 σ replicate uncertainty
1.42 = the point at which the maximum range of
uncertainty will overlap

Use of the RER is particularly useful in radiochemistry where the analytical result may be very low, along with a relatively high uncertainty. Use of a traditional RPD formula in such a case may result in apparently unacceptable RPD values which the uncertainties of the measurements overlap. Use of the replicate error ratio also eliminates the need for subjective determinations of when a particular RPD criteria would be appropriate (for example, above or below a certain activity level) and accounts directly for analysis uncertainties and uncertainties in the value of the measured standard.

5.3.2 ACCURACY

Accuracy refers to the degree of agreement of measurement with an accepted reference or true value. Accuracy is a measure of bias in a measurement system. Sources of error that

introduce bias are the sampling process, field contamination, sample preservation, sample handling, matrix, sample preparation, analysis techniques, and data reduction.

Analytical accuracy will be assessed using standard reference materials, matrix spikes, and surrogate spikes.

For standard reference samples and surrogate spikes:

$$\text{Percent Recovery} = 100 \frac{(\text{Measured Value})}{(\text{True Value})}$$

For matrix spikes:

$$\text{Percent Recovery} = 100 \frac{(C_1 - C_0)}{C_i}$$

where: C_0 = value of the unspiked aliquot

C_1 = value of spiked aliquot

C_i = value for spike added

Accuracy of radiochemistry data will be assessed using the formula for RER presented in the previous section. For the purpose of accuracy evaluation, the following substitutions will be made to the formula:

S = Known value for Reagent Spike

R = Reported value for Reagent Spike

Computer programs are used to report and store analytical data. These programs may not perform calculations. CDM Federal personnel will check entry accuracy by proofreading all output information and comparing against the original laboratory data reports.

5.3.3 COMPLETENESS

Completeness is a measure of the amount of usable data (based on evaluation of field and laboratory QC information) obtained from a measurement system compared to the amount that was expected under normal conditions. A certain amount of data must be collected in

order for conclusions based on that data to be deemed usable. A completeness goal of 90 percent has been established for this project.

5.3.4 REPRESENTATIVENESS

Representativeness is defined as the degree to which data accurately and precisely represent the true value of a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition intended to be characterized.

Representativeness of reported results depends upon a number of considerations including, but not limited to, proper monitoring design, selection of appropriate field methodology, proper sample preparation, preservation and handling, selection and execution of appropriate analytical methodology, proper decontamination, and proper sample identification and reporting of results.

5.3.5 COMPARABILITY

Comparability is defined as the confidence with which one data set can be compared to another. Comparability may be assessed by comparing sampling methodology, analytical methodology, and units of reported data. Comparability will be ensured through the use of SOPs for sampling and field operations as presented in the FSP section of the WP. All data in a particular data set will be collected by the same methods (i.e., SOPs, instrument manufacturer's instructions). Data will be grouped and evaluated according to similar sampling methods, sampling media, and laboratory analytical methods. Data will be reported in comparable units. Soil concentrations will be reported in milligrams per kilogram (mg/kg) or micrograms per kilogram ($\mu\text{g}/\text{kg}$). The analytical laboratories will use SOPs as described in their laboratory QA Plan, which is included in Attachment A of Appendix A of the Work Plan for the Removal and Stockpiling of Contaminated Soils, Hanford 1100 Area, EM-1, Hanford Reservation, Richland, Washington. EPA-approved methods will be used for all analyses.

5.3.6 PARCC GOALS

The proposed project-specific PARCC goals for sample analysis are presented in Table 5-1. These goals are based on the information provided in the USACE Delivery Order SOW dated April 5, 1995, (as modified on May 15, 1995), and are consistent with EPA SW-846 methods. The detection limits presented in Table 5-1 are goals for all samples collected for this project. Actual analytical detection limits for each sample analyzed may vary with analytical method, matrix type, and concentration of interfering contaminants.

TABLE 5-1

DATA QUALITY OBJECTIVES FOR OFFSITE ANALYSES

Constituent	Analytical Method (SW-846)	Practical Quantitation Goals		Accuracy (%R)	Precision (RPD)	Completeness (%)
		Soil (mg/kg)	Water ($\mu\text{g/l}$)			
METALS						
Arsenic	7060	0.30		68-126	≤ 35	90
Barium	6010	1.4		58-149	≤ 35	90
Cadmium	6010	0.34		75-137	≤ 35	90
Chromium	6010	0.68	10	73-137	≤ 35	90
Lead	6010	8.2	50	68-133	≤ 35	90
Mercury	7471	0.02		93-141	≤ 35	90
Selenium	7740	0.78			≤ 35	90
Silver	6010	0.46			≤ 35	90
VOLATILE ORGANIC COMPOUNDS						
Chloromethane	8240	0.010	4.4			90
Bromomethane	8240	0.010	3.5			90
Vinyl Chloride	8240	0.010	4.6			90
Chloroethane	8240	0.010	8.2			90
Methylene Chloride	8240	0.005	6.4			90
Acetone	8240	0.100	9.0			90
Carbon Disulfide	8240	0.005	5.0			90
1,1-Dichloroethene	8240	0.005	3.2	59-172	≤ 22	90
1,1-Dichloroethane (Total)	8240	0.005	2.5			90
Trans-1,2-Dichloroethene	8240	0.005	2.4			90
Chloroform	8240	0.005	2.5			90
1,2-Dichloroethane	8240	0.005	2.5			90
2-Butanone	8240	0.100	10			90
1,1,1-Trichloroethane	8240	0.005	2.5			90
Carbon Tetrachloride	8240	0.005	2.6			90
Vinyl Acetate	8240	0.050	10			90
Bromodichloromethane	8240	0.005	2.2	62-137	≤ 24	90
1,1,2,2-Tetrachloroethane	8240	0.005	1.5			90
1,2-Dichloropropane	8240	0.005	2.0			90
Trans-1,2-Dichloropropene	8240	0.005	2.4			90

TABLE 5-1 (Continued)

DATA QUALITY OBJECTIVES FOR OFFSITE ANALYSES

Constituent	Analytical Method (SW-846)	Practical Quantitation Goals		Accuracy (%R)	Precision (RPD)	Completeness (%)
		Soil (mg/kg)	Water ($\mu\text{g/l}$)			
Trichloroethene	8240	0.005	3.0			90
Dibromochloromethane	8240	0.005	2.3			90
1,1,2-Trichloroethane	8240	0.005	2.8			90
Benzene	8240	0.005	2.2	66-142	≤ 21	90
trans-1,3-Dichloropropene	8240	0.005	1.6			90
2-Chloroethyl vinyl ether	8240	0.010	3.1			90
Bromoform	8240	0.005	2.6			90
2-Hexanone	8240	0.050	21			90
Tetrachloroethene	8240	0.050	1.9			90
Toluene	8240	0.005	1.7	59-139	≤ 21	90
1,1,2,2-Tetrachloroethane	8240	0.005	1.5			90
Chlorobenzene	8240	0.005	1.4	60-133	≤ 21	90
Ethylbenzene	8240	0.005	1.3			90
Styrene		0.005	0.5			90
Total Xylenes		0.005	3.72			90
SEMI-VOLATILE ORGANIC COMPOUNDS						
Phenol	8270	0.660		26-90	≤ 35	90
bis(2-Chloroethyl) ether	8270	0.660				90
2-Chlorophenol	8270	0.660		25-102	≤ 50	90
1,3-Dichlorobenzene	8270	0.660				90
1,4-Dichlorobenzene	8270	0.660		28-104	≤ 27	90
Benzyl Alcohol	8270	1.300				90
1,2-Dichlorobenzene	8270	0.660				90
2-Methylphenol	8270	0.660				90
bis(2-Chloroisopropyl) ether	8270	0.660				90
4-Methylphenol	8270	0.660				90
1-Nitroso-di-n-propylamine	8270	0.660		41-126	≤ 38	90
Hexachloroethane	8270	0.660				90
Nitrobenzene	8270	0.660				90
Isophorone	8270	0.660				90
2-Nitrophenol	8270	0.660				90
2,4-Dimethylphenol	8270	0.660				90

TABLE 5-1 (Continued)

DATA QUALITY OBJECTIVES FOR OFFSITE ANALYSES

Constituent	Analytical Method (SW-846)	Practical Quantitation Goals		Accuracy (%R)	Precision (RPD)	Completeness (%)
		Soil (mg/kg)	Water (µg/l)			
Benzoic Acid	8270	3.300				90
bis(2-Chloroethoxy) methane	8270	0.660				90
2,4-Dichlorophenol	8270	0.660				90
1,2,4-Trichlorobenzene	8270	0.660		38-107	≤23	90
Naphthalene	8270	0.660				90
4-Chloroaniline	8270	1.300				90
Hexachlorobutadiene	8270	0.660				90
4-Chloro-3-Methylphenol (para-chloro-meta-cresol)	8270	1.300		26-103	≤33	90
2-Methylnaphthalene	8270	0.660				90
Hexachlorocyclopentadiene	8270	0.660				90
2,4,6-Trichlorophenol	8270	0.660				90
2,4,5-Trichlorophenol	8270	3.300				90
2-Chloronaphthalene	8270	0.660				90
2-Nitroaniline	8270	3.300				90
Dimethyl phthalate	8270	0.660				90
Acenaphthylene	8270	0.660				90
2,6-Dinitrotoluene	8270	0.660				90
3-Nitroaniline	8270	3.300				90
Acenaphthene	8270	0.660		31-137	≤39	90
2,4-Dinitrophenol	8270	3.300				90
4-Nitrophenol	8270	3.300		11-114	≤50	90
Dibenzofuran	8270	0.660				90
2,4-Dinitrotoluene	8270	0.660		28-89	≤47	90
Diethylphthalate	8270	0.660				90
4-Chlorophenyl-phenyl ether	8270	0.660				90
Flourene	8270	0.660				90
4-Nitroaniline	8270	3.300				90
4,6-Dinitro-2-methylphenol	8270	3.300				90
N-Nitrosodiphenylamine	8270	0.660				90
4-Bromophenol-1-phenol ether	8270	0.660				90
Hexachlorobenzene	8270	0.660				90
Pentachlorophenol	8270	3.600		17-109	≤47	90
Phenanthrene	8270	0.660				90
Anthracene	8270	0.660				90

TABLE 5-1 (Continued)

DATA QUALITY OBJECTIVES FOR OFFSITE ANALYSES

Constituent	Analytical Method (SW-846)	Practical Quantitation Goals		Accuracy (%R)	Precision (RPD)	Completeness (%)		
		Soil (mg/kg)	Water (µg/l)					
Di-n-Butylphthalate	8270	0.660		35-142	≤36	90		
Fluoranthene	8270	0.660				90		
Pyrene	8270	0.660				90		
Butylbenzylphthalate	8270	0.660				90		
3,3-Dichlorobenzidine	8270	1.300				90		
Benzo(a)anthracene	8270	0.660				90		
bis(2-Ethylhexyl) Phthalate	8270	0.660				90		
Chrysene	8270	0.660				90		
Di-n-octyl phthalate	8270	0.660				90		
Benzo(b)fluoranthene	8270	0.660				90		
Benzo(k)fluoranthene	8270	0.660				90		
Benzo(a)pyrene	8270	0.660				90		
Indeno(1,2,3-cd)pyrene	8270	0.660				90		
Dibenzo(a,h)anthracene	8270	0.660				90		
Benzo(g,h,i)perylene	8270	0.660				90		
PESTICIDES								
Alpha-BHC	8080	0.002		46-127	≤50	90		
Beta-BHC	8080	0.004				90		
Delta-BHC	8080	0.006				90		
Gamma-BHC (Lindane)	8080	0.0027				90		
Heptachlor	8080	0.002				35-130	≤31	90
Aldrin	8080	0.0027				34-132	≤43	90
Heptachlor Epoxide	8080	0.0556						90
Endosulfan I	8080	0.0094						90
Dieldrin	8080	0.0013				31-134	≤38	90
4,4-DDE	8080	0.0027						90
Endosulfan II	8080	0.0027						90
4,4-DDD	8080	0.0075						90
Endrin	8080	0.0040				42-139	≤45	90
Endosulfan Sulfate	8080	0.0442				42-139	≤45	90
4,4-DDT	8080	0.0080				23-134	≤50	90
Methoxychlor	8080	0.1179						90
Endrin Aldehyde	8080	0.0154				90		
Chlordane	8080	0.0094				90		
Toxaphene	8080	0.1608				90		

TABLE 5-1 (Continued)

DATA QUALITY OBJECTIVES FOR OFFSITE ANALYSES

Constituent	Analytical Method (SW-846)	Practical Quantitation Goals		Accuracy (%R)	Precision (RPD)	Completeness (%)
		Soil (mg/kg)	Water (µg/l)			
PCB						
Aroclor 1016	8080	0.033		69-107	0-21	90
Aroclor 1221	8080	0.033		15-178	0-20	90
Aroclor 1232	8080	0.067		10-215	0-20	90
Aroclor 1242	8080	0.044		39-150	0-20	90
Aroclor 1248	8080	0.033		38-158	0-20	90
Aroclor 1254	8080	0.033		66-122	0-23	90
Aroclor 1260	8080	0.033		58-122	0-20	90
WTPH						
WTPH	418.1	100	1.0 ¹	75-125	0-20	90
RADIOISOTOPES						
Alpha/Beta Scan	⁶	1.0 ²		NA ³	NA ⁴	90
Gamma Spectrometry	⁷	0.1 ⁵		NA ³	NA ⁴	90

¹ mg/l

² pCi/g

³ NA = Not applicable, see Section 5.3.2

⁴ See Section 5.3.1

⁵ As ¹³⁷Cs in pCi/g. As the most common man-made gamma emitting contaminant, detection limits will be based on ¹³⁷Cs. Sample mass and counting time will be predetermined to insure adequate sensitivity at the stated PQL.

⁶ESE SOP ASM 1234-007, Rev. 1 (see Appendix E of WP)

⁷ESE SOP GLM 1234-008, Rev. 0 (see Appendix E of WP)

TABLE 5-2

DATA QUALITY OBJECTIVES FOR ONSITE ANALYSES

Constituent	Analytical Method (SW-846)	Practical Quantitation Goals Soil (mg/kg)	Accuracy (%R)	Precision (RPD)	Completeness (%)
VOCs	8021	0.25*	75-130	25	90
WTPH	418.1	100	70-120	25	90
Metals					
Chromium	7190	100	60-120	30	90
Lead	7420	100	60-120	30	90

* Quantitation goal for any one analyte listed in SW-846 Method 8021.

6.0 PROPOSED SAMPLING ACTIVITIES AND PROCEDURES

6.1 SUMMARY OF PROPOSED FIELD ACTIVITIES

A detailed discussion of the field activities is provided in the WP (Section 4.0 FSP) (CDM Federal 1995a). The remediation activities at the EM-2 and EM-3 sites will consist of excavation within previously identified areas, removal of two USTs, soil sampling and field analysis, and subsequent confirmational sampling and offsite analyses. Soil contaminant data are needed to guide the excavation of the one EM-2 and three EM-3 sites. Confirmational samples of subsurface soils will be collected and analyzed offsite.

The proposed sampling locations will be from excavations within the previously identified areas. The areas selected for excavation will be field staked prior to starting the work.

Excavations will be performed by track hoe. Excavated materials will be screened visually. Any potentially contaminated materials will be placed on 10-mil-thick visqueen sheets. Contaminated soil stockpiles will be covered and secured to minimize fugitive dust.

At the direction of USACE, soil samples will be collected and analyzed by an onsite laboratory. Excavation and field testing will continue until contaminants have been removed to below action levels. The number of soil samples to be collected will be determined in the field.

6.2 SAMPLING PROCEDURES

Sampling and measurement procedures to be used for this project are in accordance with CDM Federal's SOPs. These procedures are presented in Appendix E of the EM-1 WP (CDM Federal 1995b). These SOPs address the following field operations:

- Soil sampling
- Equipment decontamination
- Field logbook content and control
- Sample labeling, packaging, and shipping
- Sample custody
- Documentation
- Use of field equipment

Copies of the following documents will be made available to field personnel:

- This QAPjP
- EM-1 WP
- EM-2 and EM-3 WP
- CDM Federal SOPs

- SSHP
- Equipment Operation and Calibration Instructions

Sample container types, preservation requirements, preparation requirements, and special handling requirements are defined in Table 6-1 of *Remedial Design Field Sampling Plan for the 1100 Area, Hanford Site* (USACE 1994a). Contained in Section 4.0 of the same document are the sample identification protocols to be used in this investigation.

6.3 PROCEDURE CHANGES

Field changes in the requirements established by any of the planning documents may be permitted in response to unforeseen field conditions, provided they are documented, justified, reviewed, and approved as described in Section 4.3.2 of the *Quality Assurance Project Plan for Field Investigations Supporting Remedial Design/Remedial Action Activities in the 1100 Area* (USACE 1994b).

7.0 SAMPLE CUSTODY

7.1 CHAIN-OF-CUSTODY REQUIREMENTS

A required part of any sampling and analytical program is ensuring the integrity of each sample from collection to final disposition. This includes the ability to trace the possession and handling of samples from the time of collection, through analysis and reporting of results, to the final disposition. This documentation of sample history constitutes "chain-of-custody." Components of the chain-of-custody (COC) records include the field documentation (sample labels, custody seals, a field logbook, and COC records) and laboratory documentation (COC record, laboratory sample sign-in/sign-out logbook, laboratory sample storage records, and laboratory sample disposal records).

A sample is considered to be under a person's custody if it is: (1) in a person's physical possession, (2) in view of the person after he/she has taken possession, or (3) secured by that person so that no one can tamper with the sample. All samples, including field screening and confirmational samples, will be subject to the COC requirements.

7.1.1 SAMPLE IDENTIFICATION

Samples will be identified through the use of a coding system to identify sample locations and sample duplicates. The coding system will ensure that samples are uniquely identified, and will provide a tracking procedure to facilitate data retrieval. The sample coding system is described in Section 4.0 of the *Remedial Design Field Sampling Plan for the 1100 Area, Hanford Site* (USACE 1994a). Each sample will also be labeled with a Hanford Environmental Information System (HEIS) number to be provided by the USACE.

7.1.2 SAMPLE LABELS

Sample labels are necessary to prevent the improper identification of samples. All samples will be labeled in accordance with CDM Federal's SOPs presented in Appendix E of the EM-1 WP (CDM Federal 1995b).

7.1.3 CHAIN-OF-CUSTODY RECORDS

To establish the documentation necessary to trace sample possession from the time of collection, a COC record will be completed for every sample and will accompany every sample to the laboratory (onsite and offsite). CDM Federal's COC SOP is presented in Appendix E of the EM-1 WP (CDM Federal 1995b).

7.1.4 CUSTODY SEALS

Custody seals are used to detect unauthorized tampering with samples after sample collection up to the time of analysis. Custody seals will be prepared and used in accordance with CDM Federal's SOPs contained in Appendix E of the EM-1 WP (CDM Federal 1995b).

7.1.5 FIELD LOGBOOK

All information pertinent to a field survey or sampling effort will be recorded in a field logbook. Field logbook requirements are presented in CDM Federal's SOPs in Appendix E of the WP.

7.1.6 LABORATORY CUSTODY PROCEDURES

Samples will be transported to both an onsite field laboratory and shipped to an offsite laboratory for analysis. All samples will be accompanied by a COC record. Samples will be received by the laboratory sample custodian. Upon receipt by the laboratory, each sample shipment will be inspected to assess the condition of the shipping container and the individual samples. The enclosed COC records will be cross-referenced with all the samples in the shipment; the COC record will then be signed and placed in the project file. A unique laboratory number will be assigned to each sample upon receipt. This number identifies the sample through all further handling. It is the laboratory's responsibility to maintain internal logbooks and records that maintain the chain of custody throughout sample preparation and analysis, and data reporting.

7.2 SAMPLE SHIPMENT

Each sample shipped to an offsite laboratory will be packaged in accordance with CDM Federal's SOPs presented in Appendix E of the WP. Field personnel will telephone the laboratory following shipment and will provide the following information:

- The number and types of samples collected
- Air carrier and airbill number(s)
- Estimated date and time of arrival
- Other pertinent information, including special handling instructions, changes in scheduled sampling activity, or deviations from established sampling procedures

8.0 EQUIPMENT OPERATION, MAINTENANCE, CALIBRATION, AND STANDARDIZATION

All field equipment used during this project will be operated, maintained, calibrated, and standardized in accordance with manufacturer's specifications and CDM Federal's SOPs.

Each piece of field equipment will have a protocol package that contains:

- Operating procedures
- Routine preventive maintenance procedures including a list of critical spare parts to be available in the field
- Calibration methods, frequency, and description of calibration solutions
- Standardization procedures (traceability of standards to nationally recognized samples)
- Precision and accuracy assessment procedures

At present, the only measurement and test equipment expected to be used onsite are a dust monitor, a photoionization detector, and a combustible gas indicator. These instruments are necessary for health and safety monitoring purposes.

Operating procedures for this equipment are included in Appendix E of the EM-1 WP (CDM Federal 1995b) and will be available onsite.

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9.0 ANALYTICAL PROCEDURES

The purpose of the contracted project laboratories is to provide analytical data of consistent, known, and documented quality, which can be used to determine the nature and extent of contamination at the site. Project protocols and methodologies are designed to provide data of known quality in strict accordance with approved QA procedures.

During the characterization and remediation of EM-2 and EM-3, samples will be analyzed by both an onsite laboratory and an offsite laboratory. Data from the field screening will be EPA at QC Level II. Based on the results of the field screening, confirmation samples will be collected and analyzed by ESE, located in Gainesville, Florida, using EPA QC Level III data requirements. In addition, 10 percent of all confirmation samples will be analyzed and validated using equivalents EPA CLP Protocol (EPA QC Level IV). All WTPH analyses will be conducted by SAS of Tacoma, WA, under contract to ESE. The samples will be mailed directly to SAS for analysis at EPA QC Level III with 10 percent at QC Level IV. Samples of product and/or waste collected by CWM will be analyzed by SAS under separate contract to CWM. Analytical data generated under this contract will meet EPA QC Level III.

The USACE North Pacific Division Laboratory in Troutdale, Oregon, is the QA laboratory designated for this project. The QA laboratory will receive and analyze QA split samples of 10 percent of all confirmatory samples plus a QA split sample of all equipment rinsate blanks. No QA split samples will be submitted for waste characterization or screening samples.

Addresses for all offsite laboratories are provided in the EM-2 and EM-3 WP (CDM Federal 1995a).

The subcontractor laboratories will adhere to EPA-approved methods as described in their laboratory QA Plans. All specified procedures will be followed exactly without deviation, unless modifications are specifically authorized by CDM Federal and the USACE.

The following sections discuss the onsite analytical procedures, offsite analytical procedures, and general laboratory requirements.

9.1 ONSITE ANALYTICAL PROCEDURES

The onsite analytical laboratory will analyze soil samples for the following parameters:

- Chromium by SW-846 Method 7190
- Lead by SW-846 Method 7420
- VOCs by SW-846 Method 8021
- TPHs by WTPH 418.1

The total number of samples to be analyzed for each parameter will be determined in the field. Field QC samples will consist of blind duplicates submitted at a frequency of approximately 1 in 20. Sample designations, and container and preservation requirements are presented on Table 4-1 of the EM-2 and EM-3 WP (CDM Federal 1995a).

9.2 OFFSITE LABORATORY ANALYTICAL PROCEDURES

Soil and waste samples will be sent to an offsite laboratory as part of this field program. The laboratory results will be evaluated against the goals and objectives set forth in Section 5.0. Additional information is detailed in the offsite laboratory's Laboratory QA Plan.

Aqueous QC samples (i.e., rinsate blanks; discussed in Section 11.0) will be analyzed for the same parameters as soil samples. Waste soils will be analyzed under EPA QC Level III for parameters as listed in Section 5.2. Table 4-1 of the EM-2 and EM-3 WP (CDM Federal 1995a) summarizes the anticipated samples and analytical methods.

9.3 OFFSITE LABORATORY QC CHECKS

The following laboratory QC check samples will be performed, as appropriate:

- Method blanks
- Blanks/spikes
- Surrogates
- Matrix spikes and matrix spike duplicates
- Laboratory duplicates
- Initial and continuing calibration checks

If the laboratory QC procedures indicate a problem with an analysis, the laboratory will notify CDM Federal immediately to determine what type of corrective action will be required. CDM Federal will in turn notify USACE personnel.

9.4 OFFSITE LABORATORY EQUIPMENT CALIBRATION

Laboratory calibration procedures are specified in the EPA-approved analytical methods and in the laboratory's QA Plan.

9.5 OFFSITE LABORATORY CUSTODY

The following laboratory custody procedures will be followed:

- Designation of a sample custodian
- Correct completion by the sample custodian of the COC record, including documentation of sample condition upon receipt
- Laboratory sample tracking and documentation procedures
- Secure sample storage (in the appropriate environment: refrigerated, dry, etc.), maintenance of sample storage records, maintenance of intra-laboratory sample custody records, and documentation of proper sample disposal and disposal date
- Proper data logging and documentation procedures including custody of all original laboratory records

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10.0 DATA QUALITY MANAGEMENT

To ensure that data management activities provide an accurate and controlled flow of data, it is important that data handling and reporting steps be defined and implemented. Data management procedures are applicable to field- and laboratory-generated data. The following sections present a description of field and laboratory data recording, validation, reduction, and reporting for this project.

10.1 DATA RECORDING AND REDUCTION

Sample data will be produced through visual observations, and performance of chemical analyses. All field activities, direct reading instruments, and measuring devices will be used in accordance with SOPs in the WP and specifications in equipment manufacturers' operations and maintenance manuals, as appropriate.

Field observations, direct reading instrument responses, and other measurements will be recorded in field logbooks. The Field Team Leaders will be responsible for ensuring that all necessary data and information are incorporated into the logbooks while field activities are occurring. All sample identification designations will be cross-referenced to their HEIS numbers in the logbooks.

The data recorded in logbooks and on forms will be transferred by CDM Federal staff to tables, figures, or logs. Some data will be entered onto spreadsheets to facilitate data analysis. The Project Manager will be responsible for data transfer activities, including instituting QC measures to ensure that data transfers have been performed accurately. The Project Manager will also check the analytical laboratory data for completeness and reasonableness. Raw laboratory data will be reconciled with field identifiers and transferred from the laboratory reports to spreadsheets. All transferred data will be checked by the CDM Federal project staff at least once for completeness and accuracy of transfer.

10.2 PROCEDURE FOR OUTLIERS

All data collected, whether analytical, field measurement, or observation, will be reviewed by the Project Manager for values or other conditions that do not reflect what is expected or known for the site. Analytical data outliers will be discussed with the analytical laboratory to determine if an outlier is a result of laboratory error. Field measurements and observations will be checked versus the field log and records and discussed with the individuals who collected the data to determine the possibility of error. If the outlier cannot be confirmed, it will be flagged and reported as such.

10.3 ANALYTICAL DATA REPORTING

For samples subject to the equivalent EPA QC Level IV reporting requirements, analytical data reporting will be according to the full CLP equivalent data package. This will include results from initial and continuing calibration, matrix spikes, matrix spike duplicates, blanks, laboratory duplicates, surrogate recoveries, sample chromatograms, mass spectra, and tuning data. For EPA methods not defined by the CLP, the data report will include calibration information, results from method blanks, blank/spikes, matrix spikes, and matrix spike duplicates. Sample chromatograms and plotted control charts associated with the blank/spikes will be presented with the data.

For samples subject to EPA Level III QC reporting requirements, analytical reporting will include results from initial and continuing calibration, matrix spikes, matrix spike duplicates, blanks, laboratory duplicates, and surrogate recoveries.

For samples subject to EPA Level II QC reporting requirements, analytical reporting will include results from initial and continuing calibration, matrix spikes, blanks, laboratory duplicates, and surrogate recoveries.

10.4 TECHNICAL REPORTING

Technical reporting will be in the form of Daily Quality Control Reports (DQCRs) and Draft and Final Close-Out Reports. The format and content of these reports are described in Section 1.4.3 of the WP (CDM Federal 1995a).

10.5 DATA VALIDATION

Laboratory analytical data will not be formally validated during this investigation. However, laboratory information necessary to perform validation will be included in laboratory sample data packages. In addition, the analytical laboratory will be required to flag the data that do not meet the QC requirements for the EPA methods used.

11.0 QUALITY CONTROL CHECKS AND SAMPLES

The QC samples being sent to the offsite laboratory will include field duplicates and rinsate blanks. The QC samples sent to the onsite laboratory will include field duplicates. Additional QA samples will be sent to the USACE North Pacific Division Laboratory. Field duplicate samples will be used as a check of laboratory and field sampling procedures. Rinsate blanks provide for evaluation of potential cross-contamination between samples. The following paragraphs present information on these QC samples.

Field Duplicates: Duplicate samples will be collected at a frequency of approximately 10 percent, thus, a minimum of one sample out of 10 to be collected will be a field duplicate. The USACE North Pacific Division QA laboratory will also receive duplicates at a frequency of approximately 10 percent. Duplicates will be collected, numbered, packaged, and sealed in the same manner as the other samples. The samples will not be identified as duplicates on the sample labels to the offsite laboratory. The identity of the duplicate samples will, therefore, be unknown to the laboratory personnel performing the analyses. Duplicate samples will be noted in the field logbook for documentation and verification purposes.

Rinsate Blanks: Equipment rinsate blanks will be comprised of the final analyte-free rinse-water from the decontamination of sampling equipment. These blanks are a check to verify the effectiveness of decontamination procedures. Rinsate samples will be collected at a minimum frequency of one in 20 samples.

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12.0 QUALITY ASSURANCE OVERSIGHT

12.1 AUDITS

Requirements for audits are the decision and responsibility of the CDM Federal QA Director, who schedules audits on a quarterly basis. All audits will meet the requirements stated in the *CDM Federal Quality Assurance Manual*, (CDM Federal 1995c) and will conform to the USACE CEQAPP 1.1. System audits are qualitative reviews of project activity and QC measure implementation to check that the overall QA program is functioning. These may include field, laboratory, and office audits. A QA office audit is currently planned for this delivery order. This audit will be conducted following the completion of field activities.

Following an audit, the QA Director or designated QA staff will develop an audit report that summarizes the audit findings, including those areas found to be in non-conformance (if any). This report will be submitted to the CDM Federal Project Manager to identify appropriate corrective actions. Resolution of corrective action requests is addressed in the *CDM Federal QA Manual*, (CDM Federal 1995c).

12.2 CORRECTIVE ACTION REQUIREMENTS

Throughout this QAPjP, various control limits have been specified that, if exceeded, require corrective action. These limits include target levels for precision, accuracy, completeness, QC sample types, and criteria for representativeness and comparability. The need for corrective action may also result from performance or system audits. USACE will be notified immediately if data do not meet the DQOs.

Responsibility and procedures for identifying and reporting nonconformances are described in the CDM Federal QA Manual (CDM Federal 1995c). Nonconformances with the established QC procedures will be identified and no additional work (which is dependent upon the nonconforming activity) will be performed until the nonconformance is corrected. In all cases, corrective action procedures will be implemented to the satisfaction of USACE.

If a nonconformance or deficiency is identified during routine work or during a CDM Federal audit, USACE will be notified, and corrective action will be initiated by CDM Federal and its subcontractors, as applicable. The corrective action steps include the following:

- Identify and define the problem
- Assign responsibility for investigating the problem
- Determine corrective action to eliminate the problem
- Assign responsibility for implementation of the corrective action

- Implement the corrective action
- Verify that the corrective action has eliminated the problem
- Document the problem identified, the corrective action taken, and its effectiveness in eliminating the problem

The person identifying a deficiency or nonconformance initiates a corrective action request and submits it to the CDM Federal QA Director, who assigns responsibility for responding to the request. The project QA Coordinator is responsible for following up on the request and monitoring the implementation of appropriate corrective actions.

Corrective action procedures that might be implemented from audit results or detection of unacceptable laboratory data are developed on a case-by-case basis. Such actions may include altering procedures in the field, re-sampling and/or re-testing, obtaining new equipment or supplies, or providing additional staff training.

12.3 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Periodic reporting keeps CDM Federal management, project management, and clients informed of QA implementation. Monthly reports prepared by the CDM Federal QA staff as part of the overall QA Program summarize the following:

- Activities conducted during the reporting period
- Audits conducted
- Quality problems found
- Corrective actions taken
- QA project plans reviewed and approved during the reporting period

13.0 REFERENCES

- CDM Federal Programs Corporation (CDM Federal). 1995a. Remedial Action Work Plan EM-2 and EM-3 Operable Units, Hanford 1100 Area, Washington
- CDM Federal Programs Corporation (CDM Federal). 1995b. Remedial Action Work Plan EM-1 Operable Unit, Hanford 1100 Area, Washington
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APPENDIX B

CDM FEDERAL SITE SAFETY AND HEALTH PLAN

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HEALTH AND SAFETY PLAN FORM

CDM Federal Health and Safety Program

CDM FEDERAL PROGRAMS CORPORATION

PROJECT DOCUMENT NO.: 6110-019-HS

PROJECT NAME 1100-EM-2 and EM-3 OUs - SOILS/UST REMOVAL ACTIVITIES

Contract No.: DACW68-94-D-0001

JOBSITE ADDRESS: Building 1262, 1240, and Tar Flow Area Northeast of building 1171

CLIENT U.S. Army Corps of Engineers -WALLA WALLA DISTRICT

of Operable Unit 1100-EM2 and Operable Unit 1100-EM-3 Hanford Site, Richland, WA

DELIVERY ORDER NO.: 019

SITE CONTACT Paul Karas

CLIENT CONTACT Randy Chong

PHONE NO. 1-509-943-5828/1-509-539-2723

PHONE NO. 1-509-527-7583

 AMENDMENT NO. _____ TO EXISTING APPROVED HSP - DATE EXISTING APPROVED HSP _____**OBJECTIVES OF FIELD WORK:**

Excavate contaminated soils based on the findings of previous investigations (conducted by others). Supervise the transfer of product from two underground storage tanks, and the cleaning and removal of the tanks. Collect and analyze screening samples to guide the excavation process. Collect and analyze samples intended to confirm completion of the removal of contaminated materials. Stage and secure contaminated materials onsite.

Excavation Sites:

- 1) EM-2 Tar Flow
- 2) EM-3 1240 French Drain
- 3) EM-3 1262 Solvent Tanks
- 4) EM-3 1240 Suspect Spill Area

Excavation standards and confined space entry procedures are documented in US Army Corps of Engineers' Safety and Health Requirements Manual (EM 385-1-1).

TYPE: Check as many as applicable

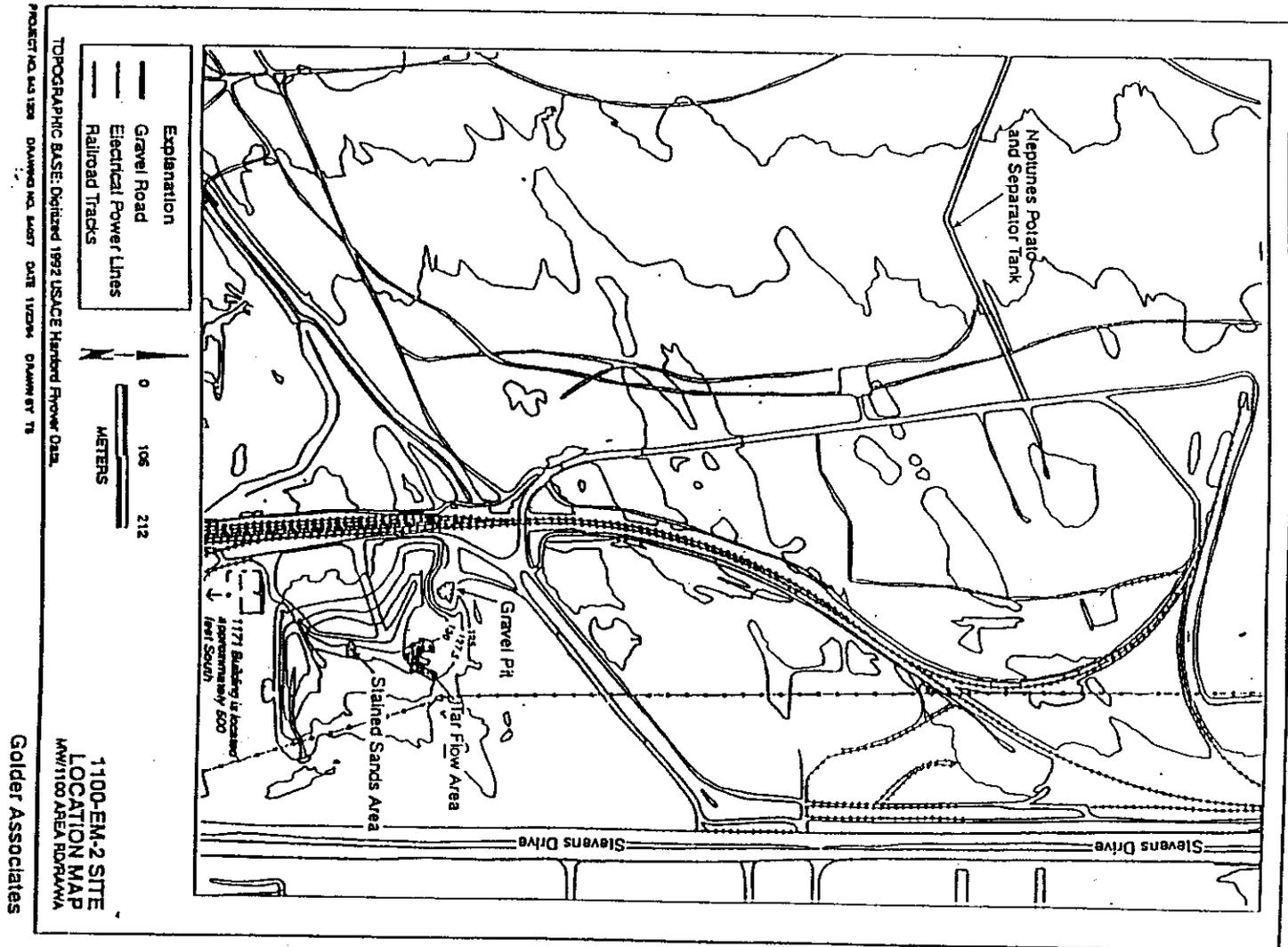
- | | | |
|--|--|--|
| <input checked="" type="checkbox"/> Active | <input type="checkbox"/> Landfill | <input type="checkbox"/> Unknown |
| <input type="checkbox"/> Inactive | <input checked="" type="checkbox"/> Uncontrolled | <input type="checkbox"/> Military |
| <input checked="" type="checkbox"/> Secure | <input checked="" type="checkbox"/> Industrial | <input checked="" type="checkbox"/> Other specify: |
| <input type="checkbox"/> Unsecure | <input type="checkbox"/> Recovery | U.S GOVERNMENT (DOE) |
| <input type="checkbox"/> Enclosed space | <input type="checkbox"/> Well Field | |

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DOERL11004 Rev. 0

DESCRIPTION AND FEATURES:

The Hanford Site is a 150,000 ha (560 square miles) reservation which has been operated by the federal government since 1943. The primary mission of the Hanford Site has been plutonium production for military use and nuclear energy research and development. The Hanford Site is located along the Columbia River in southeastern Washington and includes portions of Benton, Grant, Franklin, and Adams counties. The 1100 Area, which is adjacent to the City of Richland in Benton County, is the southeastern-most portion of and is the main portal to the Hanford Site. This health and safety plan addresses work that will be performed at the EM-2 Tar Flow Site, EM-3 1240 French Drain, EM-3 1262 Solvent Tanks, and EM-3 1240 Suspect Spill Area located within the 1100 Area.

EM-2 Tar Flow Site: Approximately 500 cubic yards of sandy soil is to be excavated and stockpiled. Soils are contaminated by heavy oil range petroleum hydrocarbons and lead. The site lies approximately 1050 feet north of the northwest corner of Building 1171. Previous investigations identified a soft tar-like substance on the ground surface which covers a lobate area of approximately of approximately 200 feet by 65 feet. Petroleum hydrocarbons were detected in the soil at 80,000 mg/kg and lead was detected at 404 mg/kg.

EM-3 1240 French Drain Site: Approximately 19 cubic meters (25 cubic yards) of soil and debris is to be excavated and stockpiled. Soils and debris are contaminated by petroleum hydrocarbons, lead, and chromium. The french drain is located on the west side of Building 1240 by a loading dock. No evidence of spills into the drain have been documented, however a PCB collection area was located close to the drain. Lead was detected at 619 mg/kg, chromium was detected at 949 mg/kg, and total petroleum hydrocarbons (TPH) was detected at 80,000 mg/kg. PCBs were detected at a maximum concentration of 170 $\mu\text{g}/\text{kg}$ (below action levels for site remediation).

EM-3 1262 Solvent Tanks: Two USTs suspected to contain waste solvents (possible tetrachloroethylene) will be sampled, emptied, cleaned, and removed. Any contaminated soils surrounding the tanks will be excavated and stockpiled. No soil sampling has occurred to date. If contamination exists, soil will be most likely to have been impacted by chlorinated volatile organic compounds (VOCs).

EM-3 1240 Suspect Spill Area Site: Approximately 92 cubic meters (120 cubic yards) of soil contaminated with pliable adhesive mixed with metal fragments and floor sweepings is to be excavated and stockpiled. Contaminant of concern is lead detected at 16,200 and 44,200 mg/kg.

SURROUNDING POPULATION: () Residential (X) Industrial () Rural () Urban () OTHER:

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HISTORY:

The primary mission of the Hanford Site has been plutonium production for military use and nuclear energy research and development. The 1100 Area was placed on the National Priorities List (NPL), in July, 1989. For NPL purposes, the 1100 Area has been divided into four Operable Units: EM-1, EM-2, EM-3, and IU-1. Each of these Operable Units include areas (subunits) where there have been suspected or confirmed releases of hazardous materials to the environment. Refer to the 1100 Area RD/RA Site Safety and Health Plan (USACE 1994) for specific details. CDM Federal will conduct UST removal, excavation, and soil removal activities at the following 1100-EM-2 and 3 Operable Unit Sites:

- EM-2 Tar Flow Site
- EM-3 1240 French Drain
- EM-3 1262 Solvent Tanks
- EM-3 1240 Suspect Spill Area

WASTE TYPES: Liquid Solid Sludge Gas Unknown Other specify:

WASTE CHARACTERISTICS: Check as many as applicable.

- Corrosive Flammable Radioactive
- Toxic Volatile Reactive
- Inert Gas Unknown Other specify:

WORK ZONES:

Delineation of exclusion zone (the contaminated job area), Contamination reduction zone (the area where decontamination takes place), and support zone (the uncontaminated area where workers should not be exposed to hazardous conditions) will be based on previous investigations sampling results and on potential routes and amount of contamination dispersion in the event of a release. Movement of personnel and equipment among these zones will be minimized and restricted to Specific Access Control Points to prevent cross contamination from contaminated areas to clean areas.

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HAZARDS OF CONCERN:

- | | |
|---|--|
| <input checked="" type="checkbox"/> Heat Stress(attach guidelines) | <input checked="" type="checkbox"/> Noise |
| <input checked="" type="checkbox"/> Cold Stress (attach guidelines) | <input checked="" type="checkbox"/> Inorganic Chemicals |
| <input checked="" type="checkbox"/> Explosive/Flammable | <input checked="" type="checkbox"/> Organic Chemicals |
| <input type="checkbox"/> Oxygen Deficient | <input checked="" type="checkbox"/> Motorized Traffic |
| <input type="checkbox"/> Radiological | <input checked="" type="checkbox"/> Heavy Machinery |
| <input type="checkbox"/> Biological | <input checked="" type="checkbox"/> Slips, Trips & Falls |
| <input type="checkbox"/> Other specify: | |

PRINCIPAL DISPOSAL METHODS AND PRACTICES:

EM-2 Tar Flow Site: Origin of petroleum hydrocarbon and lead contamination at the site is unknown.

EM-3 1240 French Drain Site: Spills occurring on or near the load dock of Building 1240 may have been captured by the french drain and discharged to the surround soils. No evidence of spills into the drain have been documented.

EM-3 1262 Solvent Tanks: No soil sampling has occurred at this site. If contamination exists it may be the result of poor management practices (loading/unloading) or leaks in the tanks or ancillary equipment.

EM-3 1240 Suspected Spill Area Site: Origin of lead contamination at the site is unknown.

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HAZARDOUS MATERIAL SUMMARY: Circle waste type and estimate amounts by category

CHEMICALS Amounts/Units: mg/Kg	SOLIDS Amounts/Units: mg/Kg	SLUDGES Amounts/Units:	SOLVENTS Amounts/Units:	OILS Amounts/Units: mg/Kg	OTHER Amounts/Units:
Acids Pickling Liquors Caustics Pesticides Dyes/Inks Cyanides Phenols Halogens Dioxins Other Specify:	Flyash Unknown Asbestos Unknown Milling/Mine Tailings Ferrous Smelter Non-ferrous Smelter <u>Metals</u> Other Specify: Lead 44,200 (Suspect Spill Area), 619 (French Drain), 404 (Tar Flow) Chromium 949 (French Drain)	Paint Pigments Metal Sludges POTW Sludge Aluminum Distillation Bottoms Other Specify:	<u>Halogenated</u> (chloro, bromo) Solvents Hydrocarbons Alcohols Ketones Esters Ethers Other Specify: Tetrachloroethylene - No sample data available but contaminant is suspected at the 1262 Solvent Tanks.	Oily Wastes Gasoline Diesel Oil Lubricants PCBs Polynuclear Aromatics <u>Other</u> Specify: TPH 80,000 (French Drain) TPH 80,000 (Tar Flow)	Laboratory Pharmaceutical Hospital Radiological Municipal Construction Munitions Other Specify:

OVERALL HAZARD EVALUATION: () High (X) Medium () Low () Unknown

JUSTIFICATION: Based upon concentrations identified during previous investigations.

FIRE/EXPLOSION POTENTIAL: () High (X) Medium (X) Low () Unknown

NOTE: Medium potential at 1262 Solvent Tanks, low potential at remaining sites.

BACKGROUND REVIEW: (X) COMPLETE () INCOMPLETE

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KNOWN OR SUSPECTED CONTAMINANTS	HIGHEST OBSERVED CONCENTRATION (specify units and media)	PEL/TLV ppm or mg/m ³ (specify)	IDLH ppm or mg/m ³ (specify)	WARNING CONCENTRATION N ppm	SYMPTOMS/EFFECTS OF ACUTE EXPOSURE	PHOTOIONIZATION POTENTIAL
Tetrachloroethylene CAS[127-18-4]	Not Analyzed for to Date. May be Present as Product in Tanks.	100 ppm (TWA OSHA)	150 ppm	5 ppm	Irritation to eyes, nose, and throat, flushed face and neck, dizziness	9.32
Lead CAS[7439-92-1]	44,200 mg/kg in Surface Soil (Suspect Spill Site)	0.100 mg/m ³ (TWA NIOSH) 0.050 mg/m ³ (TWA OSHA)	100 mg/m ³	Visible Dust or 1.0 mg/m ³ respirable dust	Fatigue, pallor, colic, and insomnia	NA
Chromium	949 mg/kg in Surface Soils (French Drain)	0.5 mg/m ³ (TWA-OSHA/ NIOSH)	250 mg/m ³	Visible Dust or 1.0 mg/m ³ respirable dust	Lung damage, eye irritation, and skin sensitization	NA
TPH (as gasoline) CAS [8006-61-9]	80,000 mg/kg in Surface Soils (French Drain)	300 ppm	NE	100 ppm	Vomiting, diarrhea, insomnia, dizziness, and headache	NA

NA=Not Available NE=None Established U=Unknown

S=Soil SW=Surface Water T=Tailings W=Waste Tk=Tanks SD=Sediment
 A=Air GW=Groundwater SL=Sludge D=Drums L=Lagoons OFF=Offsite

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FIELD ACTIVITIES COVERED UNDER THIS PLAN				HAZARD		
TASK DESCRIPTION/SPECIFIC TECHNIQUE-STANDARD OPERATING PROCEDURES/SITE LOCATION	Type	Primary	Contingency	SCHEDULE		
1 Excavation of contaminated soils	<u>Intrusive</u>	A B C D	A B C D	Hi	Med	Low
	Non-intrusive	Modified	Exit Area	6-19-95		
2 Soil sampling (No. of samples unknown)	<u>Intrusive</u>	A B C D	A B C D	Hi	Med	Low
	Non-intrusive	Modified	Exit Area	6-19-95		
3 Oversight of tank product transfer, tank removal removal and cleaning	<u>Intrusive</u>	A B C D	A B C D	Hi	Med	Low
	<u>Non-intrusive</u>	Modified	Exit Area	6-19-95		
4	<u>Intrusive</u>	A B C D	A B C D	Hi	Med	Low
	Non-intrusive	Modified	Exit Area			
5	<u>Intrusive</u>	A B C D	A B C D	Hi	Med	Low
	Non-intrusive	Modified	Exit Area			
6	<u>Intrusive</u>	A B C D	A B C D	Hi	Med	Low
	Non-intrusive	Modified	Exit Area			

PERSONNEL* AND RESPONSIBILITIES				
NAME	FIRM/REGION	CDM Federal HEALTH CLEARANCE	RESPONSIBILITIES	ONSITE?
Project Manager Paul Karas	CDM FPC/WED	CS	WORK ASSIGNMENT MGR	1 - 2 - 3 - 4
Site Health and Safety Coordinator Dana Ertel	CDM FPC/WED	CS	SITE HEALTH & SAFETY COORDINATOR	1 - 2 - 3 - 4
Field Team Leader Dana Ertel (Tar flow, suspect spill, french drain)	CDM FPC/WED	CS	FTL	1 - 2 - 3 - 4
Hazardous Waste Specialist, Brad Zolla	CDM FPC/WED	CT	SAMPLING	1 - 2 - 3 - 4
Clyde Burdine, Owner/Supervisor	Burdine Enterprises	CT	EXCAVATION SUBCONTRACTOR	1 - 2 - 3 - 4
Don Lance, FTL (Solvent Tanks)	HLA	CS	FTL	1 - 2 - 3 - 4
				1 - 2 - 3 - 4

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PROTECTIVE EQUIPMENT:

<p>BLOCK A TASKS: <u>1 - 2 - 3 - 4 - 5 - 6</u> (X) Primary LEVEL: A - B - C - <u>D - Modified</u> () Contingency</p>	<p>BLOCK B TASKS: <u>1 - 2 - 3 - 4 - 5 - 6</u> () Primary LEVEL: A - B - <u>C - D - Modified</u> (X) Contingency</p>
<p>Respiratory: (X) Not Needed () SCBA, Airline: () APR: () Cartridge: () Escape Mask: () Other:</p> <p>Head and Eye: () Not Needed (X) Safety Glasses: () Face Shield: () Goggles: (X) Hard Hat: (X) Other: Hearing Protection (>85 dB)</p> <p>Boots: () Not Needed (X) Boots: <u>Leather steel-toed work boots</u> (X) Overboots:(Latex) () Rubber:</p>	<p>Respiratory: () Not Needed () SCBA, Airline: (X) APR: MSA Ultra Twin (X) Cartridge: Type MSA GMC-H () Escape Mask: () Other:</p> <p>Head and Eye: () Not Needed (X) Safety Glasses: () Face Shield: () Goggles: (X) Hard Hat: (X) Other: Hearing Protection (>85 dB)</p> <p>Boots: () Not Needed (X) Boots: <u>Leather steel-toed work boots</u> (X) Overboots: (Latex) () Rubber:</p>
<p>BLOCK C TASKS: <u>1 - 2 - 3 - 4 - 5 - 6</u> () Primary LEVEL: A - B - C - D - Modified () Contingency</p>	<p>BLOCK D TASKS: <u>1 - 2 - 3 - 4 - 5 - 6</u> () Primary LEVEL: A - B - C - D - Modified () Contingency</p>
<p>Respiratory: () Not Needed () SCBA, Airline: () APR: () Cartridge: () Escape Mask: () Other:</p> <p>Head and Eye: () Not Needed () Safety Glasses: () Face Shield: () Goggles: () Hard Hat: () Other:</p> <p>Boots: () Not Needed () Boots: <u>Leather steel-toed work boots</u> () Overboots: () Rubber:</p>	<p>Respiratory: () Not Needed () SCBA, Airline: () APR: () Cartridge: () Escape Mask: () Other:</p> <p>Head and Eye: () Not Needed () Safety Glasses: () Face Shield: () Goggles: () Hard Hat: () Other:</p> <p>Boots: () Not Needed () Boots: <u>Leather steel-toed work boots</u> () Overboots: () Rubber:</p>
<p style="text-align: right;">Page 10 of 15</p>	

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MONITORING EQUIPMENT: Specify by task. Indicate type as necessary. Attach additional sheets as necessary.

INSTRUMENT	TASK	ACTION GUIDELINES	COMMENTS (Includes schedules of use)
Combustible Gas Indicator	1 - 2 - 3 - 4 - 5 - 6	0-10% LEL No explosion hazard 10-25% LEL Potential explosion hazard; notify SHSC. >25% LEL Explosion hazard; interrupt task/evacuate 21.0% O ₂ Oxygen normal <21.0% O ₂ Oxygen deficient; notify SHSC <19.5% O ₂ Interrupt task/evacuate	() Not Needed Solvent tanks only.
Radiation Survey Meter	1 - 2 - 3 - 4 - 5 - 6	3X Background Notify SHSC >2mR/hr Interrupt task/evacuate	() Not Needed Initial sampling of solvent tanks only.
Photoionization Detector Type <u>Hnu</u> () 11.7 ev (X) 10.2 ev () 9.8 ev () ___ ev	1 - 2 - 3 - 4 - 5 - 6	Specify: 0 - 5 ppm: Level D 5 -25 ppm: Level C > 25 ppm: Exit site; notify SHSC All readings are above background and sustained in worker's breathing zone.	() Not Needed Solvent tanks only.
Flame Ionization Detector Type _____	1 - 2 - 3 - 4 - 5 - 6	Specify:	(X) Not Needed
Detector Tubes/Monitor Type _____ Type _____	1 - 2 - 3 - 4 - 5 - 6	Specify:	(X) Not Needed
Respirable Dust Monitor Type <u>mini-Ram</u> Type _____	1 - 2 - 3 - 4 - 5 - 6	Specify: Visible Dust or 1 mg/m ³	() Not Needed Purpose: Airborne (potential) dust monitoring
Other Specify Visible nuisance dust and unusual vapors (odors)	1 - 2 - 3 - 4 - 5 - 6	Specify: If team notices dust or irritation to eyes or throat or encounters unusual odors, they will upgrade respiratory protection or exit site.	Contingency for Monitoring Equipment Failure

DECONTAMINATION PROCEDURES

ATTACH SITE MAP INDICATING EXCLUSION, DECONTAMINATION, AND SUPPORT ZONES AS PAGE TWO

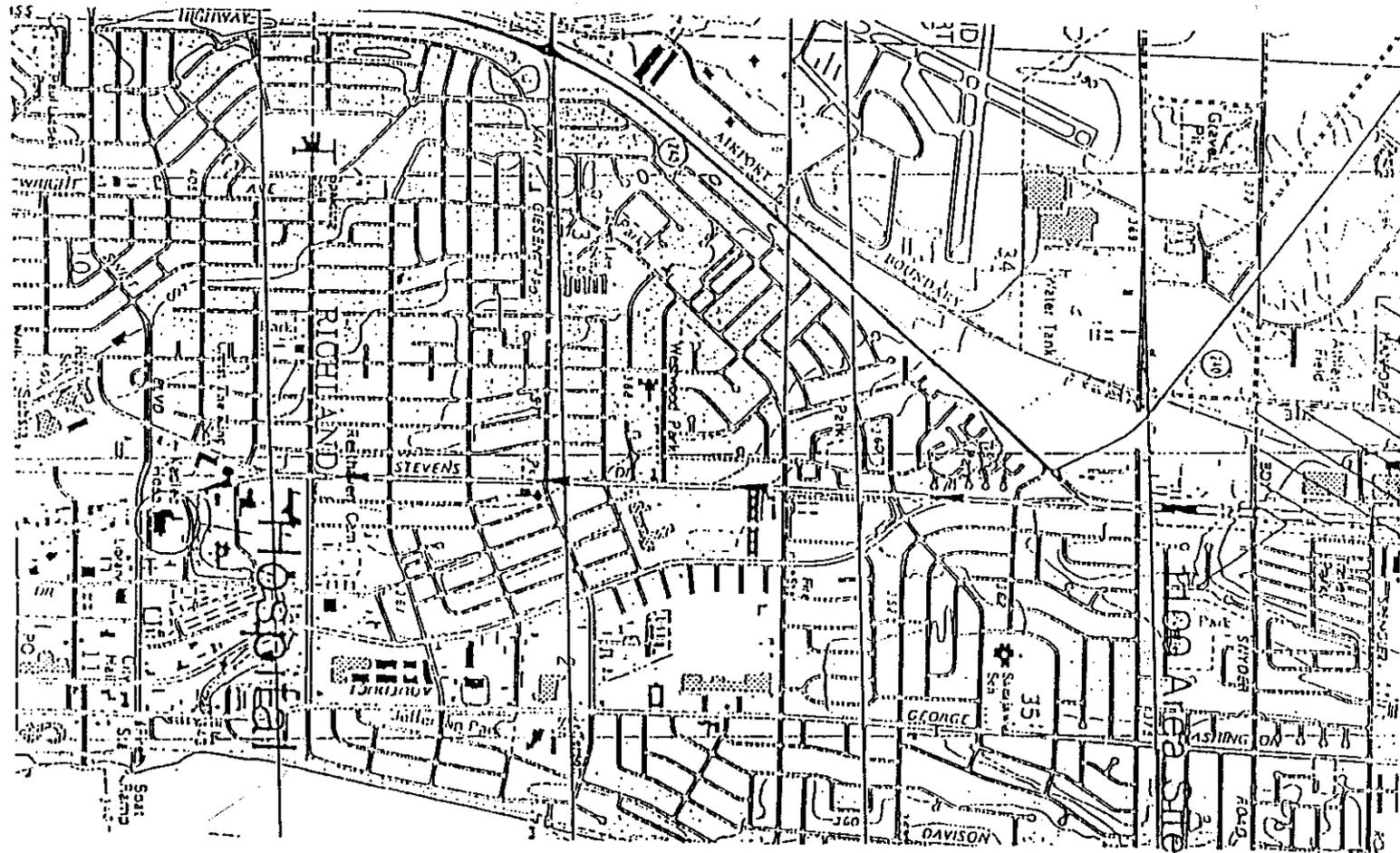
<p><u>Personalized Decontamination</u></p> <p>Personnel decontamination station will move from location to location based on work site.</p> <p>Wash hands and face if necessary with soap and water upon doffing personal protective equipment.</p> <p>Wash well before hand-to-mouth contact is made. Workers will remove protective clothing in this order:</p> <ul style="list-style-type: none"> - equipment drop - boot covers - outer gloves - hard hat - tyvek or saranex - respirator (if used) - inner gloves - face and hand wash <p>WASH HANDS AND FACE PRIOR TO ANY INGESTION OF FOOD OR DRINKS</p> <p style="text-align: right;">() Not Needed</p>	<p><u>Sampling Equipment Decontamination</u></p> <p>All sampling equipment will be thoroughly decontaminated between samples with soap, water, and then rinsing.</p> <p>These tools are decontaminated between use at each sampling location by a four-step cleaning process. These steps are:</p> <ol style="list-style-type: none"> 1. Immersion and vigorous scrubbing in a mild solution of laboratory grade detergent until all visual accumulations of soil are removed. 2. Thorough rinsing with potable water. 3. Spray rinsing with deionized grade water. 4. Air Dry. <p style="text-align: right;">() Not Needed</p>	<p><u>Heavy Equipment Decontamination</u></p> <p>All equipment and tool parts that contact excavated soil are constructed of heavy gauge steel and have no natural or synthetic components that could absorb and retain most soil-borne organic contaminants.</p> <p>Heavy equipment will be decontaminated by dry methods. See Workplan.</p> <p style="text-align: right;">() Not Needed</p>
<p><u>Containment and Disposal Method</u></p> <p>All PPE and contaminated items must be decontaminated or collected in a plastic garbage bag and disposed of properly.</p> <p>IDW will be containerized and maintained on site.</p>	<p><u>Containment and Disposal Method</u></p> <p>Decontamination fluids will be applied to contaminated soil stockpiles for dust control.</p>	<p><u>Containment and Disposal Method</u></p> <p>Wipes will be combined with PPE.</p>

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EMERGENCY CONTACTS			EMERGENCY CONTACTS	NAME	PHONE	
Water Supply			Health and Safety Manager	Chuck Myers	1-703-968-0900	
Site Telephone	1 (509) 539-2723	1 (509) 539-3516	Project Manager	Paul Karas P.G.	1-509-943-5828	
EPA Release Report No.	1-800-424-8802		Health & Safety Coordinator	Steve Fundingsland	1-303-232-0131	
			Client Contact	Randy Chong	1-509-527-7583	
Facility Management			U.S. DOE Contact	Glenn Goldberg	1-509-376-9552	
Other (specify) Chuck Myers (home) (703) 754-0700			U.S. EPA	Dave Einan	1-509-376-3883	
			WA Dept of Ecology	Dib Goswami	1-509-736-3015	
			USACE Safety	Mike Remington	1-509-376-9601 1-509-539-2704	
			State Spill Number	National Response	1-800-424-8802	
<p>CONTINGENCY PLANS</p> <p>Evacuate site if any unexpected hazardous conditions are encountered. The "buddy system" will be employed for all work being done. Site staff, if evacuated, will congregate upwind of the site in a predesignated area (to be announced at daily health and safety meeting). If a work team observe hazards for which they have not been prepared, they will withdraw from the area and call CDM Federal Health and Safety. Solo CDM representatives will not enter or remain in a work area unless accompanied by sub-contractor or facility personnel. Without regard to monitoring instrument reading, CDM Federal personnel will leave site and upgrade their level of protection if they experience nausea or dizziness.</p>			Fire Department	Richland, WA	911	
			Police Department	Richland, WA	911	
			State Police	State of Washington	1-800-283-7803/911	
			Health Department	Not Available	NA	
			Poison Control Center	State of Washington	1-800-572-5842	
			Occupational Physician	Dr. Elayne F. Theriault	1-800-229-3674	
			<p>HEALTH AND SAFETY PLAN APPROVALS</p> <p>Prepared by: Steve Fundingsland Date: May 11, 1995</p> <p>HSC Signature: _____ Date: _____</p> <p>HISM Signature: <i>[Signature]</i> Date: <i>5/12/95</i></p>			MEDICAL EMERGENCY
Hospital Name: Kadlec Hospital		Phone: 1-509-522-6774				
Hospital Address: 888 Swift Blvd						
Name of Contact at Hospital:						
		Name of 24-Hour Ambulance: Richland, WA		Phone: 911		
		Route to Hospital (Attach map with route to hospital) From 1100 Area take Stevens Drive South 2.25 miles from the Hanford Site boundary to Swift Blvd. The hospital is located on the corner of Swift Blvd and Stevens Drive.				
		Distance to Hospital: ~ 2.75 mi total		Page 13 of 15		



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APPENDIX C

CHEMICAL WASTE MANAGEMENT SITE SAFETY AND HEALTH PLAN

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**CWM Health and Safety Plan
for
The UST Removal Project
Hanford, Washington**

Prepared for:

CDM FEDERAL PROGRAMS

**1010 Jadwin Ave.
Richland, WA.
99352**

Attn: Paul Karas

Submitted by:

**CHEMICAL WASTE MANAGEMENT, INC.
TECHNICAL SERVICES DIVISION
1120 Andover Park East
Tukwila, Washington 98188**

May 25, 1995

CWM Project # 95-03-5207

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**CWM HEALTH AND SAFETY PLAN
UST REMOVAL PROJECT**

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**CWM Health and Safety Plan
for
The UST Removal Project
Hanford, Washington**

This Plan includes the following items:

- The names of specific key personnel and alternates, including Project Managers and those personnel responsible for site safety (Site Health and Safety Officer).
- A health and safety risk analysis for existing site conditions, and for each site task and operation.
- Personnel training requirements.
- Specific Personal Protective Equipment (PPE) designated to be worn by on-site personnel for each component of the job.
- Job specific medical surveillance and frequency, and medical providers to be contacted in the event of an emergency.
- A sampling strategy for air monitoring, both for ambient air and personnel, and the instrumentation to be used.
- Contamination control procedures to be followed for the duration of the job.
- Hazard Communication procedures, not only for workers, but for visitors and for the general public. (Includes internal and external site control).
- A complete contingency plan.
- A list of local agencies.
- A discussion of other procedures, including trenching and excavation, confined space entry, etc..

1.0 KEY PERSONNEL/ASSIGNMENT OF SAFETY RESPONSIBILITIES

1.1 PURPOSE

Responsibilities will be assigned and the appropriate authority will be established for key personnel with the express purpose of guaranteeing enforcement and compliance with the Health and Safety policies and procedures designated in this Plan.

1.2 PROJECT MANAGER

The Project Manager or Supervisor has the overall responsibility for the Health and Safety of all employees on site. In the event of an emergency, the Project Manager will act as the Emergency Coordinator and direct emergency actions. The Project Manager's authority will only be preempted in an emergency; and then only by officials of the local government.

1.3 SITE FOREMEN

Site Foremen or Leadmen report to the Project Manager and have the primary responsibility of enforcing the policies and procedures of the Health and Safety Plan. Foremen are responsible for integrating hazard recognition and control into all job activities through verbal and written directions, by their example, and by follow-up monitoring.

1.4 SITE SAFETY OFFICER

The Site Safety Officer (SSO) receives support from the Health and Safety Manager, and is responsible for implementing the site-specific Health and Safety Plan through the following activities:

- Implementing safety training and information sessions.
- Maintaining the on-site medical surveillance and emergency medical treatment programs, and assisting in on and off-site emergencies.
- Maintaining the personnel air-monitoring program.
- Safety compliance and record keeping.
- Reviewing planned site activities and implementing safety procedures to complete remediation activities safely.

- Implementing and overseeing the industrial hygiene program.

This project will include a trained Site Safety Officer who may also have other duties during the project.

1.5 FIELD PERSONNEL

Field personnel are responsible for reporting any unsafe or unhealthful work conditions to their Supervisor. They are responsible for keeping up-to-date on health and safety issues through attendance at the daily health and safety meetings, and for safe performance of all tasks assigned to them.

1.6 HEALTH AND SAFETY MANAGER

The Division Health and Safety Manager reports to the Technical Services General Manager and is responsible for assisting the Project Manager and his staff in preparing and implementing this Health and Safety Plan. In addition, the Health and Safety Manager will serve as the Technical liaison to regulatory agencies for health and safety issues.

2.0 HAZARD ASSESSMENT AND CONTROL MEASURES

2.1 SCOPE OF WORK ACTIVITIES

The scope of this project includes the following activities:

- 1) Establish work zones.
- 2) Sampling.
- 3) Free product removal.
- 4) Inerting: prevention of ignition of flammable gasses.
- 5) Tank removal.
- 6) Labeling
- 7) Sediment removal and rinsing.

2.2 PHYSICAL HAZARDS

All work activities associated with this project will be performed in accordance with state and federal OSHA construction safety standards and general industry safety orders. Physical hazards will be of significant concern on this project. Specific concerns are as follows:

2.2.1 Heavy Equipment

Heavy equipment introduces significant amounts of noise into the work environment, at or above levels permitted by regulation. Heavy equipment will be used in the performance of this project. Well designed traffic control, hearing protection, and standardized hand signals will provide significant levels of control from the hazards introduced.

2.2.2 Head Injuries

All personnel are required to wear a hard hat meeting applicable ANSI Standards at all times while on this project. The hat is to be worn properly, and may not be altered in any way that would lessen the degree of protection offered.

2.2.3 Foot Injuries

Because of the type of work performed on this job, steel-toed work shoes meeting all ANSI Standards will be required during all phases of the operation.

Overshoe protection will be discussed in the section on Chemical Exposure.

2.2.4 Eye Injuries

The type of work performed on this job will create the risk of eye injury. All personnel working on this job will be required to wear a full-face, air-purifying respirator with a face piece meeting all applicable ANSI Standards or, in the absence of this respirator, will wear safety glasses with side shields or goggles meeting the applicable ANSI Standards. Any activities within the support zone will require safety glasses with side shields.

2.2.5 Noise Exposure

The use of heavy equipment and the high volume of truck traffic on this job will create noise levels exceeding the TLV for noise exposures. All personnel will be required to wear ear plugs for the duration of this project, whenever in the exclusion or contamination reduction zones.

2.2.6 Thermal Stresses

Adverse climate conditions are an important consideration in planning and conducting site operations. Workers can become quite warm working in PPE in the warmer climates, such as the conditions encountered in Eastern Washington during the late spring and early summer months. There may also be significant variations in daily temperatures. The effects of ambient temperature can cause physical discomfort, loss of efficiency, personal injury, and increase the probability of accidents. One or more of the following recommendations will help reduce the risk of thermal stress on the job site.

- Plenty of liquids will be provided to replace loss of body fluids. Water and/or electrolyte drinks will be used for this purpose.
- Work will begin as early in the day as possible to minimize work during the late afternoon which is the hottest part of the day in this area.
- All CWM personnel are provided training on the causes of heat and cold stress and preventive measures.
- At ambient temperatures greater than 70 degrees F, employees working in chemical protective clothing will monitor their resting pulse at the start of the work shift and the beginning of each rest break. If an employee's pulse exceeds 110 beats per minute, his work periods will be shortened by 1/3. If his pulse exceeds 110 beats per minute at the next rest break, after shortening the work period, his work period will be shortened by 1/3 again. If the employee's pulse continues to exceed 110 beats per minute after this second reduction of the work period, he will be removed from thermally stressful work for the day.

Signs and symptoms of heat-related illness and appropriate first aid measures can be found in Technical Services Health and Safety Procedure number 20.

2.2.7 Hand Injuries

Moving machinery, sharp objects, and pinch points are all present at this work site. The risk of injury from these hazards will be minimized by wearing protective gloves, providing appropriate guards for exposed moving parts and using tools or heavy

equipment to mechanically grasp sharp objects. CWM procedures for Control of Hazardous Energy will be implemented before any work is performed on vehicles, heavy equipment or other mechanical devices.

2.2.8 Back Injuries

Bending, lifting, and climbing activities can present a risk of back injuries at this project. These risks will be minimized by training employees in proper lifting techniques and enforcing them on the job site. Objects weighing more than 50 pounds must be mechanically lifted or lifted by more than one person. Objects weighing more than 100 pounds must be lifted mechanically. Back-belts will be required for any activities requiring manual lifting.

2.2.9 Confined Space Entries

No confined entry operations are expected by CWMI personnel during the performance of this project. Using a colliwasa/hand pump or equivalent, CWM will extract free product from each tank and place the extracted material in 40 ml amber glass Volatile Organic Analysis (VOA) viles. The viles will be filled to insure no head space exists thereby protecting the sample from the effects of oxygen.

A sterilized sieve scoop will be attached to a pole of suitable material and used to collect sediment samples. The collected sediments will be placed in 2 oz septa jars. If confined space entries are necessary, they will be performed according to all Federal, State and Local regulations, and in full adherence to Tech Services Health and Safety Procedure #27. The required entry permit will be completed and issued by the Site Safety Officer.

2.2.10 Excavations

Extensive excavations are involved during the performance of this project. Multiple hazards result during any trenching or excavation operation. All excavation operations will be performed by Burdine Construction Company under a separate contract. Further precautions include:

- Sloping of excavations before entries; and/or for providing greater stability to sides of the excavation.
- Storing spoils soils well back from the edge of the excavation, (at least 5 feet).

- Keeping all personnel back from excavations and from excavation operations.
- Use of coordinated hand signals to facilitate communication.
- Only "Certified" personnel will be authorized to operate heavy equipment.

2.2.11 Inerting/Flammable Atmosphere Control

LEL monitoring will be conducted inside the tanks to prevent accidental ignition of flammable gases during the tank cleaning operations, CWM will inert the tanks prior to conducting any activities in, on or around the tanks. See work plan of specific methods.

2.2.12 Hot Work and Lockout/Tagout

Lockout/tagout procedures are not expected to be needed in the performance of this project. If work must be done around live electrical systems, all Federal, State, Local and Corporate requirements will be strictly adhered to. No hot-work will be performed, nor is any authorized in the completion of this project. Further requirements are described in Technical Services Health and Safety Procedure #24.

2.2.13 Fire Hazard

The only combustible or flammable materials handled during this project will be the residues of fuel oil and other petroleum hydrocarbons. 20# Class ABC fire extinguishers will be available on site in case any of the burnable materials on site are ignited by electrical or other means. Any fuels stored on-site for equipment will be in approved vessels, will be provided secondary containment, and will be grounded.

2.3 OTHER TASK ASSOCIATED HAZARDS

2.3.1 Demolition Activities

Demolition activities create tripping hazards as well as significant sharp edges, etc.. Personnel working in the areas of demolition will be required to wear kevlar gloves and sleeves, and steel boot inserts.

2.3.2 Cutting Visqueen for Spill Prevention or Decontamination

Cutting of plastic sheeting requires the use of razor or utility knives. Kevlar gloves will be worn to prevent laceration type injuries.

2.3.3 Tarping of Trucks

Tarping of trucks requires elevated work, usually without a platform. For this project, semi-permanent tarping racks will be set-up. All personnel will be required to tie-off whenever working from the tarping racks.

2.3.4 Backfilling Operations

Backfill operations have the same hazards as the excavation operations, but less chemical hazard concern. Same controls will be employed.

2.4 CHEMICAL CONTAMINANTS

The chemical contaminants available on this site consist of TPH's and BTEX. The concentrations available are very slight. Exposure limits are listed below in Table 2.4-1.

Table 2.4-1

Chemical Contaminant	PEL/TLV/REL	IDLH
Tetrachloroethylene	25ppm	500ppm
ODOR THRESHOLD	A3	47ppm

Exposure to chemical contaminants will be controlled in a number of ways:

- PPE - all personnel will wear personal protective equipment as specified in section 4.0 of this Health and Safety Plan for the duration of this project.
- Posting of Controlled Areas - all work areas will be identified externally, by posting the surrounding fencing, and access to the worksite will be controlled.
- Personal Hygiene - all personnel will decontaminate whenever exiting the work area. The last step of decontamination requires the thorough washing of hands and face with soap and water.
- Equipment- for the duration of this project, heavy equipment will be used whenever possible, in order to minimize worker exposure through direct contact.

Contact with contaminated or suspected contaminated surfaces will be minimized. Skin contact with dusts and inhalation of same are the exposure routes of concern during this project. Selection and implementation of appropriate respirators, personnel protective equipment and decontamination procedures will reduce or eliminate such exposures. Protective clothing requirements for each job function will be described in Section 4.0. Decontamination procedures are described in Section 5.0.

3.0 MEDICAL SURVEILLANCE

3.1 PURPOSE

The purpose of medical surveillance in the Health and Safety Plan is to provide a uniform medical program that will ensure a healthy work force. This includes the selection of employees physically able to safely perform the work tasks assigned, the monitoring of their health on a regular basis, and providing medical care for occupational injury or illness. This criteria applies to all CWM employees and their subcontractors.

3.2 MEDICAL REQUIREMENTS

3.2.1 Pre-Employment Medical Evaluation

Each prospective employee shall have a pre-employment medical evaluation to determine fitness for the job assignment. The candidate's employment is contingent upon the examining physician's concurrence that the candidate meets the medical

criteria established for the job.

3.2.2 Termination Medical Evaluation

Each employee shall be provided with a termination physical examination and medical evaluation prior to leaving employment with CWM. If the terminating employee declines this service, a written request offering this service shall be sent via certified mail to the employee's last known address and a copy of the request with the certified mail receipt will be retained in the employee's medical record file.

3.2.3 Special Medical Examinations or Consultations

Special medical examinations or consultations shall be arranged in emergency situations for all employees who were exposed, without adequate protection, to hazardous substances at concentrations above the Personal Exposure Limits (PEL). This will be done as soon as possible after the exposure has been reported.

A special medical examination will also be arranged upon notification by the employee that he has developed signs or symptoms indicating a possible overexposure to hazardous substances, or if the examining physician determines that more frequent medical examinations are necessary.

3.2.4 Site Medical Services

All CWM field staff are adequately trained in first aid and CPR and are updated annually. A minimum of two personnel will be available for each shift during which operations are conducted.

3.2.5 Verification of Physical Examinations

Verification of physical examinations for all employees is required. A copy of the pre-placement physical evaluation and respiratory compliance letter, if applicable, will be kept on file. Signed statements by an authorized representative of the contractor will be accepted on a temporary basis, not to exceed one (1) month, pending arrival of the required documentation.

3.3 PHYSICAL EXAMINATION CATEGORY AND FREQUENCY

The content and frequency of physical examinations is determined by the potential exposure hazard and the type of personnel protective equipment required by the job.

Category C- Health and Safety Personnel

Definition: Supervisory and management personnel who use respiratory protection less than 30 days per year, or who are potentially exposed to hazardous substances or health hazards less than 30 days per year.

Frequency of Exams: Pre-placement, in service every two years and termination.

Category D - Field Techs, Site Supervisors, Project Coordinators, Equipment Operators

Definition: Personnel who may potentially be exposed to hazardous substances or health hazards 30 days per year, or who are required to use respiratory protection 30 days per year.

Frequency of Exams: Pre-placement, in service every year and termination.

Both Category C and D physicals will include a medical history and exam, chest X-ray, blood count and blood chemistry, pulmonary function test, audiometric test, urinalysis and drug screen.

3.4 EMPLOYEE NOTIFICATION OF MEDICAL EXAMINATION RESULTS

The Washington Occupational Health will review the results of a medical evaluation of each employee. If the examination uncovers a serious health problem, the examining physician may confer with the employee's family physician. If both physicians agree, the family physician may make the notification, but CWM requires assurance that the employee or employee candidate is notified.

3.5 MEDICAL EVALUATION RECORDS

Records of employee medical evaluations and any biological monitoring will be stored by the examining physician for at least 40 years following the affected employee's termination of work with CWM.

Access to these records is restricted to the affected employee, unless the employee gives his express written consent to other access. CWM will receive and retain only the physician's written opinion of the employee's fitness to work.

3.6 LOCAL MEDICAL PROVIDER

For routine physical examinations and employee qualifications, the following medical providers will be used:

Virgina Mason Clinic
Tukwila, WA.

For emergency medical aid, the nearest hospital will be used. The hospital identified is:

Kadlec Hospital
Richland, WA. (509-522-6774)

The directions to the hospital are as follows:

From the 1262 Solvent Tanks site, take Stevens Drive 3.5 miles south to Swift Blvd. Take Swift Blvd east (left) One block to Goethals Drive. Kadelec Hospital is located on the corner of Swift Blvd and Goethals Drive.

4.0 PERSONAL PROTECTIVE EQUIPMENT

4.1 PURPOSE

The purpose of Personnel Protective Equipment (PPE) is to protect employees from potential hazards at the job site.

4.2 DESCRIPTION OF LEVELS OF PROTECTION

Levels of protection have been defined by EPA in the EPA Standard Operating Guide, 1984. Level A is a totally encapsulating, chemically-protective suit with self-contained breathing apparatus. Level B provides maximum respiratory protection by the use of supplied air or self-contained breathing apparatus, and dermal protection is selected on the basis of anticipated hazards. Level C incorporates an air-purifying respirator, which is specific to the contaminants of concern.

The degree of dermal protection depends on anticipated hazards.

Level D is basically a work uniform. There are numerous variations and modifications possible with each level.

4.3 PERSONNEL PROTECTIVE EQUIPMENT

Based on the contaminants identified, and the operations planned, the expected levels of protection will be Level B for sampling and Level C for cleaning with possible downgrade to Level D based on monitoring results. Level A will not be required.

4.3.1 Level D Protection

The prescribed minimum protective equipment work in the support zone is Level D. This will include:

- Hard hat;
- Safety glasses with side shields;
- Safety shoes with steel toes and shanks;
- Work uniform with long-sleeved shirt and long pants;
- Hearing protection in high noise areas; and
- Leather gloves for handling tools and equipment.

Chemical resistant gloves, boots and tyvek coveralls will be added for activities that pose a skin contact hazard.

4.3.2 Level B Protection

All operations in the exclusion and contamination reduction zones will require Level B protection. This will include:

- Supplied Air; due to the poor warning properties of the chemical.
- Safety shoes with steel toes and shank with saranex over booties or PVC boots;
- Hard hat if overhead or bump hazards exist;
- Saranex coveralls; and
- 4 mil Nitrile inner, silvershield middle and Solvex Nitrile outer gloves.

There may be a modified level C if conditions permit. Approval is required from the Health and Safety Manager.

Ear plugs will also be required for anyone working around equipment that is operating over 85 dbs. Work with sharp hand tools such as utility knives will necessitate the use of Kevlar gloves as a middle glove.

4.4 FIT TESTING

Fit tests of respiratory protection will be performed on each employee prior to his initial assignment to this project. Qualitative fit tests will be performed using irritant smoke. Employees will be fit tested with Scott full-face and Scott half-face respirators. Those individuals who cannot obtain a suitable fit using the Scott, will use a MSA full-face. Individuals will be allowed to use only those respirators for which they have been trained and fit tested. Qualitative fit tests will be repeated every 12 months and whenever an individual's physical condition changes in a way that may affect respirator fit.

This Plan includes the following items:

- The names of specific key personnel and alternates, including Project Managers and those personnel responsible for site safety (Site Health and Safety Officer).
- A health and safety risk analysis for existing site conditions, and for each site task and operation.
- Personnel training requirements.
- Specific Personal Protective Equipment (PPE) designated to be worn by on-site personnel for each component of the job.
- Job specific medical surveillance and frequency, and medical providers to be contacted in the event of an emergency.
- A sampling strategy for air monitoring, both for ambient air and personnel, and the instrumentation to be used.
- Contamination control procedures to be followed for the duration of the job.
- Hazard Communication procedures, not only for workers, but for visitors and for the general public. (Includes internal and external site control).
- A complete contingency plan.
- A list of local agencies.
- A discussion of other procedures, including trenching and excavation, confined space entry, etc..

4.5 PERSONAL HYGIENE

Project activities will be conducted in accordance with the following minimum requirements:

- Eating, drinking, and smoking will be restricted to a designated area.
- Gross decontamination and removal of all personal protective equipment will be performed before leaving the site. Contaminated clothing will be removed and collected in a drum for disposal.
- Shaking or blowing dust or other materials off potentially contaminated clothing or equipment to remove dust or other materials is not permitted.
- On site, employees will have access to portable toilets.

5.0 WORK ZONE AND DECONTAMINATION PROCEDURES

5.1 PURPOSE

A site must be controlled to reduce the possibility of exposure to any contaminants present and to limit their transport from the site by personnel or equipment.

5.2 CONTROL

A control system is required to ensure that personnel and equipment working on hazardous waste sites are subjected to appropriate health and safety surveillance and site access control.

The possibility of exposure or translocation of contaminants will be reduced or eliminated in a number of ways, including:

- Setting security or physical barriers at control points to regulate and/or exclude unnecessary personnel from the general area;
- The exclusion zone will be enclosed with temporary fencing in order to further control the worksite;
- Minimizing the number of personnel and equipment on site consistent with effective operations;
- Establishing work zones within the site;
- Conducting operations in a manner which will reduce the exposure of personnel and equipment (all trucks will be staged next to, but not within

- the exclusion zone for loading);
- Minimizing the airborne dispersion of contaminants (utilizing dust control procedures); and
- Implementing appropriate decontamination procedures for both equipment and personnel (heavy equipment will be decontaminated when being removed from the site; all personnel will decontaminate when leaving the exclusion zone).

5.3 FIELD OPERATIONS WORK AREAS

Work areas (zones) will be established based on anticipated contamination. Within these zones, prescribed operations will occur utilizing appropriate Personal Protective Equipment (PPE). Movement between areas will be controlled at checkpoints. The planned zones are:

- Exclusion Zone (contaminated),
- Contamination Reduction Zone, and
- Support Zone (non-contaminated).

5.3.1 Exclusion Zone

The Exclusion Zone is the innermost area of three (3) concentric rings and is considered contaminated, dirty or "hot". Within this area, the prescribed protection must be worn by any personnel upon entering. An entry checkpoint will be established at the periphery of the Exclusion Zone to control the flow of personnel and equipment between contiguous zones, and to guarantee that the procedures established to enter and exit the zones are followed. For this project, the Exclusion Zone will be established prior to starting the project. The zone will be noted on the site map. (See Figure 5-1). The boundary of the exclusion zone will be physically secured and posted.

Figure 5-1
Site Map for CDM Federal
(Complete on-site. Include all work-zones, all
emergency equipment, primary and alternate evacuation
routes, and other relevant information).

5.3.2 Contamination Reduction Zone

Between the Exclusion Zone and the Support Zone is the Contamination Reduction Zone. The purpose of this zone is to provide an area to prevent or reduce the transfer of contaminants which may have been picked up by personnel or equipment returning from the Exclusion Zone. Any rinsewater derived from wet decontamination will be contained and collected. For the purposes of a dry decontamination a thorough brush-down of equipment upon exit will suffice. All loads will be lined and tarped. All decontamination activities occur in this area. The boundary between the Support Zone and the Contamination Reduction Zone is the contamination control line. This boundary separates the potentially contaminated area from the clean area. Entry into the Contamination Reduction Zone from the Clean Area will be through an access control point. Personnel entering at this station will be wearing the prescribed PPE for working in the Contamination Reduction Zone. Exiting the Contamination Reduction Zone to the Clean Area requires the removal of any suspected or known contaminated PPE, and compliance with the established decontamination procedures.

During this project, a single access point will be established prior to starting the project, through which all entry and exit must take place.

5.3.3 Support Zone

The Support Zone is the outermost of three rings and is considered decontaminated, or Clean Area. It contains the Command Post (CP) for field operations and other elements necessary to support site activities. Normal street or Level D work clothes are the appropriate apparel to be worn in this zone.

5.4 ZONE DIMENSIONS

Judgement is needed to ensure safe working distances for each zone, balanced against practical work considerations. Physical and topographical barriers may constrain ideal locations. Field/laboratory measurements combined with meteorological conditions and air dispersion calculations will assist in establishing the control zone distances. When not working in areas that require the use of chemical-resistant clothing, work zone procedures may still need to limit the movement of personnel and retain adequate site control.

5.5 DECONTAMINATION PROCEDURES

5.5.1 Introduction

As part of the system to prevent or reduce the physical transfer of contaminants by people and/or equipment from the site, procedures will be instituted for decontaminating anything leaving the Exclusion Zone and Contamination Reduction Zone. These procedures include the decontamination of personnel, protective equipment, monitoring equipment, clean-up equipment, etc. Unless otherwise demonstrated, everything leaving the Exclusion Zone should be considered contaminated and appropriate methods established for decontamination. In general, decontamination at the site consists of rinsing equipment, personnel, etc., with copious amounts of water and washing the same with a detergent/water solution. Reusable decontaminated PPE will be stored for air drying.

Decontamination is addressed in two (2) ways; the physical arrangement and control of contamination zones, and the effective use of decontamination procedures.

5.5.2 Project Specific Decontamination

Solution: 10 Gallons of water add 4 pounds of trisodium phosphate.

5.5.2.1 Personnel

Employees exiting the Exclusion Zone will decontaminate as follows:

1. Wipe down the Saranex suit with decon solution.
2. Set aside hard hat for further cleaning.
3. Remove outer booties and place in container set aside for the purpose.
4. Remove outer gloves and place in container.
5. Remove inner booties and place in container.
6. Step to next station; remove respirator (if required) and set aside for cleaning.
7. Remove inner gloves and place in container.
8. Wash hands and face.
9. Eating, drinking, smoking and chewing must be restricted to designated break areas.

5.5.2.2 Equipment (sampling, etc.)

All equipment entering the exclusion zone must be decontaminated when leaving the site. Decontamination will proceed as follows:

1. Wipe down all equipment with a damp rag of the decon solution and then dispose the rag into waste PPE container. Repeat step three times. Final wipe using a dry rag.

Efforts will be made to keep equipment out of contact with contaminated material to the greatest degree possible.

5.5.2.3 Heavy Equipment

All heavy equipment will be cleaned using a stiff bristled broom, prior to leaving the site. The decontamination area will be covered with visqueen to contain contamination.

5.5.3 Respirator Cleaning

All respirators will be deconned on site using a water and disinfectant wash.

As part of the system to prevent or reduce the physical transfer of contaminants, anything leaving the Exclusion Zone and Contamination Reduction Zone will be decontaminated. This includes decontamination of personnel, protective equipment, monitoring equipment, decon equipment, etc. Unless otherwise demonstrated, everything leaving the Exclusion Zone should be considered contaminated and appropriate methods established for decontamination. In general, decontamination at the site consists of rinsing equipment, personnel, etc., with copious amounts of water and washing with detergent and water solution. Reusable, decontaminated, personnel protective equipment will be stored in the employees' gear bags. Only potable water may be used for personnel decontamination.

5.5.4 Decontamination Solution

For the purposes of this project a trisodium phosphate/water solution will be used.

5.5.5 Personnel Decontamination During Emergencies

In the event of personal injury, first aid personnel must decide if the victim's injuries are life-threatening or could be aggravated by movement. When in doubt, or if the victim is unconscious, no attempt should be made to move him until emergency medical personnel arrive. Any suspected skin contamination with dust should be removed by rinsing with clean water. If the victim is conscious and it is reasonably possible, his personnel protective equipment will be removed before transporting him to the hospital. If this is not practical, the victim dressed in protective clothing should be wrapped in a tarp or plastic sheeting to protect the ambulance during transport.

6.0 EMPLOYEE EXPOSURE MONITORING

6.1 PURPOSE

The purpose of air monitoring is to identify and quantify airborne levels of hazardous substances in order to determine and verify the level of employee protection required on site. Air monitoring results will be used to determine appropriate levels of protection and to assess risk in any uncontrolled release. Due to the relatively low levels of contaminants present, the elevated levels of personal protection and contamination control in place, no personal exposure monitoring will be completed.

6.2 TANK MONITORING

During the tank opening, sampling, product removal and the cleaning phases of this project CWM will monitor LEL/O₂, for the presence of any flammable gases or oxygen deficient atmospheres. CWM will adhere to applicable procedures as outlined in the USACE EM 385-1-1 when working on or around a UST.

7.0 TRAINING

7.1 PURPOSE

Employee training is intended to ensure safe work practices and protection of personnel and property.

7.2 STRUCTURE

CWM employees will receive health and safety training in accordance with 29 CFR 1910.120 prior to working on the job site. The training program will fulfill all requirements set forth in Washington State Department of Labor and Industries standards and federal OSHA standards for construction and general industries, including applicable hazardous waste regulations. Project Managers, Foreman and Site Safety Officers receive an additional 16 hours of instruction in Health and Safety Plan implementation, site control, monitoring, etc..

Hazardous waste workers and transporters of hazardous waste will receive at least 40 hours of health and safety training before they are allowed to work on site. At least 8 hours of annual refresher training will be presented thereafter. In addition, daily crew meetings will be held prior to work commencement to discuss safety concerns and changes in work or procedures.

7.3 METHODS

Materials and information will be presented by the Site Safety Officer, the CWM Health and Safety Manager, or other qualified trainers. Training will consist of classroom lectures, field exercises, and written or oral performance evaluations. The bulk of the training information will be presented in lecture form. If the training involved skills or procedures requiring practice, lectures will be supplemented by field exercises.

Evaluations of employee performance will be conducted at the end of every training session. These may be in the form of written tests or the instructor's observation of skills performed.

Written records of training will be maintained in each employee's CWM training file.

7.4 TRAINING CONTENT

Training topics include, but are not limited to, the following subjects:

- Hazard communication,
- Chemical and physical hazard awareness,
- OSHA lead standards,
- Safe work practices,

- Personal protective clothing,
- Respirators,
- Hearing conservation,
- Employee rights and responsibilities,
- Emergency procedures,
- Decontamination procedures,
- Site specific safety rules, and
- Review of the job site owner's safety rules and procedures.

7.5 SPECIALIZED TRAINING

Employees who are required to operate heavy equipment or specialized vehicles, such as box vans or commercial trucks, must be properly trained to perform such operations. This training must be documented in the form of a certificate or a statement by a trained instructor that the individual has had adequate training and/or experience to enable him to safely operate the specified equipment. Employees who drive commercial vehicles, as defined by the Department of Licensing, must have a current driver's license that meets the requirements for the class of vehicle they are driving.

8.0 COMMUNITY PROTECTION

8.1 PURPOSE

Protection of the safety and health of the community is a priority of Chemical Waste Management, Inc. (CWM). The community interest at the site will be protected in three major ways. Protection will be provided by a contingency plan to be implemented in emergencies, standard procedures to prevent migration of contaminants off site, and information given to public officials charged with protecting the public health.

8.2 HAZARD CONTAINMENT

A major part of community protection is preventing the spread of contamination off site. Procedures implemented will include securement of the work area and proper masking of fences surrounding exclusion zone areas using visqueen. All soil will be kept damp to prevent dusting, and all personnel and equipment leaving the site will be decontaminated.

8.3 DIRECT-READING INSTRUMENTS

Due to the low concentrations available, and the engineering controls in place, direct reading instruments that will be used in the performance of this project will be the GASTEC LEL/O2 meter.

9.0 SITE SECURITY

9.1 ACCESS

Job site access will be limited to authorized employees and visitors only. CWM will comply with customer site specific procedures for entry and access to the work area. All personnel entering the work area must meet the minimum requirements stated on this Health and Safety Plan. All persons entering the site will receive a brief orientation on the hazards present on the site, the requirements of the Health and Safety Plan, and the controls in place for their protection.

9.2 CWM EMPLOYEES AND CONTRACTORS

All persons entering the worksite will enter through the main gate as designated on the site map (Figure 5-1).. CWM employees and contractors will be logged in upon arrival at the work site each work shift. They will also be logged out at the end of each work shift. These logs will become part of the CWM project file.

9.3 VISITORS AND REGULATORY AGENCIES

Visitors and individuals representing government regulatory agencies must be authorized to access the work site by CWM, and/or the customer. These individuals will be logged in and out of the job site for each visit. Visitors and regulatory representatives will not be allowed access to the Contamination Reduction or Exclusion Zones without documentation of appropriate training, medical clearances, and appropriate PPE. All such visitors must be escorted by a CWM or CDM Federal representative at all times.

10.0 CONTINGENCY PLAN

10.1 PURPOSE

The Contingency Plan sets forth an approved course of action to be taken in the event of an emergency. It defines guidelines for responsibility, agency contacts, communication systems, emergency response and reporting procedures that are essential to ensure that appropriate and timely action is taken. It applies to all CWM employees, contractors, and visitors at the work site.

10.2 ANTICIPATED EMERGENCY CONDITIONS

Potential emergency situations at the project location would include employee injuries, open fires, release of dust outside of work area, and natural disasters such as earthquakes.

10.2.1 Injuries

Injured employees will be given immediate first aid treatment by trained workers at the job site. If additional medical treatment is necessary, the employee will be transported to the local hospital, either in a CWM vehicle or by ambulance. All injuries must be reported in writing as described in Section 11.0 of this Plan.

During emergency situations, personnel will be transported to the nearest Hospital. The route to the hospital is as follows:

Please reference section 3.6 for Hospital location and phone number

After the individual is stabilized, he/she will be transported to a hospital nearby the patients home. All work-related illnesses and injuries will be reported to CNA Insurance, the CWM Workers' Compensation carrier. Follow-up medical care will be provided by the local medical providers.

10.2.2 Releases

Due to extensive control of dust, no releases are expected. If any visible release is observed, all work will be shut down immediately, and controls will be re-evaluated. Reportable quantity spills and releases will be reported to the appropriate Federal, State and Local agencies.

10.2.3 Fires

Potential fire situations that may occur would be those involving combustible materials on-site. Portable ABC-type fire extinguishers will be available in various locations on the work site. Employees will attempt to control incipient stage small fires using portable extinguishers without endangering themselves in the process. If such control efforts are unsuccessful, employees will immediately call 9-1-1 to summon the local fire department. The same procedure will apply to small electrical or "waste basket" fires that could occur. Employees will not attempt to fight structural fires. In the event of such an occurrence, employees will immediately summon the local fire department by calling 9-1-1.

All CWM employees have received fire extinguisher training prior to their assignment to this project.

10.2.4 Earthquakes

In the event of an earthquake, employees will stop all work. Those working in the building will exit and move to an open area away from vehicles, trees and structures. Employees on foot, working in outdoor areas, will move to an open area away from vehicles, trees and structures. Employees in vehicles will stop work and stay inside the unit until the tremor stops.

Following the earthquake, the Project Manager/Site Safety Officer will check electrical and water lines for possible breaks or damage before work resumes.

10.2.5 Emergency Phone Numbers

Site Address: Hanford, WA.. Phone: (509) 376-2063

Police: City of Richland Phone: 9-1-1

Fire: City of Richland Phone: 9-1-1

Ambulance: Phone: 9-1-1

Water: 600 Area Manager, Ken Smith Phone: (509) 376-2063

Gas: 600 Area Manager, Ken Smith Phone: (509) 376-2063

Electric: 600 Area Manager, Ken Smith Phone: (509) 376-2063

10.3 RESPONSIBILITIES

The Project Manager is responsible for assessing conditions, directing emergency actions, and notifying CWM, customer representatives, and government agencies. He will designate specific employees to perform fire and spill control, as necessary.

In the event of a site evacuation, all employees will move to an upwind assembly area via the closest emergency exit (emergency exits are identified on the site map). The Site Foremen will perform a head count at the assembly area and report any missing persons to the Project Manager

The Project Manager/Site Safety Officer is responsible for obtaining first aid and medical treatment for any injured employees. He will report all injuries to the Health & Safety Manager. Employees trained in first aid and CPR will assist.

10.4 GOVERNMENT AGENCIES

Appropriate government agencies will be contacted to provide emergency assistance and report spills, as necessary. A list of these agencies and their phone numbers are as follows:

Westinghouse Spills & Unplanned Releases	(509) 373-4942
Ken Smith, Hanford 600 Area Manager	(509) 376-2063
National Response Center	(800) 424-8802

Local emergency response agencies, such as police, fire and ambulance, will be contacted and briefed on the Contingency Plan before work begins.

10.5 SITE CONTROL

Personnel and vehicle access to the work site will be clearly marked for use in emergencies. An area map will be posted at the work site showing all emergency exits and the location of emergency equipment and supplies. (See Figure 5-1 for locations of emergency equipment and evacuation routes.)

All personnel will comply with security and site access procedures. The Project Manager will immediately notify CWM and customer representatives of any unauthorized access.

10.6 EMERGENCY EQUIPMENT

On-site emergency response equipment will include materials used during routine operations and reserved items stored in strategic areas of the job site. The following is a list of routinely available emergency equipment:

- Twenty pound ABC, dry chemical fire extinguishers,
- Portable safety shower/eyewash station,
- Tarps/blankets to reduce spread of contamination when transporting injured personnel,
- First aid kit,
- Hand tools, shovels for spill control,
- Recovery drums for collecting spilled materials.

A map of the work area showing the location of these materials will be posted on-site.

10.7 TRAINING

All employees will have a thorough understanding of this Contingency Plan and other emergency procedures when work begins at the job site.

11.0 INCIDENT REPORTING

11.1 PURPOSE

An incident is any unplanned event resulting in personal injury, property damage, loss of assets, fire, explosion, spill, release, or adverse publicity. Accurate and timely reporting of incidents ensures appropriate emergency response, agency notification, incident investigation, and corrective measures to prevent a reoccurrence.

11.1.1 Definitions

- Incident - Any unplanned, unfortuitous event resulting in injury, damage, loss of assets, or adverse publicity which requires notification to a regulatory agency, regardless of severity.
- Spill - Any unplanned escape of material, solid or liquid, from its primary container, vessel, tank, etc., regardless of quantity.
- Release - Any unplanned escape of vapor, aerosol or gas from its primary container.

11.2 REPORTING REQUIREMENTS

All incidents will be reported as outlined below. The reporting level progresses up the management structure as the severity of the incident increases. When in doubt, employees will report incidents to the highest level of management.

Field personnel will be cautioned to inform each other of the non-visual effects of the presence of toxics, such as:

- Headaches
- Dizziness
- Nausea
- Blurred vision
- Cramps
- Irritation of eyes, skin, or respiratory tract
- Changes in complexion or skin discoloration

- Changes in apparent motor coordination
- Changes in personality or demeanor
- Excessive salivation or changes in pupillary response
- Changes in speech ability or pattern

11.3 INITIAL VERBAL REPORTS

Employees will immediately report all incidents to the Project Manager. The Project Manager is responsible for reporting incidents to the CWM General Manager or Health and Safety Manager.

The General Manager and Health and Safety Managers are responsible for evaluating each incident and determining the appropriate response and notification procedures. Incidents involving medical treatment more than first aid, fire or explosion, Reportable Quantity (RQ) spills or releases, serious property damage, publicity, or non-CWM personnel must be immediately reported to the CWM Regional and Corporate Health and Safety Managers. An incident reporting call list will be posted at the job site at all times. The Project Manager is responsible for updating this list if personnel or phone numbers change. All employees at the job site will be trained in incident reporting procedures and the location of the call list.

11.4 WRITTEN FOLLOW-UP REPORTS

Employees and supervisors involved in an incident are required to submit written reports to the CWM Health and Safety Manager within one working day after the incident.

These reports must include a complete description of the incident, its causes, and corrective actions taken to prevent reoccurrence. All incident reports are reviewed by the CWM Vice President.

Written reports of minor first aid injuries and non-RQ spills or releases, vehicle damage greater than \$1000, or property damage greater than \$500 must be submitted to the Regional Health and Safety Manager within 5 working days of the incident. Reports of hospitalization, multiple injuries, non-CWM personnel involvement, or publicity must be submitted to the Regional Health and Safety Manager within one working day of the incident.

11.5 MONTHLY SUMMARY REPORTS

The CWM Health and Safety Manager will submit a monthly summary of incidents to the CWM Regional Health and Safety Manager. Individual incident reports will be retained for at least 6 years or for the duration of any workers' compensation or insurance claims, whichever is longer.

11.6 OSHA REPORTS

OSHA recordable injuries and illnesses will be included on an OSHA 200 field log maintained at the project site. Each recordable incident will be entered in the log within 6 days of its occurrence. A new OSHA 200 log will be started at the beginning of each calendar year. Logs will be retained for five years after their completion. CWM Supervisor's Accident Reports will be retained as supplemental records for the same time period, meeting requirements for OSHA 101.

11.7 OVERT PERSONNEL EXPOSURE

If overt personnel exposure occurs during the project, typical responses should include the following:

Skin or Eye Contact	Wash and rinse affected area thoroughly with copious amounts of soap and water, then provide appropriate medical attention. Eyes and skin should be rinsed for a minimum of 15 minutes upon chemical contamination.
Inhalation	Move to fresh air and, if necessary, decontaminate and transport to emergency hospital.
Ingestion	Decontaminate and transport to emergency hospital.
Puncture Wound or Laceration	Decontaminate and transport to emergency hospital.

12.0 PLAN APPROVAL

This Health and Safety Plan has been prepared specifically for the project described. It shall not be represented as appropriate for any other projects. All personnel on the worksite are obligated to adhere to the requirements of this Plan. Only the Environmental Health and Safety Manager shall authorize any variances from the

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APPENDIX D

MODIFICATION TO CDM FEDERAL STANDARD OPERATING PROCEDURE 4-5

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PROJECT-SPECIFIC MODIFICATION

SOP Title: Field Equipment Decontamination
at Nonradioactive Sites

SOP 4-5
Revision: 1
Date: May 18, 1995
USEPA Region: 10
Page 1 of 1

Technical Review: Susan L. Flaherty 5/19/95
Signature/Date

QA Review: [Signature] 5/30/95
Signature/Date

Approved: [Signature] 5/19/95
Project Manager Signature/Date

Issued: [Signature] 5/31/95
QA Director Signature/Date

Prepared by: Paul Karas

Project Manager: Paul Karas

Project No.: 6110-019

Client: USACE/Walla Walla District

Reason and Duration of Modification: Modification is made at the request of USACE - Walla Walla District and applies only to work conducted under Delivery Order 19 under Contract No. DACW68-94-D-0001.

Modification (attach additional sheets if necessary; state section and page numbers when applicable):

This modification consists of two parts.

The first portion of this modification consists of an alternative method of heavy equipment decontamination to replace Section 5.1 of SOP 4-5. Heavy equipment (including the track-hoe and shovels) will be decontaminated at waste soil stockpile locations. Decontamination will consist of removing the majority of potentially contaminated soil with a shovel or trowel followed by dry brushing. As a final step the equipment will be swabbed with a clean, damp, disposable wipe. No decontamination wastewater water will be generated.

The second portion of this modification consists of changes to Section 5.3 Sampling Equipment Decontamination and applies to all soil sampling conducted under Delivery Order 19. At the request of the USACE, Steps 5, 6, and 8 requiring acid and solvent rinses are deleted. Equipment rinsate blanks will be collected as described in the project plans to evaluate potential cross-contamination.

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APPENDIX E

**ENVIRONMENTAL SCIENCE AND ENGINEERING
STANDARD OPERATING PROCEDURES**

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SOP-ASM1234-007
Revision 1
Date 11/11/93
Page 1 of 9

Environmental Science & Engineering, Inc.
Gainesville Laboratory
Gainesville, Florida

**TITLE: DETERMINATION OF GROSS ALPHA AND GROSS BETA
ACTIVITIES IN SEDIMENTS, SLUDGES, SOILS, AND AIR FILTERS
(MODIFIED METHOD 9310)**

Effective Date: 11/15/93

Prepared by: Richard M. Kinney

Richard M. Kinney 11/15/93

Reviewed by: Kenneth U. Erondu

KU Erondu 11/15/93

Approved by: John J. Mousa, Ph.D.
(Gainesville Laboratory Director)

John J. Mousa 11/15/93

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- 7.0 PROCEDURE
- 8.0 CALCULATIONS
- 9.0 REFERENCES
- 10.0 ATTACHMENT

**TITLE: DETERMINATION OF GROSS ALPHA AND GROSS BETA
ACTIVITIES IN SEDIMENTS, SLUDGES, SOILS, AND AIR FILTERS
(MODIFIED METHOD 9310)**

1.0 PURPOSE

- 1.1 The purpose of this Standard Operating Procedure(SOP) is to ensure consistent and accurate analysis of sediments, sludges, soils, and air filters for gross alpha and gross beta radioactivity.

2.0 SCOPE

- 2.1 This method is a screening procedure for the detection of gross alpha and gross beta activity in sediments, sludges, soils, and air filters and a prerequisite to more detailed analyses when specific radionuclides are determined. This method is applicable to sediment, sludge, and soil samples which have been prepared as outlined in SOP-ASM3234-001.
- 2.2 Only those alpha emitters of energies greater than 3.9 megaelectronvolts(MeV) and beta emitters of maximum energies greater than 0.1 MeV can be measured with this procedure.

3.0 METHOD SUMMARY

- 3.1 After determining the solids content of the digestate solution, an aliquot of the sample is evaporated to a small volume and transferred quantitatively to a tared 2-inch stainless steel counting planchet. The sample solids are dried to a constant weight, cooled, and counted for alpha and/or beta radioactivity. Air filters are affixed to stainless steel counting planchets and counted for alpha and/or beta radioactivity.
- 3.2 Occasionally, sample aliquots after drying may not reach a constant weight. These samples are heated to a dull red color with a small propane torch to convert any salts contained in the solids to oxides, prior to counting.

4.0 INTERFERENCES

- 4.1 Fluctuations in sample weights that may occur while counting are often attributed to sample solids high in salts. Since the weight of the sample solids is the only factor used to determine the efficiency of the counting system used, steps must be taken to assure a consistent sample weight. Generally, steps to convert nitrate salts to oxides are used to obtain consistent weights.

- 4.2 Alpha and beta radioactivities can be impeded by the solids of which they are a part. This "Self Absorption" affects both alpha and beta, however because of the large mass size for alphas relative to betas, alphas are more easily impeded than betas. Because of sample self absorption, the sample solids density on the counting planchet should not exceed 5 mg/cm² for alpha and not more than 10 mg/cm² for beta measurements. For analyses requiring both alpha and beta determinations, the solids density should not exceed the requirements for alpha determination. A density of 5 mg/cm² corresponds to a total sample weight of 100 mg for a 2-inch counting planchet. A density of 10 mg/cm² corresponds to a total solids weight of 200 mg.
- 4.3 Sample nonuniformity in the counting planchet is a major interference to the counting of alpha and beta radioactivity. It is therefore important to make sure that the solids are evenly distributed on the counting planchet.

5.0 APPARATUS, MATERIALS AND REAGENTS

- 5.1 EG&G Berthold LB770-2 10 Channel Simultaneous Low Background Gas Flow Proportional Counter.
- 5.2 2-inch stainless steel counting planchets.
- 5.3 Various sizes of beakers.
- 5.4 Analytical Balance.
- 5.5 Rubber Policeman.
- 5.6 6 N HNO₃, mix 3 volumes 16 N HNO₃ with 5 volumes DI water.
- 5.7 Heat Lamp, 200 watt.
- 5.8 Hot Plate.
- 5.9 Glass Desiccator.

6.0 CALIBRATIONS

- 6.1 Alpha and beta radioactivities are affected by the amount of solids in the sample and the detector efficiency. This interference is corrected using the self-absorption curve. Prepare separate self-absorption curves by plotting weight of solids for alpha and beta against detector efficiency as outlined in SOP-ASG3234-003, "Method For The Calibration Of The Berthold LB770-2

10 Channel Low Level Gas Flow Proportional Counter For Alpha And Beta Radioactivities," Section 6.2.

- 6.2 When counting for beta radioactivity using proportional counting, alpha radiations can be incorrectly counted as beta radiations. This interference, known as "Crosstalk," or "Spillover" is corrected for as outlined in SOP-ASG3234-003, Section 6.3.

7.0 PROCEDURE

7.1 Air Filters

- 7.1.1 Affix the air filter sample to a labeled stainless steel counting planchet with double-stick tape.
- 7.1.2 Count the detector control, background, QC and environmental samples as outlined in the instrument SOP (SOP-ASG3234-001). After counting, store the samples in a glass desiccator until the data has been accepted by the appropriate staff.

7.2 Soils, Sediments, and Sludges

- 7.2.1 Digest the samples following the procedures outlined in SOP-ASM3234-001.
- 7.2.2 For each sample to be analyzed, label a two inch stainless steel counting planchet with the respective sample name or number. Record the sample names or numbers in the sample weight logbook. Tare each planchet and record the weight in the logbook.
- 7.2.3 Determine the solids content of the sample digestate by pipetting 1 ml of 16 N HNO₃, then 10 ml of sample into the respective counting planchet. Dry the sample under the heat lamp, cool in a desiccator, reweigh, and record the final weight in the sample weight logbook. Calculate the amount of solids obtained from 10 ml of sample by subtracting the tare weight of the planchet from the weight of the planchet plus the solids. Record the weight in the logbook.
- 7.2.4 Calculate the volume of sample necessary to obtain 80 mg of solids on the counting planchet using the following equation:

$$\text{Volume (to obtain 80 mg solids)} = \frac{(80 \text{ mg needed})(10 \text{ ml})}{(\text{mg solids in } 10 \text{ ml})}$$

- 7.2.5 After determining the required volumes for each sample in a batch,

transfer the calculated volumes to the appropriately size beakers. Transfer the sample names or numbers and volumes in the sample weight log book along with information concerning QC samples to be analyzed. If original planchets used during solids determination are to be used, make sure to account for the 10 ml already on the planchet.

- 7.2.6 Transfer the beakers to a hot plate. Evaporate the samples to a volume of 5 to 10 ml, remove from the hot plate, and allow to cool. Add 5 ml of 16 N HNO₃, and return the beaker to the hot plate. Evaporate the sample to a volume of 5 ml. Repeat the addition of 5 ml of 16 N HNO₃, for a total of three times.
- 7.2.7 After the final HNO₃ addition, when the volume is 3 to 5 ml, remove the beaker from the hot plate and allow to cool. Be sure not let the sample totally evaporate on the hot plate.
- 7.2.8 After the sample has cooled to room temperature, rinse the beaker with a small volume of 6 N HNO₃, and transfer the sample and rinseate to the appropriately labeled planchet and put under a heat lamp.
- 7.2.9 Rinse the beaker again with a small volume of 6 N HNO₃, and scrub with a rubber policeman. Rinse the rubber policeman and beaker with DI water and transfer the rinseate to the planchet. Dry the samples under the heat lamp, cool in a desiccator, and reweigh.
- 7.2.10 Count the detector control, background, QC and environmental samples as outlined in the instrument SOP (SOP-ASG3234-001). After counting, store the samples in a glass desiccator until the data has been accepted by the appropriate staff.

8.0 CALCULATIONS

- 8.1 Calculate the Alpha activity of the sample in pCi/g as follows:

$$\text{Alpha(pCi/g)} = \frac{(A - B)}{(E)(V)(2.22)}$$

where:

- A = Gross alpha count rate of the sample (cpm)
B = Alpha Background count rate for the detector
E = Efficiency of the detector at the given sample weight calculated as specified in SOP-ASM3234-003, (cpm/dpm)
V = Sample weight in grams (g), determined by dividing the

2.22 = analysis volume by the total digestate volume and multiplying by the total weight of sampl prepared. conversion factor from dpm to pCi (dpm/pCi)

8.2 Calculate the error at the 95% confidence level associated with the alpha count as follows:

$$\text{Alpha C.E. (pCi/g)} = \frac{(1.96)(R/t_1 + B/t_2)^{1/2}(1000)}{(E)(V)(2.22)}$$

where:

R_0 = Gross sample count rate (cpm)
B = Background count rate (cpm)
 t_1 = counting time for sample count
 t_2 = counting time for background count
E = Efficiency of the detector at the given sample weight calculated as specified in SOP-ASG3234-003, (cpm/dpm)
V = Sample weight in grams (g), determined by dividing the analysis volume by the total digestate volume and multiplying by the weight of sample prepared.
2.22 = Conversion factor from dpm to pCi. (dpm/pCi)

8.3 Calculate the beta activity of the sample in pCi/g as follows:

$$\text{Beta (pCi/g)} = \frac{B - (A)(C)}{(E)(V)(2.22)}$$

where:

B = Net beta count rate of the sample (cpm)
A = Net alpha count rate of the sample (cpm)
C = Beta/Alpha Crosstalk correction factor determined as outlined in SOP-ASG3234-003.
E = Detector beta efficiency at the given sample weight as determined in SOP-ASG3234-003, (cpm/dpm).
V = Sample weight in grams (g), determined by dividing the analysis volume by the total digestate volume and multiplying by the weight of sample prepared.
2.22 = Conversion factor from dpm to pCi (dpm/pCi).

8.4 Calculate the beta counting error at the 95% confidence interval associated with the beta count as follows:

$$\text{Beta C.I. (pCi/g)} = \frac{(1.96 \cdot R_s - B) \sqrt{1000}}{(E)(V)(2.22)}$$

where:

- R_s = Gross sample beta count rate (cpm)
- B = Beta Background count rate (cpm)
- t_s = counting time for sample
- t_b = background counting time
- E = Detector beta efficiency at the given sample weight, determined as outlined in SOP-ASG323-003. (cpm/dpm)
- V = Sample weight in grams (g), determined by dividing the analysis volume by the total digestate volume and multiplying by the total weight of sample prepared.
- 2.22 = conversion factor from dpm to pCi (dpm/pCi)

8.5 Calculate the beta activity of air filters in pCi as follows:

$$\text{Beta (pCi)} = \frac{B - (A) \cdot C}{(E)(2.22)}$$

where:

- B = Net beta count rate of the sample (cpm)
- A = Net alpha count rate of the sample (cpm)
- C = Beta:Alpha Crosstalk correction factor determined as outlined in SOP-ASG323-003.
- E = Detector beta efficiency at the given sample weight as determined in SOP-ASG323-003. (cpm/dpm).
- V = Sample weight in grams (g), determined by dividing the analysis volume by the total digestate volume and multiplying by the weight of sample prepared.
- 2.22 = Conversion factor from dpm to pCi (dpm/pCi).

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- 8.6 Calculate the beta counting error at the 95% confidence interval associated with the beta count as follows:

$$\text{Beta C.E. (pCi)} = \frac{(1.96)(R_0/t_1 + B/t_2)^{1/2}(1000)}{(E)(2.22)}$$

where:

- R_0 = Gross sample beta count rate (cpm)
 B = Beta Background count rate (cpm)
 t_1 = counting time for sample
 t_2 = background counting time
 E = Detector beta efficiency at the given sample weight, determined as outlined in SOP-ASG3234-003, (cpm/dpm)
 V = Sample weight in grams (g), determined by dividing the analysis volume by the total digestate volume and multiplying by the total weight of sample prepared.
2.22 = conversion factor from dpm to pCi (dpm/pCi)

9.0 REFERENCES

- 9.1 Prescribed Procedures For Measurement of Radioactivity in Drinking Water (EPA-600/4-80-032) August, 1980. Method 900.0, "Gross Alpha and Gross Beta Radioactivity in Drinking Water."
9.2 EPA Method 9310, Gross Alpha and Gross Beta, Test Methods for Evaluating Solid Waste, EPA SW 846 3rd Edition, September 1986.

10.0 ATTACHMENT

- 10.1 Table 1. Precision, Accuracy, and Detection Limit Data of Gross Alpha and Gross Beta in Soil (Modified EPA 3050/9310).

Table 1. Precision, Accuracy, and Detection Limit Data of Gross Alpha and Gross Beta in Soil (Modified EPA 3050/9310)

Parameter	Precision* (Max RPD)	Accuracy* (%Recovery)	Detection Limit+ (pCi/g)
Gross Alpha	27	79-133	0.54
Gross Beta	9	90-108	0.77

*Based on method validation study.

+Based on EPA's detection limits calculation procedure recommended for radionuclide analyses. (Reference: Carbon-14 in Aqueous Samples, Environmental Measurements Laboratory Manual, 1981).

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SOP-GLM1234-008

Revision 0

Date 06/10/94

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Environmental Science & Engineering, Inc.
Gainesville Laboratory
Gainesville, Florida

TITLE: ANALYSIS OF GAMMA EMITTING RADIONUCLIDES IN ENVIRONMENTAL MATRICES UTILIZING HIGH-PURITY GERMANIUM DETECTORS, EG&G ORTEC MAESTRO™ MULTICHANNEL ANALYSIS (MCA) SYSTEMS, AND EG&G ORTEC OMNIGAM™ GAMMA ANALYSIS SOFTWARE

Effective Date: 7/13/94

Prepared by: Richard M. Kinney

Richard M. Kinney 6/10/94

Reviewed by: Kenneth U. Erundu

Kenneth U. Erundu 6/11/94

Approved by: John J. Mousa, Ph.D.
(Gainesville Laboratory Director)

John J. Mousa 6/13/94

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TITLE: ANALYSIS OF GAMMA EMITTING RADIONUCLIDES IN ENVIRONMENTAL MATRICES UTILIZING HIGH-PURITY GERMANIUM DETECTORS, EG&G ORTEC MAESTRO™ MULTICHANNEL ANALYSIS (MCA) SYSTEMS, AND EG&G ORTEC OMNIGAM™ GAMMA ANALYSIS SOFTWARE

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to ensure proper and consistent analysis of environmental matrices for gamma emitting radionuclides.

2.0 SCOPE

- 2.1 This SOP is applicable to waters, soils, vegetation, and air samples to be analyzed for quantitative gamma emitting radioisotope content utilizing high-purity germanium detectors, EG&G ORTEC MAESTRO™ Multichannel Analysis (MCA) systems, and EG&G ORTEC OMNIGAM™ Gamma Analysis software. See Attachment A and B for a list of commonly encountered gamma emitting radioisotopes in environmental and nuclear process matrices.
- 2.2 This method is applicable to the identification and quantitation of gamma emitters exhibiting gamma rays with energies between approximately 50 keV and 2000 keV.
- 2.3 This SOP does not include instructions for instrument setup. Setup procedures are outlined in the instrument manual.
- 2.4 This SOP does not include instructions for performing daily instrument performance checks, electronic adjustments, or instrument maintenance. These topics are discussed in the instrumental SOP, SOP-GLG1234-005, "Procedure for Operation and Maintenance of Gamma Spectroscopy Systems."

3.0 METHOD SUMMARY

- 3.1 Adjustments to the gamma spectroscopy system electronics are made, prior to sample or background analysis, to assure the user that gamma peaks of known energy are located in the proper channels. Stability in instrument performance is then determined through the counting of a check source containing a broad distribution of radioisotopes representing the energy range of interest. Net area counts obtained in three energy ranges (Am-241 @ 59.54 keV, Cs-137 @ 661.62 keV, and Co-60 @ 1332.50 keV) are then plotted versus statistical limits which have been previously generated by repeated counting of the control check source. Results of peak resolution as the full peak width at half the peak maximum (FWHM) are also plotted against limits which

have been generated in the same manner as for the net area. Lastly, the centroid channel locations of the three gamma peaks are compared to limits which have been set based upon the EG&G ORTEC OMNIGAM™ Gamma Analysis software system's limits for identifying gamma peaks. Instrument electronic adjustments and daily performance checks are discussed in the instrument SOP, SOP-GLG1234-005. The instrument must pass all performance criteria to be used for sample or background analysis.

3.2 Background Determination

The contribution of gamma peaks intrinsic to the detector, the detector shielding, and other sources of radioactivity within close proximity to the detector (building materials, cosmic radiation, etc.) is determined through counting of an empty detector. Backgrounds are determined on a weekly basis for 86,400 seconds (one day) and are analyzed to determine the activity of specific radioisotopes contributing to sample spectra during acquisition. The background analysis file is used to generate a Peak Background Correction Table. Activities of radioisotopes in the table are subtracted from sample spectra during analysis using the EG&G Ortec OMNIGAM™ system.

3.3 Calibrations

3.3.1 Standard sources of known radioactivity content which have been prepared in the same configuration as samples are counted for a predetermined period of time. Standard sources contain a wide variety of radioisotopes with a distribution of gamma energies ranging from approximately 60 keV to 2000 keV. The calibration spectra are used to generate an energy (in keV) versus channel number curve (Attachment C) to be used during sample analysis. Energy calibrations are performed on a monthly basis for all sample configurations to be counted.

3.3.2 An efficiency calibration is performed by counting the standard source used for energy calibration for a predetermined period of time. An efficiency curve which relates the ratio of observed count rate to known decay rate is created through the OMNIGAM™ Gamma Analysis software. Efficiency calibrations are performed annually and after major instrument maintenance or repair for all matrices.

3.3.3 Energy and Efficiency calibration data are used in all environmental sample analyses.

3.4 Sample Analysis

3.4.1 Water samples are prepared either by transferring 1.0 liter of a previously acidified sample to a two liter Marinelli beaker or 3.0 liters of the sample to a three liter Marinelli beaker. Soils are dried and ground as detailed in SOP-ASM3234-013. The dried soils are then transferred to a tared aluminum can, sealed, and reweighed. Vegetation samples are received in a dried ground form and are sealed in aluminum cans in the same manner as for soils. Air filters are affixed to petri dishes.

3.4.2 Samples are analyzed by placing the samples, as prepared, on top of the germanium detector and counting for a predetermined period of time. Counting times should be determined by minimizing the count time factor (T) in the equation in Step 9.1.4 to reach desired quantitation limits. All counting parameters are controlled through use of the EG&G ORTEC Multichannel Analysis (MCA) system. Once acquired, the gamma-ray spectra are saved and converted from a channel file (.CHN) to a spectrum file (.SPC) which is analyzed through the EG&G ORTEC OMNIGAM™ Gamma Analysis system, combining the channel versus gross counts (.CHN) file with the Energy and Efficiency Calibration files. Radioisotopes are identified qualitatively through gamma-ray libraries which contain energy and percent abundance information for all gamma emitting radionuclides requested for analysis. Quantitative analysis is completed through the combination of the sample spectrum files (.SPC) with libraries, peak background correction tables, and sample mass or volume data which is manually entered by the analyst. Radioisotope activities are decay corrected to the collection date and time.

4.0 INTERFERENCES

4.1 Matrix inhomogeneity is a major interference to this method. Potential problems associated with inhomogeneity are avoided by preparing the matrix for analysis to closely replicate the source used for calibration.

4.2 Interferences intrinsic to the sample matrix (i.e. density, elemental composition, etc.) may occur.

4.3 Detector contamination can produce a high bias in isotope activity quantitation. This interference is eliminated through weekly background counts and contamination control mechanisms.

4.4 Combinations of radioisotopes with similar gamma peak energy are a major interference to this method. The ability to resolve peaks of similar gamma energy is a

limitation of the germanium detector. Automatic deconvolution of overlapping peaks is provided by the OMNIGAM™ software program to minimize this interference.

5.0 APPARATUS AND MATERIALS

5.1 High Purity Germanium Detector Systems.

5.1.2 System 1:

An EG&G Ortec Model GEM-30185-P High purity germanium detector cooled with liquid nitrogen in an EG&G Ortec Vertical configuration 40 gallon Dewar. The detector system is surrounded by a three inch layer of lead to minimize interferences from cosmic radiation. Voltage is supplied through an EG&G Ortec Model 659 High Voltage Supply. An EG&G Ortec Model 672 Amplifier is used for detector signal amplification and shaping. All electronics are supplied power through an EG&G Ortec Model 4001A BIN Power Supply. System 1 is set up as MCB number 2 in the MCA system.

5.1.1 System 2:

A Model GEM-20180 EG&G Ortec High Purity Germanium Detector cooled by liquid nitrogen in an EG&G Ortec Vertical configuration 40 gallon dewar. The detector system is surrounded by a three-inch layer of lead to minimize interference from cosmic radiation. Voltage is supplied through an EG&G Ortec Model No. 459 High Voltage Supply. An EG&G Ortec Model No. 672 Amplifier is used for amplification and shaping of the detector signal. All electronics are supplied power through an EG&G Ortec Model 4001A BIN Power Supply. System 2 is set up as MCB number 3 in the MCA system.

5.2 Calibration Sources, NIST traceable Sources with a wide distribution of gamma energies between approximately 60 and 2000 keV prepared to replicate the form of samples to be analyzed.

5.3 EG&G Ortec OMNIGAM™ Gamma Analysis Software.

5.4 EG&G Ortec Model 916A Multichannel Buffer (MCB) systems (2).

5.5 Marinelli beakers, disposable, two and three liter models.

5.6 Petri dishes, various sizes.

- 5.7 Aluminum cans, 8 ounce size,
- 5.8 Aluminum Can Sealer, Dixie Canner Equipment Company, Model Number 23.

6.0 SOFTWARE INSTRUCTIONS

- 6.1 Several data file types and names are created and used in the process of acquiring and analyzing background, calibration, and sample spectrum using OMNIGAM and MAESTRO software. A summary of the file types and naming conventions is listed as follows:

- 6.1.1 .CHN

A MAESTRO™ generated raw spectrum file. The name for the sample spectrum file is assigned by the analyst prior to spectrum acquisition. The filename is limited to eight characters and should include reference to the sample name and field group associated with the sample.

- 6.1.2 .CLB

A calibration file which contains curve equations relating energy to channel, peak resolution to channel, and efficiency to peak energy. File is created in OMNIGAM™ prior to sample analysis. The file is assigned a name by the analyst performing the calibration and should include reference to the matrix and configuration of the calibration source. For example, a calibration of a 1.0 liter water source could be named 1LWATER.CLB.

NOTE: The parameter filename (6.1.6) and the calibration filename must have the same file name, except for the extension for analyses to be completed properly.

- 6.1.3 .LIB

A library file created in OMNIGAM™ prior to spectrum analysis. The name for the file is limited to eight characters and should include reference to the calibration file (if it is for calibration purposes) or the field group of the samples to be analyzed (if it is for sample or background analysis) .

- 6.1.4 .PBC

A matrix specific background correction file created using a background spectrum and matrix specific calibration files. The file is created using a program called PBCTABLE™ prior to sample spectrum analysis. The name

for the table created is limited to eight characters and should make reference to the matrix and the date on which the background spectrum was acquired. For example, a background spectrum which was collected on April 1, 1994 to be analyzed in conjunction with soil samples could be assigned a name of SBKG0401.PBC.

6.1.5 .SPC

A spectrum file (.CHN) which has been converted to a format which is usable by the OMNIGAM™ program. The conversion file will automatically be assigned the same name as the raw spectrum which was converted, except with the .SPC extension.

6.1.6 .PRM

An analysis parameter file created in OMNIGAM™ during spectrum analysis. The parameter filename is limited to eight characters and should make reference to the MCB number of the detector which was used and the sample matrix to be analyzed. For example, if the detector located at MCB number 1 was used for the analysis of 1.0 liter soil samples, then the parameter file could be named 001ONEL.PRM. **NOTE: The parameter filename and the calibration filename (6.1.2) must have the same file name, except for the extension for analyses to be completed properly.**

6.1.7 .RPT

A formatted report file created by OMNIGAM™ during spectrum analysis. The report file is automatically assigned the name of the spectrum file (.SPC) which was analyzed, except for the .RPT extension.

6.1.8 .UFO

An unformatted results file created by OMNIGAM™ prior during spectrum analysis. The unformatted output file is automatically assigned the name of the spectrum file (.SPC) which was analyzed, except for the .UFO extension.

6.2 Libraries for calibration, background correction, and sample spectrum analysis should be created as follows:

6.2.1 At the C:\ prompt type **START** and press return.

6.2.2 Choose **GO TO OPERATION MENU** from the options specified. Select **Build Gamma-Ray Libraries for OMNIGAM** from the options listed. Create a library of isotopes for the calibration source being used as follows:

- 6.2.2.1 Select **Create a new library** from the options given and press return. Enter a name for the new library and press return. The library name entered will automatically be assigned an extension of .LIB.
- 6.2.2.2 Enter the desired number of radionuclides and the number of peaks per nuclide for the library. For calibration purposes, refer to the manufacturer's standard source data sheet for isotope information. For sample analysis, the number of peaks per nuclide is limited to seven for practical purposes. Press F10 to be returned to the Gamma-Ray Librarian main menu.
- 6.2.2.3 Select **Transfer nuclides from one library to another**. Enter the name of the library being created and press return. Enter the name of the library to transfer radioisotope data from and press return.
- Note: Generally, initial creation of a library involves the selection of radioisotopes and peak data from a large 'MASTER' library which contains peak energies, percent abundances, and half-lives for the isotopes of interest. The MASTER library currently being used in this system is labeled as "ESMASTER. LIB."**
- 6.2.2.4 Enter the maximum number of peaks per nuclide to transfer and press return. When all entries have been completed, press F10. The Master library specified will be displayed.
- 6.2.2.5 Select radioisotopes to include in the library by toggling to the isotope with the arrow keys. Select the highlighted isotope by pressing 'Y' (for Yes) under the **TRANSFER** header and press return. Enter '0' as the nuclide position in the library and press return. Repeat the selection process until all desired isotopes have been entered into the new library. Press F10 to save the new library and return to the library main menu.
- 6.2.2.6 Select **Change nuclide values and change, insert, or delete peaks**. Type in the library file name and the isotope content of the library will be displayed. To observe the peak data for a radioisotope of interest, toggle to the isotope with the arrow keys and press return. Toggle to the **nuclide uncertainty** header by pressing the return key and type in the nuclide

uncertainty specified on the manufacturer's standard data sheet.

- 6.2.2.7 Press F10 to observe the peaks included for the isotope of interest. Delete the peaks which are not desired for calibration or analysis by toggling to the peak number with the return key and press the delete key until the peak number is removed.

Note: For calibration purposes, the peaks to include are detailed in the manufacturer's standard source data sheet. For sample analysis purposes, the seven most abundant peaks are included.

- 6.2.2.8 Repeat the peak deletion process until only the desired peaks remain. Press F10 to return to the library radioisotope content display menu. Repeat the isotope selection and peak deletion process until only the desired peaks remain in the library. Press F10 to save the library when completed.

- 6.2.2.9 From the library main menu, select **Sort the Library** and press return. The library will be sorted by gamma-peak energy and saved.

7.0 SAMPLE PREPARATION

7.1 Waters

7.1.1 1.0 liter volume

Measure 1.0 liter of a previously acidified water sample (HNO_3 to $\text{pH} < 2$) to a labeled, disposable two liter Marinelli beaker. Place the accompanying lid on the beaker, seal and record the sample number on the lid. Record the analyst name, sample name, and sample volume in the Gamma Spectroscopy Sample Preparation Logbook.

7.1.2 3.0 liter volume

Measure 3.0 liter of a previously acidified water sample (HNO_3 to $\text{pH} < 2$) to a labeled, disposable three liter Marinelli beaker. Place the accompanying lid on the beaker, seal and record the sample number on the lid. Record the analyst name, sample name, and sample volume in the Gamma Spectroscopy Sample Preparation Logbook.

7.2 Soils

- 7.2.1 Obtain the soil sample which has been previously dried and ground as detailed in SOP-GLM1234-013.
- 7.2.2 Obtain an eight ounce aluminum can with lid and record the sample name on the outside can surface and top of lid. Obtain a tare weight for the empty can/lid combination and record the weight in the gamma spectroscopy soil preparation logbook.
- 7.2.3 Transfer the soil sample through a funnel until the soil nearly reaches the top of the can. Place the lid on the can top and tamp the can on a benchtop to compact the soil. Repeat the filling and tamping process until the soil reaches an even level when the lid is placed on top of the can.
- 7.2.4 Seal the can with the can sealer by positioning the lid on top of the can and placing the can/lid combination on the sealer base plate. Firmly secure the can in the sealer by pressing the can lever fully downward thus clamping the can tightly against the chuck. When the can is firmly seated attach the lid to the can by turning the rotating arm of the sealer 20 times. Remove the can from the sealer by releasing the can lever. Remove the can and store until time for sample analysis.

7.3 Vegetation

- 7.3.1 At present, vegetation samples are received in a dried, ground form. Prepare vegetation samples for analysis by following steps 7.2.2 through 7.2.4 as for soil sample preparation.

7.4 Filters

- 7.4.1 Filters received for analysis are Whatman Model 934-AH Glass Microfibre filters.
- 7.4.2 Record the sample name on a petri dish lid using a Sharpee marker.
- 7.4.3 Using tweezers, carefully remove the filters from sample packaging. Invert the top of a large (4.5-5.0 inch diameter) petri dish and lay the filter sample flat, inside the lip of the dish top. Place the bottom of the petri dish inside the lip of the dish top to flatten the filter. Compress the filter as tightly as is practical and tape the system together using clear tape.

8.0 INSTRUMENTAL ANALYSIS

8.1 System Calibration

Energy to channel calibrations are performed for each matrix type to be analyzed by counting a standard radioactivity source in the same configuration as the samples to be analyzed for a set period of time and generating a curve relating the peak energies (in keV) to channel position. Efficiency calibrations are generated from the same spectrum by generating a curve relating the observed count rate at different energies versus the known decay rate of the source. Efficiency calibrations are performed annually or following major instrument maintenance or repair. Energy calibrations are performed monthly or following major instrument maintenance or repair. Calibrations are performed as follows:

Note: If performance checks for the instrument have not been made for the day, refer to the instrument SOP, SOP-GLG1234-005, and complete electronic adjustments and performance checks prior to acquiring any spectra for calibration, backgrounds, or sample analysis.

- 8.1.1 Place the calibration source on the endcap of the detector. From the MCA system main menu, select **DISPLAY** and choose **SELECT MCB** from the options given. Enter the MCB number of the detector to be used and press return.
- 8.1.2 From the MCA system menu select **ACQUIRE** and select **PRESET**. Enter a count time of 10,000 seconds and press return. Select **ACQUIRE** from the main menu and choose **START** from the options given. Document the calibration sample name, analyst name, counting date, and counting time in the instrument run logbook.
- 8.1.3 When counting has been completed, select **ACQUIRE** from the main menu and select **COPY MCB TO BUFFER** from the options given.
- 8.1.4 Choose **FILE** from the main menu and choose **SAVE** from the options given. Type in a name for the spectrum to be saved and press return. Type in a description of the sample which was counted and press return. The spectrum file will be saved as the name specified with an extension of **.CHN**.
- 8.1.5 Exit the MCA system. At the DOS prompt, type **START** and press **ENTER** to begin the spectrum calibration process.
- 8.1.6 Create a library for the calibration as outlined in Section 6.2 using radioisotope and gamma-ray energy data supplied by the manufacturer on the standard data sheet.

- 8.1.7 Select **ANALYSIS PARAMETERS** from the main menu. Enter the appropriate Analysis Parameter data for the system calibration as outlined in Attachment D.
- 8.1.8 Press **F10** when Analysis Parameter data entries have been completed.
- 8.1.9 From the main menu select **PERFORM SPECTRUM CONVERSION**. Enter the file name of the calibration spectrum (named in Step 8.1.4). The output filename will be assigned as the spectrum filename with a .SPC extension. Verify that data in the other fields is correct and press **F10**.
- 8.1.10 Select **CALIBRATE THE SYSTEM** from the main menu. Select **ENERGY CALIBRATION** from the options listed. Enter the file name of the calibration spectrum (.CHN file) and press return.
- 8.1.11 Enter the name of the calibration library created in Step 8.1.6.
- 8.1.12 The output filename will be automatically assigned the same filename as the calibration spectrum except with a .SPC extension.
- 8.1.13 Enter 50 as the start channel number and 4000 as the stop channel number.
- 8.1.14 Enter a description for the Energy/Shape calibration. In the calibration description, record the control number for the calibration standard, a description of the matrix and configuration, and the name of the analyst performing the calibration. Press **F10** when data entry has been completed.
- 8.1.15 The results of the energy/shape calibration fit are displayed. Notice the %Diff column for both energy and shape. Large %Diffs should be deleted and not used in the calibration fit. Delete all high (> 8% Diff) peaks and press **F10** when completed.
- 8.1.16 From the Calibration menu select **EFFICIENCY CALIBRATION**. Enter the file name of the calibration spectrum (.SPC file) and press return.
- 8.1.17 Enter the name of the calibration library created in Step 8.1.6.
- 8.1.18 Enter a unique name, including a reference to the matrix type and configuration for the output filename. For example, a three liter water calibration may be entered as 3LWATER. Note an extension of .CLB will be automatically added to the filename entered.
- 8.1.19 Enter 50 as the start channel and 4000 as the stop channel for calibration.

- 8.1.20 Enter a description of the efficiency calibration as detailed for the energy/shape calibration in Step 8.1.14.
- 8.1.21 Enter the overall source uncertainty from the calibration source data sheet. When all selections are correct press **F10**.
- 8.1.22 Enter the date and time as the reference date and time from the calibration source data sheet. If the source activity for each isotope on the calibration source data sheet is listed in Bequerels, enter the Calibration values in the designated field for each radioisotope. If calibration values are listed in gammas/sec enter 1.0 for the bequerels on this screen. When all entries are correct press **F10**.
- 8.1.23 If gammas per second is the desired activity to be input, enter them here. Press **F10** when all entries are correct.
- 8.1.24 Press **F10** again.
- 8.1.25 The shape of the efficiency curve should resemble the example listed as Attachment E of this SOP. Precision in determining efficiency values is enhanced by breaking the continuous curve into two distinct curves. The formation of the two curve system is made by specifying a **knee** value, or a point of separation between the two curves. Knee values are generally in the range of 180.0 keV for germanium spectroscopy systems, however experimentation in selecting numbers is often necessary to achieve the best possible fit. Enter a knee energy value and enter **quadratic** as the curve fit type to be used both above and below the knee value. Selections of types of curve fit are made by depressing the space bar. When all selections are satisfactory, press **F10**.
- 8.1.26 A table of efficiency fit results is now displayed. Observe the %Diff values and delete any peaks with a %Diff of greater than 5%. Press **F10** when data is satisfactory. Select **Save this calibration and return to the calibration menu** from the options offered and press **F10**.
- 8.1.27 To transfer the efficiency calibration to the calibration spectrum, select **Transfer efficiency calibration from file to file** and press **F10**.
- 8.1.28 Enter the name of the .CLB file created in Step 8.1.18 as the input filename. Enter the name of the .SPC file created in Step 8.1.6 and press **F10**. The calibration is now completed.
- 8.1.29 Return to the main menu by selecting **Exit to system**.

8.2 Background Counting

Interferences from background radiation (from shielding and cosmic radiation) are determined through weekly counting of the empty detector system.

Note: If performance checks for the instrument have not been made for the day, refer to the instrument SOP, SOP-GLG1234-005, and complete electronic adjustments and performance checks prior to acquiring any spectra for calibration, backgrounds, or sample analysis.

When the instrument is determined to be in control, background counts are performed as follows:

- 8.2.1 Remove all materials from the detector system. Set the **PRESET** for the MCA system for 86,400 seconds (one day) and begin acquisition of the background spectrum. Document the sample name, analyst name, counting date, and counting time in the instrument run logbook.
- 8.2.2 When counting has been completed, select **ACQUIRE** from the main menu and select **COPY MCB TO BUFFER** from the options given.
- 8.2.3 Choose **FILE** from the main menu and choose **SAVE** from the options given. Type in a name for the background spectrum to be saved and press return. Type in a description of the background counting process and press return.
- 8.2.4 Perform Peak Background Correction (PBC) analysis as follows:
 - 8.2.4.1 Exit the MCA system. At the DOS prompt, enter **START** and press enter to begin the spectrum analysis process.
 - 8.2.4.2 Choose **GO TO OPERATION MENU** from the options given and select **ANALYSIS PARAMETERS** from the main analysis menu. Enter background analysis parameter data as detailed in Attachment F.
 - 8.2.4.3 When all Analysis Parameter data has been entered, press F10 to save the parameter file.
 - 8.2.4.4 From the main menu select **PERFORM SPECTRUM CONVERSION**. Enter the file name of the background spectrum (named in Step 8.2.3) and the name for the conversion file to be created (same name as spectrum file named in 8.2.3 except with a .SPC extension). Verify that data in the other fields is correct and press **RETURN**.

- 8.2.4.5 From the main menu select **ANALYZE A SPECTRUM USING OMNIGAM**. Type in the name of the background spectrum which was converted in step 8.2.4.4 and press return. Verify that all data field entries are correct and press F10. The background spectrum analysis will be performed, a file copy of an analysis report will be generated, and the main menu will reappear.
- 8.2.4.6 Exit the OMNIGAM main menu.
- 8.2.4.7 At the C:\USER prompt, type **PBCTABLE**. Select **CREATE A PBC TABLE FROM A UFO FILE** from the options listed. Under the "Table File Name" heading, enter the name of the peak background table to be created (generally, the name of the background spectrum named in Step 8.2.3 without an extension is entered). Under the "Input File Name" heading, enter the same file name with a .UFO extension. Press F10 when data entry is completed.
- 8.2.4.8 The Peak Background Correction Table is automatically saved as the name specified in Step 8.2.3 with an extension of .PBC. Use the PBC table in sample analysis as detailed in Section 8.3.

8.3 Sample Counting

Note: If performance checks for the instrument have not been made for the day, refer to the instrument SOP, SOP-GLG1234-005, and complete electronic adjustments and performance checks prior to acquiring any spectra for calibration, backgrounds, or sample analysis.

Then the instrument is determined to be in control, sample analysis are performed as follows:

- 8.3.1 Place the sample on the endcap of the detector. From the MCA system main menu, select **DISPLAY** and choose **SELECT MCB** from the options given. Enter the MCB number of the detector to be used and press return.
- 8.3.2 From the MCA system menu select **ACQUIRE** and select **PRESET**. Enter a count time of 10,000 seconds and press return. Select **ACQUIRE** from the main menu and choose **START** from the options given. Document the sample name, analyst name, counting date, and counting time in the instrument run logbook.
- 8.3.3 When counting has been completed, select **ACQUIRE** from the main menu and select **COPY MCB TO BUFFER** from the options given.

- 8.3.4 Choose **FILE** from the main menu and choose **SAVE** from the options given. Type in a name for the spectrum to be saved and press return. Type in a description of the sample which was counted and press return.
- 8.3.5 Repeat the process detailed above until all samples have been counted. Exit the MCA system.
- 8.3.6 At the DOS prompt enter **START** to begin the analysis program. Choose **GO TO OPERATION MENU** from the options given and select **ANALYSIS PARAMETERS** from the main analysis menu. Enter sample specific analysis parameter data as detailed in Attachment G.
- 8.3.7 When all Analysis Parameter data has been entered, press **F10** to save the parameter file.
- 8.3.8 From the main menu select **PERFORM SPECTRUM CONVERSION**. Enter the file name of the sample spectrum (named in Step 8.3.4) and the name for the conversion file to be created (same name as spectrum file named in 8.3.4 except with a .SPC extension). Verify that data in the other fields is correct and press **F10**.
- 8.3.9 From the main menu select **ANALYZE A SPECTRUM USING OMNIGAM**. Type in the name of the sample spectrum which was converted in step 8.3.8 and press return. Verify that all data field entries are correct and press **F10**. The sample spectrum analysis will be performed, a file copy of an analysis report will be generated, and the main menu will reappear.
- 8.3.10 Obtain a printout of the report file by exiting the Analysis system. At the DOS prompt type **PRINT FILENAME.RPT** and obtain the system printout from the printer.

9.0 QUANTITATION LIMITS

9.1 Quantitation limits for gamma spectroscopy measurements are performed as follows:

9.1.1 Prepare a suitable blank material in the desired configuration as detailed in Section 7.0 using the following materials:

9.1.1.1 For water samples use either 1.0 or 3.0 L of 0.5 M HCl, depending on the volume of sample being analyzed.

9.1.1.2 For soil samples use blank standard soil.

- 9.1.1.3 For filter samples use Whatman Model 934-AH Glass Microfibre filters.
- 9.1.2 Count the blank matrix for at least 86,400 seconds and analyze the spectrum as detailed in Section 8.3. The library to be used for blank matrix analysis should be created as detailed in Section 6.2 and should include only the most abundant peak of all of the radionuclides for which quantitation limits are to be determined.
- 9.1.3 Obtain a printout of the analysis report as specified in Step 8.3.10.
- 9.1.4 Calculate quantitation limits as follows:

$$\text{Quantitation Limit (pCi)} = \frac{(4.65) \times (\sigma_B) + 2.71}{(T)(P)(E)(2.22)}$$

where: σ_B = standard deviation of the counts of an appropriate matrix blank. The standard deviation is calculated by taking the square root of the background counts from the analysis report for the radioisotope of interest,

T = counting time in minutes,

P = percent abundance for the gamma-ray peak used for quantitation,

E = efficiency (matrix specific) at the energy of the gamma peak used for quantitation, calculated by the analyst from the efficiency curve formula, and

2.22 = conversion factor from disintegrations per minute (dpm) to picocuries.

- 9.1.5 Concentration units for quantitation limits can be obtained by dividing the quantitation limit in pCi by the volume or mass of sample which is ordinarily analyzed.

10.0 CALCULATIONS

10.1 The activity of radioisotopes are calculated as follows:

$$A(\text{pCi}) = \frac{(N)(D)}{(T)(E)(2.22)(P)} - B$$

- where:
- A = Activity in pCi of the radionuclide of interest,
 - N = Net counts in peak of interest,
 - D = factor representing the decay of radionuclide of interest since the collection time,
 - T = counting time in minutes,
 - E = efficiency factor for the gamma peak of interest,
 - 2.22 = conversion factor from dpm to pCi,
 - P = fractional percent abundance of the gamma peak of interest, and
 - B = activity of radioisotope present in the background.

Note: The concentration of a radionuclide in a material is determined by dividing the activity in pCi by the mass or volume of sample which was analyzed.

10.2 The total uncertainty value is calculated as follows:

$$\sigma_t = (\sum \sigma_{r(t)} + 1/3 \sum \sigma_{s(t)})^{1/2}$$

where: σ_t = Total uncertainty,

$\sigma_{r(t)}$ = random error, and

$\sigma_{s(t)}$ = systematic error.

Note: The random error is comprised of errors related to counting, random summing, and absorption correction. The systematic error is comprised of errors related to nuclide uncertainty from library, efficiency fitting uncertainty from calibration files, calibration source uncertainty, and geometry correction.

11.0 REFERENCES

- 11.1 EG&G Ortec OMNIGAM™ Basic Gamma-Ray Analysis Software Manual.
- 11.2 EG&G Ortec Multichannel Analysis System Manual.
- 11.3 E.S. Gladney, D.B. Curtis, D.R. Perrin, J.W. Owens, and W.E. Goode, "Nuclear Techniques for the Chemical Analysis of Environmental Materials," Los Alamos Scientific Laboratory report LA-8192-MS(1980).
- 11.4 Environmental Measurements Laboratory US Department of Energy, Health and Safety Laboratory Procedures Manual, HASL-300, Section 4.5.2.3, "Gamma."
- 11.5 Currie, L.A. "Limits for Quantitative Detection and Quantitative Determination" Analytical Chemistry V. 40, No.3 pp. 586-593, 1968.

12.0 ATTACHMENTS

- 12.1 Attachment A - **COMMONLY OCCURRING GAMMA EMITTING RADIOISOTOPES ENCOUNTERED IN NUCLEAR PROCESS MATRIX ANALYSES**
- 12.2 Attachment B - **COMMONLY OCCURRING GAMMA EMITTING RADIOISOTOPES ENCOUNTERED IN ENVIRONMENTAL MATRIX ANALYSES**
- 12.3 Attachment C - **EXAMPLE ENERGY (keV) VERSUS CHANNEL CURVE**
- 12.4 Attachment D - **ANALYSIS PARAMETER FILE ENTRIES FOR SYSTEM CALIBRATION**
- 12.5 Attachment E - **EXAMPLE EFFICIENCY VERSUS ENERGY (keV) CURVE**
- 12.6 Attachment F - **ANALYSIS PARAMETER FILE ENTRIES FOR BACKGROUND SPECTRUM ANALYSIS**
- 12.7 Attachment G - **ANALYSIS PARAMETER FILE ENTRIES FOR SAMPLE ANALYSIS**

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Attachment A

Commonly Occurring Gamma Emitting Radioisotopes
Encountered in Nuclear Process Matrix Analyses

Isotope	Half-life	Energy (keV)	Percent Abundance (%)	Source
I-131	8.04 days	364.48	81.25	Fission
		636.97	7.27	
		284.30	6.06	
		80.18	2.62	
		722.89	1.80	
Xe-131M	11.9 days	163.93	1.96	Neutron Activation
Xe-133M	2.19 days	233.22	10.0	Fission, Neutron Activation
Xe-133	5.243 days	81.00	38.0	Fission, Neutron Activation
Na-22	2.602 years	1274.53	99.94	Cosmic, Neutron Activation
Cr-51	27.7 days	320.08	10.08	Neutron Activation
Mn-54	312.12 days	834.83	99.98	Neutron Activation
Fe-59	44.5 days	1099.25	56.50	Neutron Activation
		1291.60	43.20	
		192.35	3.08	
		142.65	1.02	
Co-57	271.8 days	122.06	85.95	Neutron Activation
		136.47	10.33	
		14.4	9.68	
Co-58	70.82 days	810.77	99.45	Neutron Activation
Co-60	5.271 days	1332.50	99.98	Neutron Activation
		1173.24	99.90	
Zn-65	243.9 days	1115.55	50.75	Neutron Activation
Rb-86	18.63 days	1077.00	8.64	Neutron Activation
Y-91	58.51 days	1204.90	0.30	Fission
Zr-95	64.02 days	756.73	54.50	Fission, Neutron Activation
		724.20	44.15	Fission, Neutron Activation

Attachment A continued

Commonly Occurring Gamma Emitting Radioisotopes
Encountered in Nuclear Process Matrix Analyses

Isotopes	Half-life	Energy (keV)	Percent Abundance (%)	Source
Nb-95	34.97 days	765.78	99.79	daughter Zr-95
Ru-103	39.26 days	497.08	90.90	Fission, Neutron Activation
		610.33	5.73	
Ru/Rh-106	1.02 years	621.92	9.80	Fission
		1050.36	1.53	
Ag-108M	127 years	722.94	90.86	Neutron Activation
		433.94	90.50	
		614.28	89.87	
Ag-110M	249.76 days	657.76	94.64	Neutron Activation
		884.68	72.68	
		937.49	34.36	
		1384.30	24.28	
		763.94	22.29	
Sb-124	60.2 days	1690.98	47.33	Neutron Activation
		722.79	10.76	
		2090.94	5.49	
Sb-125	2.76 years	427.89	29.44	Neutron Activation
		600.56	17.78	
		635.90	11.32	
		463.38	10.45	
		176.33	6.79	
		35.49	6.01	
		606.64	5.02	
		671.41	1.80	
		380.43	1.52	
Te-125M	58 days	109.29	0.28	daughter Sb-125

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Attachment A continued

Commonly Occurring Gamma Emitting Radioisotopes
Encountered in Nuclear Process Matrix Analyses

Isotopes	Half-life	Energy (keV)	Percent Abundance (%)	Source
Te-129M	33.6 days	109.29	0.28	Fission, Neutron Activation
Te-131M	1.25 days	773.68	38.10	Fission, Neutron Activation
		852.23	20.60	
		793.77	13.80	
		1125.47	11.41	
		1206.60	9.74	
		334.28	9.55	
Te-132	3.26 days	228.26	88.20	Fission
		49.82	14.40	
		116.40	1.94	
		111.86	1.85	
Cs-134	2.062 years	604.70	97.56	Neutron Activation
		795.84	85.44	
		569.32	15.43	
		801.93	8.73	
		563.23	8.38	
		1365.15	3.04	
		1167.94	1.80	
		475.35	1.47	
		1038.57	1.00	

Attachment A continued

Commonly Occurring Gamma Emitting Radioisotopes
Encountered in Nuclear Process Matrix Analyses

Isotopes	Half-life	Energy (keV)	Percent Abundance (%)	Source
Cs-136	13.16 days	818.51	99.70	Neutron Activation
		1048.07	79.76	
		340.55	42.17	
		1235.36	20.04	
		273.65	11.07	
		176.60	9.97	
		153.25	5.75	
		86.36	5.18	
		66.88	4.79	
		163.92	3.39	
Cs-137	30 years	661.66	85.21	Fission
Ba-140	12.75 days	537.31	24.39	Fission
		162.67	6.21	
		304.87	4.30	
		423.73	3.12	
La-140	1.678 days	1596.21	95.40	Fission, Neutron Activation
		487.02	44.27	
		815.77	22.90	
		328.76	20.61	
		925.19	6.93	
		867.85	5.59	
		751.64	4.24	
		2521.40	3.42	
		432.49	2.91	
		919.55	2.70	
Ce-141	32.5 days	145.44	48.20	Neutron Activation

Attachment A continued

Commonly Occurring Gamma Emitting Radioisotopes
Encountered in Nuclear Process Matrix Analyses

Isotopes	Half-life	Energy (keV)	Percent Abundance (%)	Source
Ce-144	284.89 days	133.51	11.09	Fission
		80.12	1.36	
Np-239	2.355 days	106.12	22.86	Neutron Activation
		277.60	14.20	
		228.19	10.70	
		209.76	3.32	
		334.31	2.05	
		315.88	1.61	

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Attachment B

Commonly Occurring Gamma Emitting Radioisotopes
Encountered in Environmental Matrix Analyses

Isotopes	Half-life	Energy (keV)	Percent Abundance (%)	Source
Th-234	4.468e+9 years	63.29	4.47	U-238 Chain
		92.38	2.60	
		92.80	2.56	
Pa-234	4.468e+9 years	131.29	20.00	U-238
		883.24	12.00	
		733.22	8.60	
		152.69	6.70	
		698.85	4.60	
		989.65	4.10	
Th-230	75380 years	67.67	0.38	U-238
Ra-226	1600 years	186.10	3.50	U-238
Pb-214	1600 years	351.92	35.80	U-238
		295.21	18.50	
		241.98	7.50	
Bi-214	1600 years	609.13	44.79	U-238
		1764.49	15.36	
		1120.29	14.80	
		1238.11	5.86	
Pb-210	22.3 years	46.52	4.05	U-238
U-235	7.038e+8 years	185.71	57.50	Naturally Abundant
		143.76	10.90	
		163.33	5.00	
		205.31	5.00	
		109.16	1.50	
		202.11	1.00	
Th-231	7.038e+8 years	84.21	6.60	U-235

Attachment B continued

Commonly Occurring Gamma Emitting Radioisotopes
 Encountered in Environmental Matrix Analyses

Isotopes	Half-life	Energy (keV)	Percent Abundance (%)	Source
Pa-231	32760 years	300.02	2.39	U-235
		283.67	1.60	
		302.65	1.60	
		330.06	1.31	
Th-227	32760 years	235.97	11.20	U-235
		256.24	6.70	
		329.84	2.73	
		79.72	2.10	
Ra-223	32760 years	369.39	13.60	U-235
		154.18	5.59	
		323.88	3.90	
		144.18	3.26	
		338.28	2.78	
		444.94	1.27	
		122.31	1.19	
Rn-219	32760 years	271.13	9.90	U-235
		401.70	6.64	
Ac-228	1.405e+10	911.21	26.60	Th-232 Chain
		968.97	16.17	
		338.32	11.25	
		964.77	5.11	
Th-228	1.405e+10 years	84.37	1.27	Th-232 Chain
Ra-224	1.405e+10 years	240.99	3.97	
Pb-212	1.405e+10 years	238.63	43.65	
		300.09	3.34	

Attachment B continued

Commonly Occurring Gamma Emitting Radioisotopes
Encountered in Environmental Matrix Analyses

Isotopes	Half-life	Energy (keV)	Percent Abundance (%)	Source
Bi-212	1.405e+10 years	727.18	6.65	Th-232
		1620.56	1.51	
		785.42	1.11	
Tl-208	1.405e+10 years	2614.53	99.16	Th-232
		583.19	84.48	
		510.77	22.61	
		860.56	12.43	
		277.36	6.31	
		763.13	1.82	
K-40	1.277e+9	1460.83	10.67	Natural Source

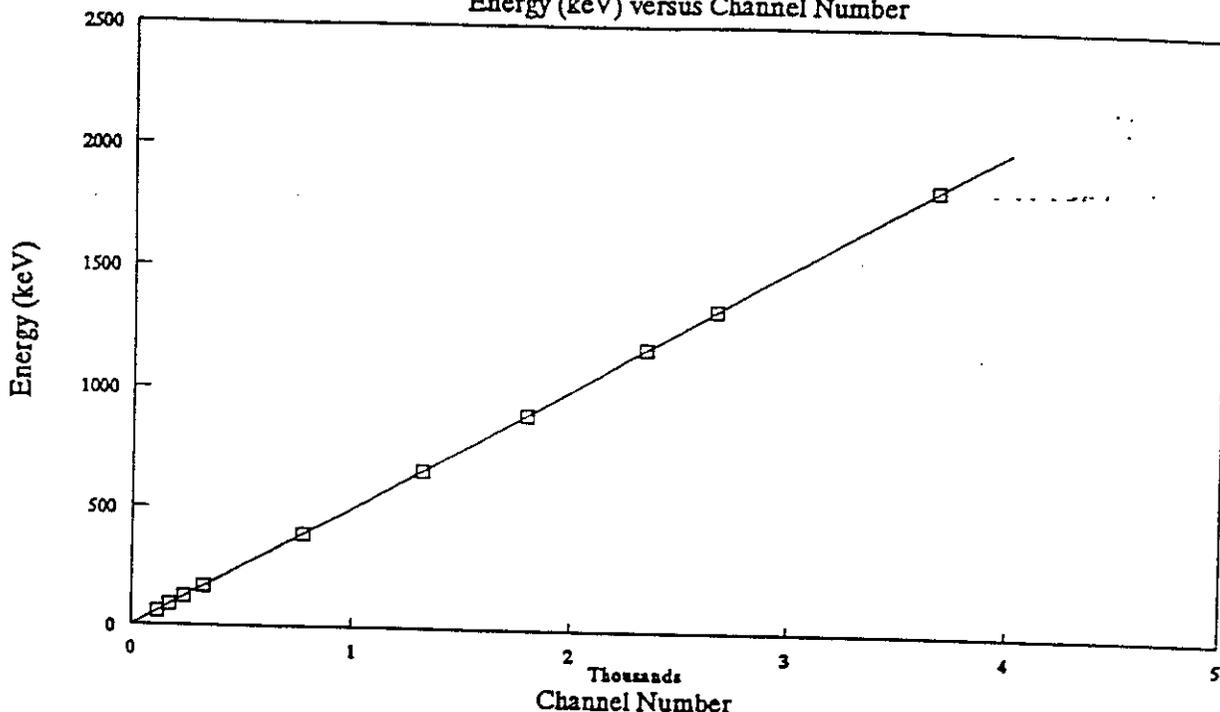
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Attachment C

Example Energy (keV) versus Channel Curve

ENERGY CALIBRATION FIT

Energy (keV) versus Channel Number



$$\text{Energy} = 0.1611 + 0.500080 * \text{Channel} - 8.52454e-008 * \text{Channel} * \text{Channel}$$

Energy Table

Channel	Energy (keV)	Fit (keV)	Delta
118.88	59.54	59.61	-0.12%
175.89	88.04	88.12	-0.09%
243.85	122.07	122.1	-0.02%
331.31	165.85	165.83	0.01%
782.56	391.71	391.45	0.07%
1322.93	661.62	661.58	0.01%
1796.07	898.02	898.06	-0.00%
2346.86	1173.23	1173.31	-0.01%
2665.64	1332.51	1332.59	-0.01%
3673.27	1836.01	1835.94	0.00%

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Attachment D
Analysis Parameter File Entries for System Calibration

<u>MENU OPTION</u>	<u>RESPONSE</u>
MCA	2 or 3 depending on Gamma System used for analysis
SEGMENT	1
OUTPUT FILENAME	Assign a unique name to the parameter file. For example, for a 1.0 liter water calibration, name the parameter file 11WTRCAL.PRM. See Note below.
REPORT TYPE	Isotope Activities, isotope/peak and energy/peak matrices.
ERROR REPORTING TYPE	Total & Counting as Activity.
SIGMA	1
LIBRARY FILENAME	Name of Calibration Library Created in Step 8.1.6.
REPORTING UNITS	Bequerels
MULTIPLIER	1.00
DIVISOR	1.00
DECAY CORRECTION	N
BACKGROUND IS THE	Best Method (Based on Spectrum).
PBC CORRECTION	No
RANDOM SUMMING	No
ABSORPTION CORRECTION	No
GEOMETRY CORRECTION	No
MDA TYPE	Currie Limit
DECAY DURING ACQUISITION	N
LIBRARY BASED PEAK STRIPPING	No

Note: Calibration files and parameter files must have the same filename (excluding extension) for proper spectrum analysis to take place.

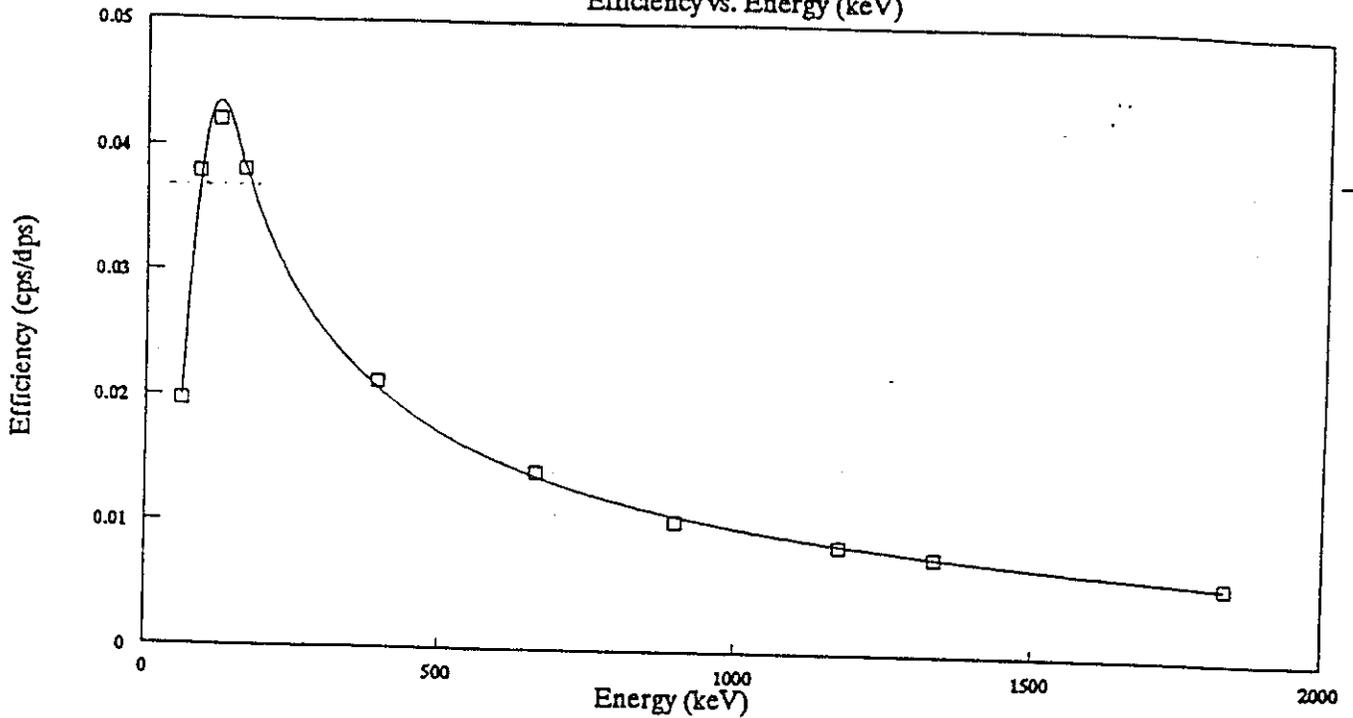
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Attachment E

Example Efficiency versus Energy (keV) Curve

Efficiency Calibration Fit

Efficiency vs. Energy (keV)



Efficiency Calibration Fit

Knee Energy = 165.00 keV

Above the Knee: Quadratic

$$\text{LOG(Eff)} = -0.9149 - 0.238964 \cdot \text{LOG(Eng)} - 0.0429704 \cdot (\text{LOG(Eng)})^{**2}$$

Below the Knee: Quadratic

$$\text{LOG(Eff)} = -37.9575 + 14.478503 \cdot \text{LOG(Eng)} - 1.50499 \cdot (\text{LOG(Eng)})^{**2}$$

Efficiency Table

Energy	Effic.	Fit	Delta
59.67	0.019713	0.019870	-0.80%
88.17	0.037933	0.036874	+2.79%
122.18	0.042102	0.043478	-3.27%
165.00	=====KNEE=====		
165.68	0.038106	0.038461	-0.93%
391.67	0.021260	0.020789	+2.22%
661.62	0.014181	0.013850	+2.33%
898.03	0.010358	0.010813	-4.39%
1173.38	0.008545	0.008649	-1.22%
1332.77	0.007754	0.007760	-0.08%
1835.81	0.005985	0.005871	+1.90%

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Attachment F
Analysis Parameter File Entries for Background Spectrum Analysis

<u>MENU OPTION</u>	<u>RESPONSE</u>
MCA	2 or 3 depending on Gamma System used for analysis
SEGMENT	1
OUTPUT FILENAME	Assign the name of the calibration file to be used for determining the background radioisotope contribution. For example, if a peak background correction table is to be created for soil analysis, name the parameter file SOIL.PRM.
REPORT TYPE	Isotope Activities, isotope/peak and energy/peak matrices.
ERROR REPORTING TYPE	Total & Counting as Activity.
SIGMA	1
LIBRARY FILENAME	Create a library of radioisotopes suspected to be contained in the background spectrum as detailed in Section 6.2.
REPORTING UNITS	Bequerels
MULTIPLIER	1.00
DIVISOR	1.00
DECAY CORRECTION	N
BACKGROUND IS THE	Best Method (Based on Spectrum).
PBC CORRECTION	No
RANDOM SUMMING	No
ABSORPTION CORRECTION	No
GEOMETRY CORRECTION	No
MDA TYPE	Currie Limit
DECAY DURING ACQUISITION	No
LIBRARY BASED PEAK STRIPPING	No

Note: Calibration files and parameter files must have the same filename (excluding extension) for proper spectrum analysis to take place.

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Attachment G
Analysis Parameter File Entries for Sample Analysis

<u>MENU OPTION</u>	<u>RESPONSE</u>
MCA	2 or 3 depending on Gamma System used for analysis
SEGMENT	1
OUTPUT FILENAME	Assign a unique name to the parameter file. The filename should contain reference to the type of matrix and configuration being analyzed. For example, 1.0 liter water samples contained in Marinelli beakers could be named 1LWTRMAR.PRM.
REPORT TYPE	Isotope Activities, isotope/peak and energy/peak matrices.
ERROR REPORTING TYPE	Total & Counting as Activity.
SIGMA	1
LIBRARY FILENAME	Name of Sample Analysis Library Created as detailed in Section 6.2.
REPORTING UNITS	Bequerels ¹
MULTIPLIER	1.00 ¹
DIVISOR	1.00 ¹
DECAY CORRECTION	Yes. Enter the collection date and time for sample being analyzed.
BACKGROUND IS THE	Best Method (Based on Spectrum).
PBC CORRECTION	Yes. Enter the name of the matrix specific PBC table generated in Step 8.2.4.7.
RANDOM SUMMING	No
ABSORPTION CORRECTION	No
GEOMETRY CORRECTION	No
MDA TYPE	Currie Limit
DECAY DURING ACQUISITION	N
LIBRARY BASED PEAK STRIPPING	No

Note: Calibration files and parameter files must have the same filename (excluding extension) for proper spectrum analysis to take place. ~~IS SUBJECT TO THE RESTRICTIONS NOTED IN THE~~

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DO NOT DUPLICATE~~

Attachment G continued...

Analysis Parameter File Entries for Sample Analysis

Units of activity for sample analysis are generally specified by the client or internal policies prior to sample counting. The predominant unit of activity for environmental measurements is the Becquerel (Bq), defined as one decay per second. Another unit of activity which is commonly used is the picocurie (pCi), which is defined as 2.22 decays per minute. Conversion from Bq to pCi can be made by dividing the number of Bqs present by 0.037. Conversion from pCi to Bq can be made by multiplying the number of pCi's found by 0.037. The OMNIGAM system defaults to Bq for reporting and if other units are desired, the proper Multiplier and Divider must be entered to achieve the desired units. If total Bequerels for reporting is required, the Multiplier and Divider should be set to 1.00. If units of pCi are desired set the multiplier at 1.00 and the divider at 0.037. Also, the Multiplier and Divider values entered by the user can be manipulated to incorporate units of concentration to be calculated. For example, if units of pCi/Kg are required for reporting for soil analyses, the Multiplier should be set at 1.00 and the Divider should be set at a value corresponding to the product of 0.037 (to convert from Bq to pCi) and the mass of sample analyzed (in Kg).