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POST REMEDIAL ACTION REPORT FOR BUILDING 432 (PROOF SAMPLER), STRUCTURE 427 (IMHOFF TANK), AND PROCESS SEWER LINE

Weldon Spring Site Remedial Action Project
Weldon Spring, Missouri

JULY 1996 **REV. 0**

U.S. Department of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

Prepared by MK-Ferguson Company and Jacobs Engineering Group

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APPROVALS

Department Manager — Date 7/8/96

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Weldon Spring Site Remedial Action Project

Post Remedial Action Report for Building 432 (Proof Sampler), Structure 427 (Imhoff Tank), and Process Sewer Line

Revision 0

July 1996

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and
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for the

U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations Office
Under Contract DE-AC05-86OR21548

ABSTRACT

Building 432 (Proof sampler), Structure 427 (Imhoff Tank), and associated process sewer line were located on the southern side of the chemical plant site. The process sewer pipe extended off site approximately 350 ft, discharging into a drainage way that flows to the Missouri River. These structures handled chemical and radiological process waste. With the exception of approximately 80 ft of process sewer line that remains in place, all of these items were dismantled, removed, and placed on site in temporary storage for later placement in the disposal cell. The section of process sewer pipe that remains lies beneath the Department of Army training facility access road and two active water mains that supply portions of St. Charles County, Missouri.

This report discusses the radiological and chemical survey methods and results that justify the unrestricted release of the remaining portion of the process sewer line and the remediated area. Following remediation of the areas of concern, all post-remedial action soil samples indicated concentrations below the cleanup criteria contained in the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* and the guidelines for residual radioactivity established by DOE Order 5400.5.

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1 INTRODUCTION

1.1 Scope

The Weldon Spring Remedial Action Project conducted a remedial action of Building 432 (proof sampler), Structure 427 (Imhoff Tank) and associated process sewer pipe line extending off-site during May through July 1994.

This report includes the survey and sampling methods, the characterization results, the excavation control results, and the post-remedial action results for Building 432 (proof sampler), Structure 427 (Imhoff tank), and a section of process sewer pipe line that originated near the Imhoff tank and extended southward off site approximately 350 ft. In addition, this report includes the survey and representative sample results for approximately 80 ft of the process sewer pipe that remains under two active water mains that supply portions of St. Charles County, Missouri. The structures are shown on Figure 1-1.

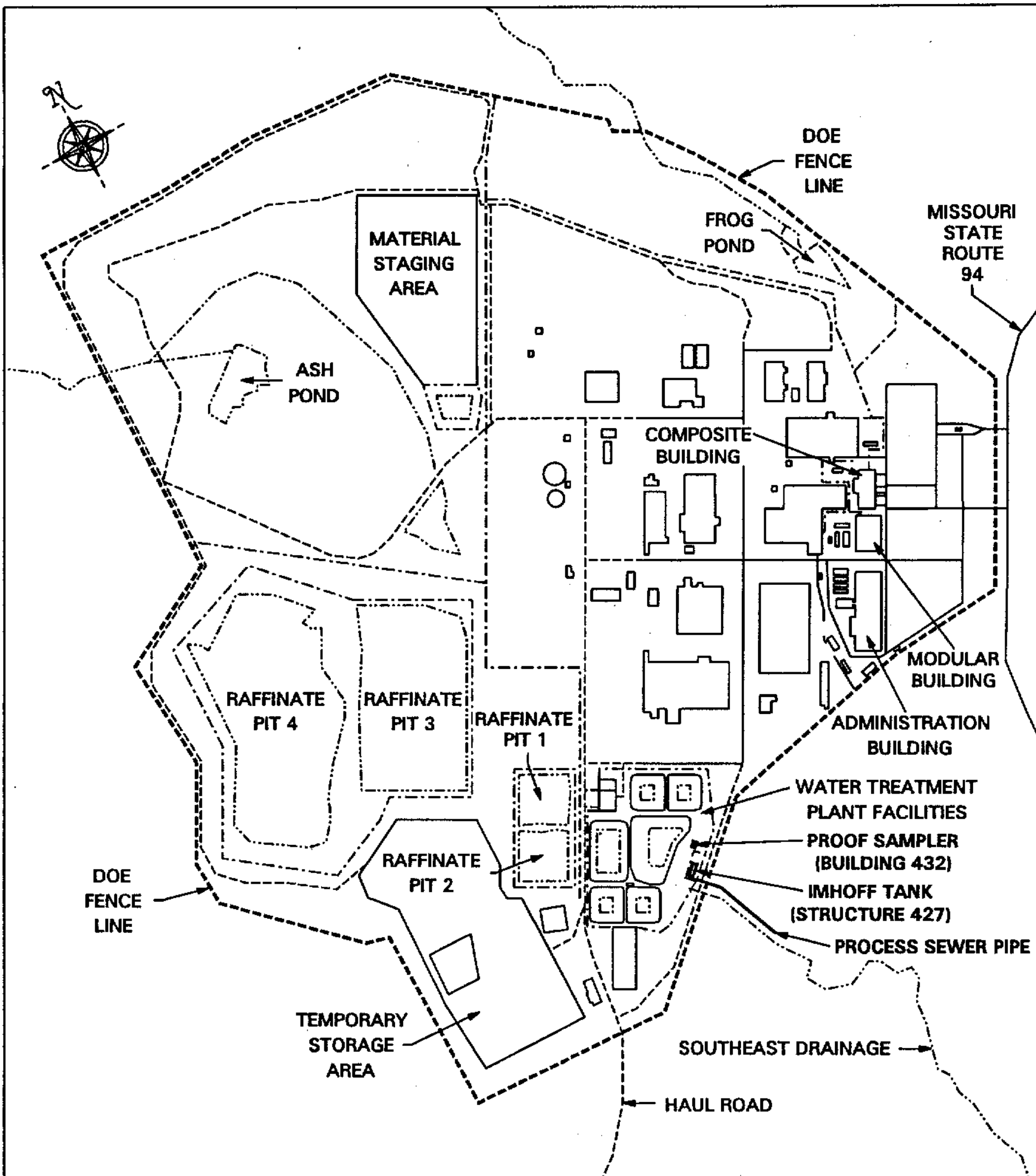
1.2 Purpose

The purpose of this report is to detail the radiological and chemical survey methods and to present the post remedial action survey and analytical results for Building 432, Structure 427, and associated process sewer pipeline in order to verify the effectiveness of the remediation.

1.3 Summary

Based on the soil sample and survey results, Building 432 (proof sampler), Structure 427 (Imhoff Tank), and the process sewer excavation areas may be released for unrestricted use. Results of soil samples and walk-over surveys indicated that the areas are below the U.S. Department of Energy (DOE) guidelines for residual radioactive materials in soil and the site specific radiological and chemical cleanup criteria as specified in the *Record of Decision for the Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (ROD) (Ref. 2).

A section of process sewer that lies below two active water mains that supply portions of St. Charles County, Missouri and the Army property access road was not removed. To safely



THE WELDON SPRING
CHEMICAL PLANT SITE

FIGURE 1-1

REPORT NO.: DOE/OR/21548-564		EXHIBIT NO.: A/CP/069/1195	
ORIGINATOR: DR	DRAWN BY: GLN	DATE: 7/2/96	

remove this section of process sewer would require shutting off both mains and supporting them during process sewer removal. According to the utility company, both the water mains cannot be shut off concurrently.

To determine if the process sewer had leaked, soil samples that represent the floor of the original excavation were collected both upstream and downstream of the unexcavated section. These samples were collected because, had the process sewer leaked, the original pipe excavation would act as a conduit, resulting in significant soil contamination downstream of the leak. The soil samples collected in the adjacent areas both upstream and downstream of the unexcavated section indicated no contamination above the cleanup criteria. These results, as well as all the confirmation sample results, indicate that the process sewer waste stream did not contaminate, above the cleanup criteria, the soils surrounding the process sewer. Core samples of the concrete sewer pipe were also collected. These samples represented the total thickness of the pipe and were collect at both ends of the unexcavated section of pipe. Analysis indicated that the pipe is below the cleanup criteria. To prevent use of the sewer pipe in the future, the pipe is scheduled to be filled with grout.

1.4 Site History

In April 1941, the U.S. Department of the Army acquired about 17,000 acres of land in St. Charles County, Missouri to construct the Weldon Spring Ordnance Works - a production facility for trinitrotoluene (TNT) and dinitrotoluene (DNT) explosives. The facility began operations in 1941 and closed in 1946. By 1949, all but about 2,000 acres of the ordnance works property had been transferred to the State of Missouri and the University of Missouri for use as a wildlife area and agricultural land. Except for several small parcels transferred to St. Charles County, the remaining property became the chemical plant area of the Weldon Spring site and the adjacent U.S. Department of Army Reserve Training Area.

In May 1955, the U.S. Atomic Energy Commission (AEC), predecessor of the U.S. Department of Energy (DOE), acquired 205 acres of the property from the Army for construction of a uranium feed materials plant. An additional 15 acres was later transferred to the AEC for expansion of waste storage capacity. Uranium ore concentrates were processed at the plant from 1957 to 1966. Thorium ore concentrates were processed at the plant from 1964 to 1966.

Plant operations generated several chemical and radioactive waste streams, including raffinates from the refinery operation and washed slag from the uranium recovery process. Waste slurries were piped to the raffinate pits, where the solids settled to the bottom and the supernatant liquids were decanted to the plant process sewer. This sewer drained off site to the Missouri River via the Southeast Drainage. Some solid waste was also disposed of on site during the plant's operational period. The quarry, which had been used by the Army since the early 1940s to dispose of chemically contaminated waste, was transferred to the AEC in July 1960. Radioactively contaminated wastes such as uranium and thorium residues, building rubble, and process equipment were disposed of in the quarry through 1969.

The Army reacquired the chemical plant property in 1967 and began decontamination and dismantling operations to prepare the facility for herbicide production. Much of the resultant debris was placed in the quarry; a small amount was also placed in Raffinate Pit 4. The project was canceled in 1969 prior to any herbicide production, and the plant has remained essentially unused and in caretaker status since that time. The Army returned the raffinate pits portion of the chemical plant area to the AEC in 1971. The remainder of the property was transferred to the DOE in 1985. Prior to that transfer, the Army conducted building repair and additional decontamination activities in 1984. The DOE established a project office at the site in 1986 to support cleanup activities, and several interim response actions have been developed and implemented since that time.

The U.S. Environmental Protection Agency (EPA) listed the quarry on the National Priorities List (NPL) in 1987, and the chemical plant area was added to this listing in 1989. The balance of the former Weldon Spring Ordnance Works property, which is adjacent to the DOE portion of the property and for which the Army has responsibility, was added to the NPL as a separate listing in 1990.

The *Record of Decision for the Management of the Bulk Wastes at the Weldon Spring Quarry* (Ref. 1) was approved for management of the quarry bulk wastes in 1990. The selected remedy entailed removal of the bulk wastes from the quarry, transportation along a dedicated haul road to the chemical plant area, and interim storage in the temporary storage area south of the raffinate pits.

The *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (Ref. 2) was approved for management of chemical plant and quarry wastes in 1993. The selected remedy involves emplacement of wastes in an on-site engineered disposal facility.

1.5 Description of Remediation Area

Following is a brief description of the removed structures. For a more complete description of the buildings and their use, see the *Project History and Completion Report* published in October of 1960 (Ref. 3).

Structure 427 (Imhoff Tank) was designed as the primary sanitary sewage treatment plant for the chemical plant. It was sized to handle sewage wastes for approximately 1,300 persons per day. The primary equipment included an Imhoff tank, comminutor and bar screen structure, and sump. The walls and floor of the Imhoff Tank were approximately 18 in. thick with an overall dimension of approximately 55 ft x 21 ft x 26 ft. The Imhoff Tank extended approximately 25 ft below-grade and contacted bedrock. Just prior to entering the Imhoff Tank, the sanitary sewer pipe had a by-pass connection to the process sewer. Also, the Imhoff tank was equipped with an overflow pipe that connected to the process sewer.

Building 432 (the proof sampler) was primarily a below-grade structure and flume covered by an aboveground prefabricated building that was used as a sampling station for the process waste streams. The building had an area of 144 sq ft and a volume of 2,016 cu ft. The below-grade structure was 12 ft x 12 ft x 13 ft deep.

The process sewers were used to handle large quantities of manufacturing wastes containing chemicals and radioactive materials highly diluted with water. The process sewer system carried the wastes from the various process buildings to the southeast drainage that flows to the Missouri River.

The process sewer left the chemical plant site southeast of the Imhoff tank crossing under the chemical plant patrol road, chemical plant property fence, two active water mains, the Army property paved access road, and connected to a reinforced-concrete manhole approximately 140 ft east and 20 ft south from the southeast corner of the Imhoff tank. From the Army property manhole, the process sewer then continued to the southeast, generally following the

Southeast Drainage, crossing under an abandoned railroad spur embankment and ultimately discharging approximately 135 ft southeast of the railroad embankment to the Southeast Drainage.

The piping consists of approximately 500 ft of 24-in. diameter 3 in. thick reinforced-concrete belled-end pipe. Depth of pipe varies from approximately 8 ft at the property fence to daylighting at the outfall of the process sewer. The maximum depth was at the railroad embankment, where the process sewer pipe was approximately 14 ft below the finish grade of the railroad embankment.

2 GUIDELINES AND SURVEY PROCEDURES

2.1 U.S. Department of Energy/Weldon Spring Site Remedial Action Project Guidelines for Residual Radioactive Material and Chemical Contamination

2.1.1 Soils Cleanup Guidelines

The Weldon Spring Site Remedial Action Project (WSSRAP) used U.S. Department of Energy (DOE) Order 5400.5, *Radiation Protection of the Public and Environment*, as the basis for residual concentrations of radioactive material in soil. In addition, as low as reasonably achievable (ALARA) goals for soils, which are more conservative than the DOE Order 5400.5 generic guidelines for thorium and radium, were applied as specified in the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (ROD) (Ref. 2). Table 2-1 summarizes the DOE Order 5400.5 guidelines for soils and ALARA goals applied to the Weldon Spring Chemical Plant (WSCP) area. Because U-238 soil cleanup criteria are not listed in DOE Order 5400.5, site-specific risk-based values were developed for the WSCP and are listed in the table. The ALARA goals listed in Table 2-1 apply to both surface and subsurface contamination. Residual concentrations of radioactive material in soil are defined as those in excess of background concentrations averaged over an area of 100 m^2. Values listed in Table 2-1 include background levels. The maximum allowable "hot spot" is defined by the following:

$$\text{Maximum concentration} = \text{cleanup criteria} * (100/A)^{1/2}$$

Where A is the area of the "hot spot" in square meters.

Cleanup standards for chemical contamination in surface and subsurface soils at the WSSRAP are identified in the ROD (Ref. 2) and are summarized in Table 2-1. The chemical contaminants of concern for the WSSRAP include arsenic, total chromium, hexavalent chromium, lead, thallium, polynuclear aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), and trinitrotoluene (TNT). ALARA goals are also included for chemical constituents as summarized in Table 2-1.

TABLE 2-1 Soils Cleanup Criteria and ALARA Goals for Remedial Actions at the WSSRAP[a]

CONTAMINANT/CRITERION	SOIL CONCENTRATION[b]
Ra-226[c]	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	6.2
• Subsurface (>6 in. depth)	16.2
ALARA Goal[d]	5
Ra-228[c]	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	6.2
• Subsurface (>6 in. depth)	16.2
ALARA Goal[d]	5
Th-230	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	6.2
• Subsurface (>6 in. depth)	16.2
ALARA Goal[d]	5
Th-232	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	6.2
• Subsurface (>6 in. depth)	16.2
ALARA Goal[d]	5
U-238[e]	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	120
• Subsurface (>6 in. depth)	120
ALARA Goal[d]	30

TABLE 2-1 Soils Cleanup Criteria and ALARA Goals for Remedial Actions at the WSSRAP[a] (Continued)

CONTAMINANT/CRITERION	SOIL CONCENTRATION[b]
Arsenic	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	75
• Subsurface (>6 in. depth)	750
ALARA Goal	
• Surface (0 - 6 in. depth)	45
• Subsurface (>6 in. depth)	75
Chromium (total)	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	110
• Subsurface (>6 in. depth)	1,110
ALARA Goal	
• Surface (0 - 6 in. depth)	90
• Subsurface (>6 in. depth)	110
Chromium (VI)	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	100
• Subsurface (>6 in. depth)	1,000
ALARA Goal	
• Surface (0 - 6 in. depth)	90
• Subsurface (>6 in. depth)	100
Lead	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	450
• Subsurface (>6 in. depth)	4,500
ALARA Goal	
• Surface (0 - 6 in. depth)	240
• Subsurface (>6 in. depth)	450
Thallium	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	20
• Subsurface (>6 in. depth)	200
ALARA Goal	
• Surface (0 - 6 in. depth)	16
• Subsurface (>6 in. depth)	20

TABLE 2-1 Soils Cleanup Criteria and ALARA Goals for Remedial Actions at the WSSRAP[a] (Continued)

CONTAMINANT/CRITERION	SOIL CONCENTRATION[b]
PAHs[f]	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	5.6
• Subsurface (>6 in. depth)	56
ALARA Goal	
• Surface (0 - 6 in. depth)	0.44
• Subsurface (>6 in. depth)	5.6
PCBs[g]	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	8
• Subsurface (>6 in. depth)	80
ALARA Goal	
• Surface (0 - 6 in. depth)	.65
• Subsurface (>6 in. depth)	8
TNT	
Cleanup Criteria:	
• Surface (0 - 6 in. depth)	140
• Subsurface (>6 in. depth)	1,400
ALARA Goal	
• Surface (0 - 6 in. depth)	14
• Subsurface (>6 in. depth)	140

(a) All values include background levels.
(b) Radiological activities are in pCi/g; chemical concentrations are in mg/kg.
(c) At locations where both Ra-226 and Ra-228 are present, the cleanup criterion of 6.2 pCi/g (including background) in the top 15 cm (6 in.) of soil, and 16.2 pCi/g (including background) in each 15-cm (6-in.) layer of soil more than 15 cm (6-in.) below the surface, applies to the sum of the concentrations of these two radionuclides.
(d) Values reflect surface and subsurface criteria.
(e) U-238 cleanup criteria are WSSRAP site-specific values.
(f) Benzo(a)anthracene, benzo(b)floranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, and ideno (1,2,3-cd) pyrene.
(g) Aroclor 1248, Aroclor 1254, Aroclor 1260.

The maximum allowable "hot spot" is the same as that for radiological contamination. The ALARA goals listed in Table 2-1 were used to guide the remedial action.

2.1.2 Surface Radioactivity Guidelines

Surface contamination guidelines applied to remedial actions at the WSSRAP were extracted from DOE Order 5400.5, Figure IV-1. Previous sampling of the Imhoff Tank, proof sampler, and process sewer indicated that the primary contaminant in the remediation vicinity is uranium; therefore, guidelines for natural uranium were applied. Beta activity levels are considered representative of uranium surface activity, based on the equivalent alpha to beta decay ratio that exists with uranium; therefore, the beta-gamma activity guidelines were applied. The specific residual surface activity guidelines are presented in Table 2-2.

TABLE 2-2 Applicable Residual Surface Activity Guidelines

RADIONUCLIDES	AVERAGE FIXED CONTAMINATION	MAXIMUM FIXED CONTAMINATION	AVERAGE REMOVABLE CONTAMINATION
Natural Uranium (alpha emissions)	5,000 dpm/100 cm^2	15,000 dpm/100 cm^2	1,000 dpm/100 cm^2
Beta-Gamma Emitters	5,000 dpm/100 cm^2	15,000 dpm/100 cm^2	1,000 dpm/100 cm^2

2.2 Survey and Sampling Procedures

All sampling and surveys were conducted and documented in accordance with WSSRAP Environmental Safety and Health (ES&H) procedures. The applicable procedures were as follows:

- ES&H 2.3.8 *Contamination Survey*
- ES&H 2.5.1 *Radiological Soil Sampling*

- ES&H 2.5.2 *In Situ Radiation Measurements*
- ES&H 2.5.5 *Sample Preparation Procedure for Radiological Soil Samples*
- ES&H 2.5.8 *Th-230 Determinations in Soils by the UNC Method*
- ES&H 2.6.1 *Alpha Detector Calibration and Operational Check*
- ES&H 2.6.2 *Calibration and Use of Ludlum Model 2220 Scaler and the Model 44-10-2 (2x2 NaI) Detector*
- ES&H 2.6.3 *GM Detector Calibration, Operation, and Usage*
- ES&H 2.6.4 *Ludlum Model 2000 Scaler and Model 43-10 Detector: Gross Alpha Measurement Operation and Calibration*
- ES&H 2.6.9 *Instructions for Calibration and Operation of the High Purity Germanium Detector*
- ES&H 4.1.3 *Sampling Equipment Decontamination*
- ES&H 4.4.1 *Numbering System for Environmental Samples and Locations*
- ES&H 4.4.5 *Soils/Sediment Sampling*

2.3 Surface Walk-Over Surveys

The WSSRAP uses portable sodium iodide (NaI) detectors to measure qualitative surface gamma radioactivity. A Ludlum Model 44-10 2x2 NaI scintillation probe coupled to a Ludlum Model 2220 or Model 2221 ratemeter/scaler is used for walk-over surveys. The areas of interest are surveyed by swinging the probe in a sinusoidal pattern approximately 6-in. from the surface. Walking over the survey area in this manner provides essential a 100% scan of the surface. In areas consisting of primarily soil, a count rate of 1.5 times background is used for preliminary delineation of surface areas containing residual radiological contamination.

2.4 Surface Activity Measurements

The WSSRAP uses portable alpha scintillation and Geiger-Mueller (G-M) detectors to measure surface contamination. A Ludlum Model 44-9 G-M detector coupled to a Ludlum Model 3 or Model 2221 ratemeter/scaler is used for beta/gamma radiation measurements. A Ludlum Model 43-5 alpha detector coupled to a Ludlum Model 12 ratemeter/scaler or Ludlum Model 2220/2221 ratemeter/scaler or a Bicron Model A-50 alpha detector are used for alpha radiation measurements. In situ surface activity measurements are made with the detector held stationary with the detector as close as possible to the surface being measured.

2.5 Soil Sampling

Soil characterization samples were collected prior to remediation, and confirmation samples were collected after remediation. All soil samples were collected in accordance with Procedure ES&H 2.5.1, *Radiological Soil Sampling* Procedure ES&H 4.4.5, *Soils/Sediment Sampling* and the *Addendum to the Supplementary Soil Sampling Plan: Imhoff Tank/Process Sewer Line Characterization Soil Sampling Plan (Ref. 10)*.

Samples are collected with a stainless steel hand-held auger or trowel and bucket. Samples are collected in 6 in. increments. Samples requiring off-site analysis were homogenized and placed in two 500 ml wide-mouth glass jars, properly labelled, and immediately placed on ice. Care is taken to avoid prolonged exposure of the sample to direct sunlight. Samples analyzed on-site for radiological parameters were placed in properly labelled polyethylene bags and transported to the site laboratory.

Sample custody control activities were in accordance with the sample custody program for the Weldon Spring site, which includes documentation of the methods of preservation, sample identification, recording sample location, and methods of sample acquisition. Applicable forms required to record this information are specified in WSSRAP Procedures ES&H 2.5.1, *Radiological Soil Sampling*; ES&H 4.1.1, *Numbering System for Environmental Samples and Sample Locations*; ES&H 4.1.2, *Chain of Custody*; ES&H 4.1.4, *Quality Control Samples for Aqueous and Soil Matrices: Definitions, Identification Codes, and Collection Procedures*; and ES&H 4.4.5, *Soil/Sediment Sampling*.

2.6 Background Radiation Levels

To determine background soil concentrations, soil samples were taken within a 5 mi radius of the site (Ref. 1) in areas unaffected by plant operations. The average background soil concentrations are as follows:

Radionuclides	Average Soil Concentration
Ra-228	1.2 pCi/g
Ra-226	1.2 pCi/g
Th-232	1.2 pCi/g
U-238	1.2 pCi/g
Th-230	1.2 pCi/g

Background gamma radiation measurements of the soil were taken with a 2x2 sodium iodide (NaI) detector. The surface NaI background gamma radiation levels were approximately 11,500 cpm (*Characterization Report IRA No. 13 on Army Reserve Property Vicinity Property No. 2* [Ref. 8]). Below surface (i.e, borehole) gamma radiation measurements are approximately 20,000 cpm (*Report on Radiological Findings and Recommendations Regarding Army Reserve Property No. 1* [Ref. 7]). Gamma measurements taken below the surface are greater due to detector geometry. The NaI gamma measurements are slightly variable, depending on detector efficiency and soil composition.

3 CHARACTERIZATION

The various building characterization efforts performed at the Weldon Spring Chemical Plant provided data on the degree of building and associated equipment contamination and was used during feasibility studies to determine the appropriate ultimate disposition of the materials.

The purpose of the soil characterization in the vicinity of the Imhoff tank, proof sampler, and process sewer was to determine the magnitude of soil contamination and to support the development of subcontractor excavation specifications.

In addition characterization results were used to develop health and safety requirements during remedial action activities.

3.1 Building 432 Characterization Surveys

Building 432 was surveyed by Ryckman/Edgerley/Tomlinson & Associates (RETA) and by the Project Management Contractor (PMC). In 1977, RETA took measurements in and around this building. They were all at the "releasable" level (Ref. 6).

The PMC performed a radiological survey on this building in 1988. The results are presented in the *Buildings Radiological Characterization Report* (Ref. 4). The characterization included a total of five bulk samples (samples of floor debris) collected in the above- and below-ground areas of Building 432. The average activity of each radionuclide found in the samples is presented in Table 3-1:

TABLE 3-1 Building 432 Bulk Sample Results

RADIONUCLIDE	AVERAGE ACTIVITY (pCi/g-dry)*
Ra-226	3.1 ± 0.8
U-234	68.8 ± 22.3
U-235	5.3 ± 17.1
U-238	88.2 ± 23.2

TABLE 3-1 Building 432 Bulk Sample Results (Continued)

RADIONUCLIDE	AVERAGE ACTIVITY (pCi/g-dry)*
Th-230	10.0 ± 3.0
Th-232	1.3 ± 1.6
Th-228	1.2 ± 0.7

* Average of bulk samples.

A 2 cm core sample was taken of the concrete floor in an area of elevated beta-gamma radiation. After the core was removed the beta-gamma radiation level on the freshly exposed surface was less than the minimum detectable amount (MDA) of the detector, indicating surficial rather than volumetric contamination of the floor.

In April of 1992, the PMC took a sample of the sediment and sludge at the bottom of the process sewer sampling area. The sample was analyzed by an off-site laboratory for chemical and radiological contaminants. The radiological and chemical analytical results are listed in Table 3-2.

TABLE 3-2 Results of Building 432 Process Sewer Sludge

PARAMETER	CONCENTRATION	UNITS
Th-228	2.7	pCi/g
Th-230	34	pCi/g
Th-232	6.7	pCi/g
Uranium total	54	pCi/g
Arsenic (TCLP)	<140	μg/l
Chormium (TCLP)	0.6	mg/l
Lead (TCLP)	3.0	mg/l
PCBs	2.9	mg/kg

< Indicates the result was non detect and the value listed is the detection limit.

3.2 Structure 427 Characterization Surveys

Structure 427 was surveyed by RETA in 1977 and the results of these measurements are presented in the *Weldon Spring Chemical Plant Survey and Assessment*. About 68% of the total surface contamination measurements were at the "releasable" level. The remaining measurements indicated contamination above the "releasable" level (Ref. 6).

In April of 1992, the PMC took a sample of the Imhoff tank sludge. The radiological and chemical results are listed in Table 3-3.

TABLE 3-3 Results of Structure 427 Sludge

PARAMETER	CONCENTRATION	UNITS
Th-228	5.6	pCi/g
Th-230	26	pCi/g
Th-232	5.2	pCi/g
Uranium total	1710	pCi/g
Arsenic	14.0	mg/kg
Chromium	<14	mg/kg
Lead	130	mg/kg
Thallium	<1.6	mg/kg
PCBs	15.3	mg/kg

< Indicates the result was non detect and the value listed is the detection limit.

3.2.1 Process Sewer Line and Imhoff Tank Soil Characterization Surveys

Two previous studies have been performed at the chemical plant that involved soil sampling in the vicinity of the Imhoff tank and proof sampler.

As part of the overall site radiological characterization performed in 1987, two locations were sampled near the Imhoff tank. The samples were collected from the surface to a depth of

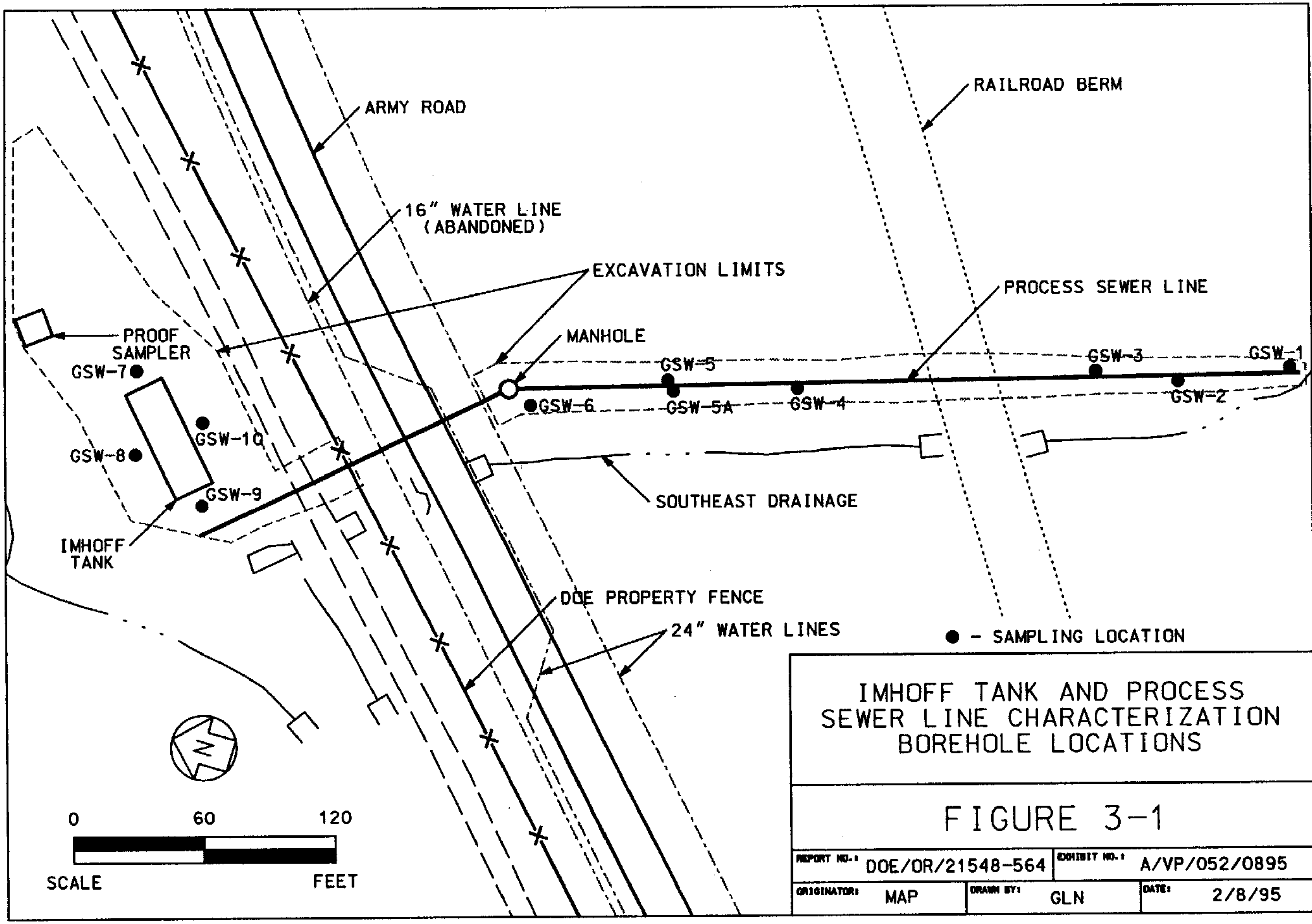
11 ft and were analyzed for U-238. The results indicated a maximum concentration of 6.6 pCi/g and was collected from 0 to 1 ft depth.

During development of the Imhoff tank/process sewer removal work package (WP-233) surface and subsurface samples were collected in the area where the process sewer extended off-site and subsurface samples were collected adjacent to the Imhoff tank. The surface samples were collected at four locations along the length of the off-site portion of the process sewer line. Samples were collected with a hand-held auger to a depth of 12 in. Samples were analyzed for U-238, Ra-226, Th-228, Th-230, and Th-232. Sample analysis indicated that U-238 was the only radionuclide above background levels with a maximum concentration of 2.6 pCi/g. Chemical data indicated that the concentrations of the contaminants of concern were below the clean-up criteria, which are summarized in Table 2-1.

In order to determine if the subsurface soils adjacent to the Imhoff tank and process sewer were contaminated, the PMC collected subsurface soil samples from 11 locations in July 1992. Seven sample locations adjacent to the process sewer and four locations adjacent to the Imhoff tank were sampled as shown on Figure 3-1. A truck mounted drill rig equipped with split spoon auger was used to collect samples. Samples were analyzed at an independent laboratory for U-238, Ra-226, Ra-228, Th-230 and Th-232 and for chemical parameters.

Prior to soil sampling the process sewer was surveyed and stakes were placed in the ground over the pipe approximately every 50 ft. Along the process sewer soil sampling was initiated at a depth corresponding to the bottom of the sewer pipe. This was accomplished by positioning the drill rig directly over the pipe and drilling to the pipe. The rig was then repositioned 1 to 2 ft from the pipe centerline to collect samples at a depth 2 ft below the top of the pipe. Radiological sample results and sampling depths are listed in Table 3-4. The chemical results for the contaminants of concern are listed in Table 3-5.

Subsurface soil samples were collected on each side of the Imhoff tank. The boreholes were drilled approximately 5 ft from the tank walls at varying depths and extended to bedrock or auger refusal. Radiological sample results and sampling depths are listed in Table 3-4. The concentrations of the chemical contaminants of concern are listed in Table 3-5.



IMHOFF TANK AND PROCESS SEWER LINE CHARACTERIZATION BOREHOLE LOCATIONS

FIGURE 3-1

TABLE 3-4 Process Sewer Line and Imhoff Tank Radiological Characterization Soil Sample Results

SAMPLE NO.	SAMPLE DEPTH (FT)	U-238 pCi/g	RA-226 pCi/g	TH-230 pCi/g	TH-232 pCi/g
GSW-1	3-5	26.0	7.2	0.9	1.1
	5-7	10.1	4.4	2.3	0.9
	7-9	23.5	5.1	1.8	1.1
GSW-2	3.5-5.5	5.5	3.7	1.5	1.1
	5.5-7.5	3.3	3.4	1.4	0.5
	7.5-9.5	3.3	2.9	1.3	0.5
GSW-3	4-6	4.0	5.6	0.7	0.0
	6-8	2.6	3.0	1.6	1.2
	8-10	2.3	4.3	1.9	0.4
GSW-4	5-7	2.2	4.2	1.0	0.9
	7-9	1.3	6.6	0.3	0.9
	9-11	1.8	4.4	1.2	1.1
GSW-5	7-9	1.9	4.1	2.5	1.2
	9-11	1.5	5.3	0.9	1.3
	11-13	1.7	3.8	1.2	0.9
GSW-5A	5-7	1.5	3.7	1.1	1.4
GSW-6	9-11	1.5	4.8	0.9	1.1
	11-13	1.2	4.3	1.0	0.4
	13-15	1.2	4.3	1.4	1.2
GSW-7	15-16	1.3	5.7	0.6	0.0
GSW-8	14.5-16.5	0.9	0.2	1.1	0.0
	23.5-24.5	1.0	3.5	1.0	0.4
GSW-9	14.5-16.5	0.9	4.9	1.5	1.0
	19.5-21.5	1.9	4.7	0.9	0.7

TABLE 3-4 Process Sewer Line and Imhoff Tank Radiological Characterization Soil Sample Results (Continued)

SAMPLE NO.	SAMPLE DEPTH (FT)	U-238 pCi/g	RA-226 pCi/g	TH-230 pCi/g	TH-232 pCi/g
GSW-10	10.5-12.5	1.9	4.7	1.9	0.7
	13.5-15.5	8.7	2.7	2.1	1.2

TABLE 3-5 Process Sewer Line and Imhoff Tank Chemical Characterization Soil Sample Results

SAMPLE NO.	SAMPLE DEPTH (FT)	ARSENIC mg/kg	CHROMIUM mg/kg	LEAD mg/kg	THALLIUM mg/kg	PCBs[a] mg/kg
GSW-1	3-5	5.1	10.5	10.8	<0.3	0.2
	5-7	6.4	14.2	15.5	<0.3	0.4
	7-9	<0.5	15.7	9.9	<0.5	0.3
GSW-2	3.5-5.5	3.0	10.2	8.8	<0.4	<0.1
	5.5-7.5	4.8	21.5	13.4	<0.4	0.2
	7.5-9.5	4.2	3.3	11.6	<0.4	<0.1
GSW-3	4-6	5.2	12.1	12.6	<0.5	<0.1
	6-8	0.7	14.8	17.3	<0.5	0.2
	8-10	2.8	17.3	92.2	<0.5	0.3
GSW-4	5-7	2.8	10.8	11.3	<0.4	0.4
	7-9	1.1	6.3	216.0	<0.4	<0.1
	9-11	1.3	7.0	11.4	<0.4	<0.1
GSW-5	7-9	11.1	22.3	22.9	<0.5	<0.1
	9-11	6.6	12.1	15.3	<0.5	<0.1
	11-13	6.1	13.9	11.0	<0.5	<0.1
GSW-5A	5-7	3.6	10.6	11.5	<0.5	<0.1

TABLE 3-5 Process Sewer Line and Imhoff Tank Chemical Characterization Soil Sample Results (Continued)

SAMPLE NO.	SAMPLE DEPTH (FT)	ARSENIC mg/kg	CHROMIUM mg/kg	LEAD mg/kg	THALLIUM mg/kg	PCBs[a] mg/kg
GSW-6	9-11	8.1	11.0	15.9	<0.4	<0.1
	11-13	4.3	10.9	13.4	<0.5	<0.1
	13-15	4.5	16.9	12.1	<0.5	<0.1
GSW-7	15-16	1.5	7.8	11.2	<0.5	<0.1
GSW-8	14.5-16.5	6.8	13.1	12.0	<0.4	<0.1
	23.5-24.5	12.6	21.5	45.3	<0.5	<0.1
GSW-9	14.5-16.5	1.8	7.4	9.9	<0.4	<0.1
	19.5-21.5	3.2	6.0	11.2	<0.6	<0.1
GSW-10	10.5-12.5	5.3	14.4	8.5	<0.5	<0.1
	13.5-15.5	3.3	9.8	10.8	<0.5	<0.1

(a) The concentration and detection limit listed is a summation of Aroclor 1248, 1254, and 1260.
< Indicates the result was non detect and the value listed is the detection limit.

4 EXCAVATION SURVEYS

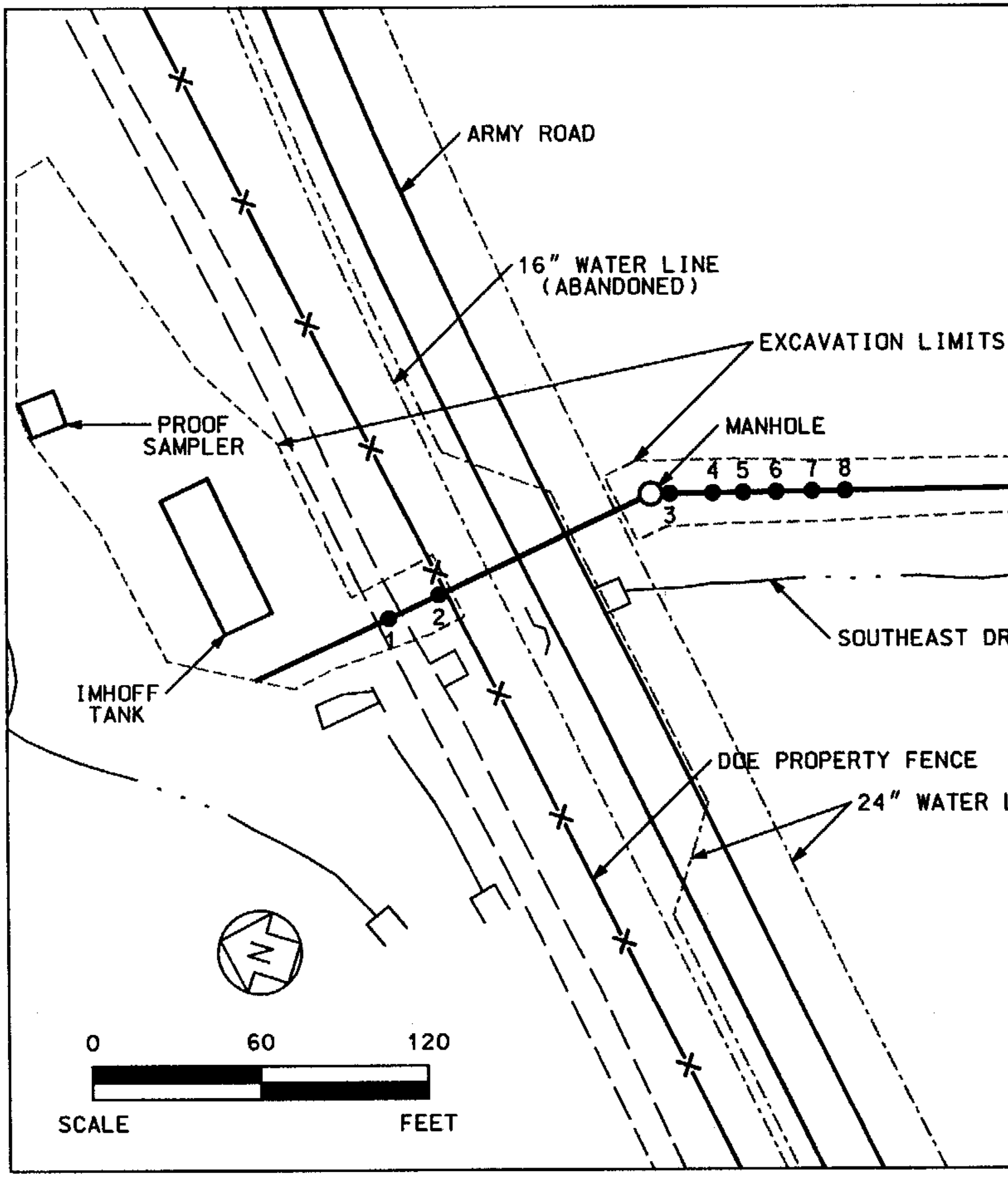
4.1 Process Sewer Pipeline Excavation

The process sewer line extends off site in the direction of the Southeast Drainage and passes beneath two active water mains (St. Charles County and Missouri cities) on the south side of the Army access road. Field locations performed by the water companies revealed that a water main thrust block lies directly on top of the process sewer line. According to the water company, the thrust block is constructed of approximately 5 cu yd of concrete and probably extends several feet along the process sewer line.

To safely remove the process sewer line below the water mains would require shutting off both mains, supporting the mains and thrust block, removing the process sewer line and backfilling. The water companies and the Project Management Contractor (PMC) determined that the process sewer line should not be excavated beneath the water mains while the mains are active. However, per the utility companies, the two water mains cannot be shut off concurrently, nor can one of the two lines be shut off during peak season (through the summer months). This led to the decision that this section of process sewer line should be left intact.

The design specifications for the process sewer pipe excavation included the removal of soil in a 2 ft radius around the pipe. To facilitate the process of excavation, sampling, and backfilling, the 2 ft envelope of soil was designated as potentially contaminated. In order to determine if the process sewer had leaked, the pipe bedding material (i.e., gravel/soil) was sampled prior to removal of the 2 ft soil envelope. Sampling of the pipe bedding material was conducted both upstream and downstream of the pipe section to remain intact. The pipe bedding material had a maximum depth of 6 in. and was non-existent in some locations. Due to the channeling effect of the undisturbed clay under the process sewer, sampling directly below the pipe would indicate if the pipe had significant leakage.

Process sewer pipe excavation was initiated at the manhole (see Figure 4-1) and proceeded to the south. The soil was excavated to a level that would accommodate removal of the process sewer pipe. The excavation was sloped back from the trench floor at a 1:1 ratio.



SAMPLE LOCATIONS ALONG PROCESS SEWER LINE

FIGURE 4-1

REPORT NO.: DOE/OR/21548-564	EXHIBIT NO.: A/VP/049/0895	
ORIGINATOR: MAP	DRAWN BY: GLN	DATE: 2/8/95

The sewer pipe was removed and hauled to Ash Pond for storage. The portion of the process sewer within the site perimeter fence and the manhole were excavated in the same manner.

A walk-over survey of the bedding material was performed with a 2x2 NaI gamma scintillation detector. The survey indicated primarily background levels (i.e., <12,000 cpm) with a maximum reading of 13,300 cpm. South of the manhole, five soil samples were then collected in the center of the pipeline excavation trench at approximately 15 ft intervals. Two soil samples were also collected in the center of the pipe excavation trench on the chemical plant property and one sample was collected under the manhole structure. Sample locations are shown on Figure 4-1. The samples were shipped to an independent laboratory for chemical and radiological analysis. The radiological results are listed in Table 4-1. The chemical results for the contaminants of concern are listed in Table 4-2.

TABLE 4-1 Process Sewer Line Excavation Radiological Soil Sample Results

SAMPLE	U-238	RA-226	RA-228	TH-230	TH-232
1	1.1	<0.2	<1.1	2.9	<0.4
2	0.9	<0.4	<1.2	1.3	<0.6
3	1.8	0.6	1.0	(0.5)	0.9
4	1.2	2.7	(0.5)	0.6	0.9
5	0.9	2.4	<2.5	0.7	0.7
6	1.6	2.7	0.3	1.1	1.0
7	1.8	3.2	(0.7)	0.8	1.1
8	1.4	2.0	(0.5)	0.9	0.8

Note all results are in pCi/g
( ) Results below lower limit of detection.
< Indicates the result was non detect and the value listed is the detection limit.

TABLE 4-2 Process Sewer Line Excavation Chemical Soil Sample Results[a]

SAMPLE ID	ARSENIC	CHROMIUM TOTAL	LEAD	THALLIUM	PAHs[b]	PCBs[c]	TNT
1	7.9	10.0	50.9	<0.4	<1	0.2	<0.02
2	4.7	14.5	84.7	<0.4	<1	1.8	<0.01
3	6.8	17.9	11.8	<0.8	<0.03	<0.1	<0.3
4	1.2	19.5	8.2	<0.3	<1	<0.1	<0.02
5	7.3	22.7	12.8	<0.3	<1	<0.1	<0.02
6	12.3	39.6	14.2	9.8	<1	<0.1	<0.02
7	5.6	8.4	9.5	<0.2	<1	<0.1	<0.02
8	8.1	11.1	9.0	<0.2	<1	<0.1	<0.02

(a) Concentrations are in mg/kg.
(b) The detection limit listed is a summation of the separate detection limits for the PAHs of concern listed in Table 2-1.
(c) The concentration and detection limit listed is a summation of Aroclor 1248, 1254, and 1260.
< Indicates the result was non detect and the value listed is the detection limit.

After sampling the bedding material, an additional 2 ft envelope of soil was excavated from the bottom of the excavation trench. The remaining pipe and associated 2 ft soil envelope were excavated to the outfall, and the material was hauled to the Ash Pond area.

A gamma radiation walkover scan of the exposed surface was performed to determine if areas of elevated gamma radiation were present. This would immediately indicate whether additional excavation was necessary. Walkover scans of all areas after remediation revealed background gamma radiation levels. Also, portions of the excavation were scanned with a G-M detector. The G-M detector indicated primarily background readings (i.e., ~40) with a maximum in situ rate of 90 cpm.

4.2 Building 432 and Structure 427 (Imhoff Tank)

The top 6 in. of soil within the construction areas (i.e., excavation limits), shown in Figure 3-1, was removed prior to building dismantlement and below grade structure excavation activities. The top soil was placed in the Ash Pond area. The above-ground section of Building 432 and associated equipment were dismantled and placed in the material staging area (MSA) for temporary storage before final placement in the on-site disposal cell. The Building 432 foundation, the Imhoff Tank structure, and the process sewer pipe associated with Building 432 were excavated and placed at the Ash Pond area. Also, a 2 ft envelope of soil surrounding the below-grade structures was removed and placed in Ash Pond.

Following the excavation, a gamma radiation walkover scan of the exposed surface was performed. The gamma radiation walkover scan was performed to determine if areas of elevated gamma radiation were present, which would immediately indicate whether additional excavation was necessary (i.e., 1.5 x background). The walkover scans of the excavation revealed a small area (approximately 4 m^2) of elevated gamma radiation (i.e., 20,000 cpm) within the footprint of Building 432. Approximately 2 ft of additional soil was excavated in this area. The area was resurveyed and indicated background levels of gamma radiation.

5 CONFIRMATION SAMPLING

5.1 Process Sewer Line

Confirmation sampling began following removal of the concrete pipe and the 2-ft soil envelope around the pipe. Samples were collected approximately every 20 ft from the Imhoff tank to the site perimeter fence, and from the manhole to the process sewer outfall. Samples were collected in the center of the excavation floor and approximately 2 ft above the floor on each side wall (i.e., east and west). Sample locations are shown on Figure 5-1. The samples were sent to an independent laboratory for radiological and chemical analysis. All results were less than the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site (ROD)* (Ref. 2) cleanup criteria for subsurface soils, which are summarized in Table 2-1. The radiological sample results are listed in Table 5-1 and the chemical sample results are listed in Table 5-2. The trench was backfilled in and the soil compacted.

TABLE 5-1 Radiological Results of Process Sewer Confirmation Soil Samples[a]

MAP LOCATION	SAMPLE SITE	RA-226	RA-228	TH-230	TH-232	U-238
A	Bottom of trench	.962	5.05	4.73	1.15	1.19
A	East Side	1.43	<4.47	1.98	1.17	.85
A	West Side	1.15	<3.57	1.61	1.19	.716
B	Bottom of trench	3.91	<3.07	.821	1.14	.933
B	East Side	2.77	<5.11	.709	1.04	.62
B	West Side	2.91	5.84	.695	1.13	.765
C	Bottom of trench	.87	1.21	.60	.43	1.09
D	Bottom of trench	2.09	<2.77	1.01	1.06	.695
D	East Side	2.54	<2.57	.563	.912	.621
D	West Side	3.59	(.776)	.760	1.1	.740
E	Bottom of trench	3.08	<1.97	1.05	1.45	.905
E	East Side	2.37	.126	.688	1.00	.821

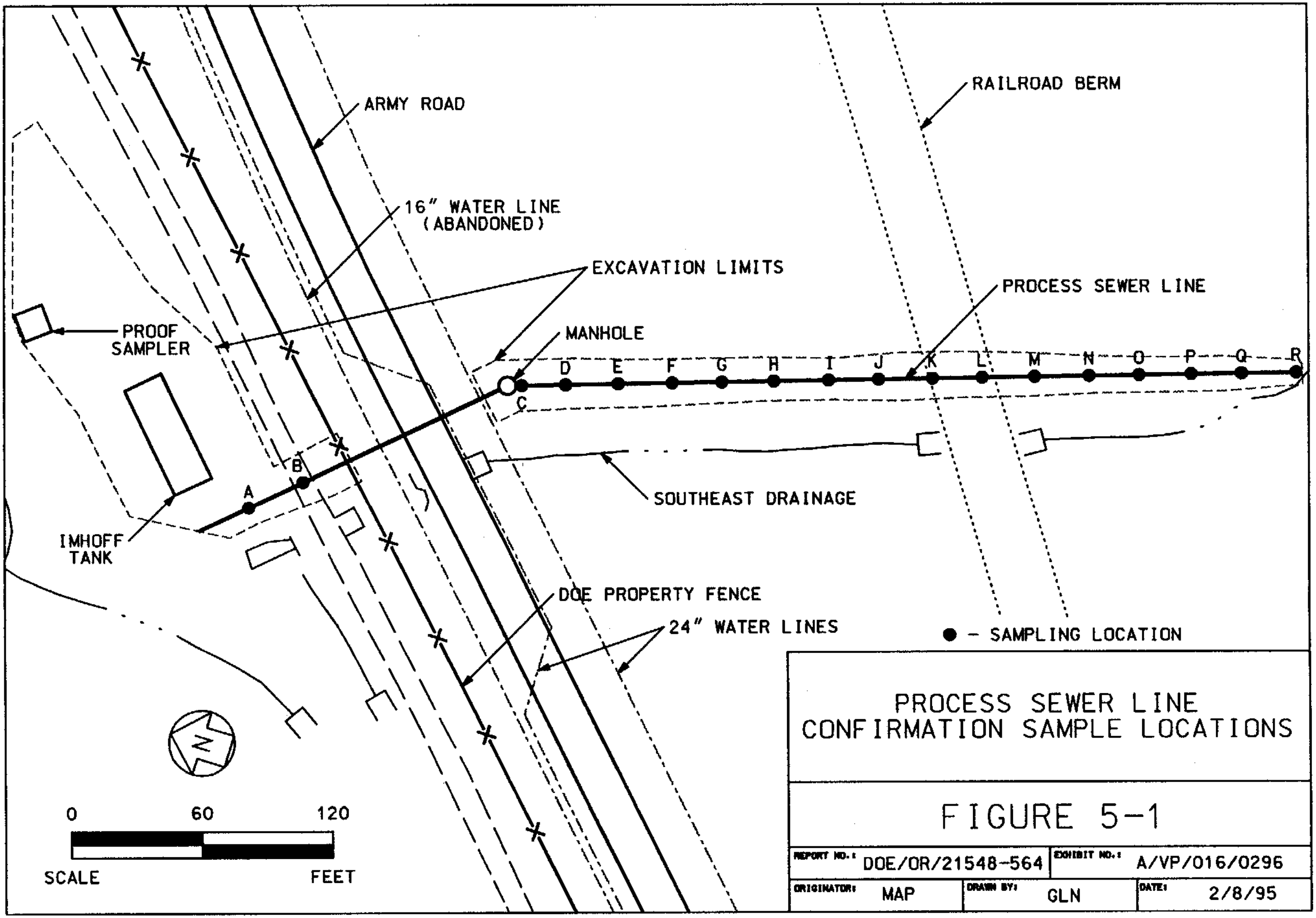
TABLE 5-1 Radiological Results of Process Sewer Confirmation Soil Samples[a] (Continued)

MAP LOCATION	SAMPLE SITE	RA-226	RA-228	TH-230	TH-232	U-238
E	West Side	3.22	(.548)	.919	1.13	.763
F	Bottom of trench	2.22	<1.54	.736	1.32	.724
F	East Side	3.36	(4.37)	3.27	1.09	.949
F	West Side	3.23	<6.02	.944	1.16	.810
G	Bottom of trench	2.49	<5.66	.758	1.29	.724
G	East Side	2.21	<6.14	.852	1.22	.939
G	West Side	1.86	<4.91	.742	1.32	.735
H	Bottom of trench	4.67	<7.60	.808	1.23	.892
H	East Side	2.66	(1.6)	.670	1.22	.840
H	West Side	2.05	<5.57	.701	1.22	.733
I	Bottom of trench	1.98	(.984)	.982	1.36	.923
I	East Side	1.6	<4.13	.96	1.33	1.02
I	West Side	2.37	(.989)	.859	1.27	.932
J	Bottom of trench	3.05	<5.17	.822	1.24	1.46
J	East Side	3.13	<3.49	.835	1.16	1.38
J	West Side	2.31	3.47	.866	1.2	1.15
K	Bottom of trench	3.27	<3.93	.953	1.15	1.32
K	East Side	3.97	<3.46	1.21	1.03	1.03
K	West Side	3.73	<4.04	.849	.969	.972
L	Bottom of trench	ND	<4.24	.925	1.23	1.36
L	East Side	3.21	<4.58	.380	.626	1.43
L	West Side	2.71	<4.38	1.19	1.14	1.19
M	Bottom of trench	2.62	12.5	1.13	1.28	1.63
M	East Side	3.64	<3.33	1.22	1.19	1.6

TABLE 5-1 Radiological Results of Process Sewer Confirmation Soil Samples[(a)] (Continued)

MAP LOCATION	SAMPLE SITE	RA-226	RA-228	TH-230	TH-232	U-238
M	West Side	2.72	<4.53	1.95	1.25	1.71
N	Bottom of trench	3.38	5.83	1.37	1.37	1.94
N	East Side	4.46	<2.06	1.1	1.37	1.66
N	West Side	4.19	<2.62	1.21	1.26	1.67
O	Bottom of trench	4.28	<2.93	1.69	1.28	3.32
O	East Side	2.91	<5.94	1.32	1.05	1.54
O	West Side	3.08	<8.34	.854	1.05	1.68
P	Bottom of trench	3.63	<4.10	1.09	1.01	4.27
P	East Side	ND	<5.16	1.16	1.04	2.27
P	West Side	3.11	4.73	1.14	1.05	4.49
Q	Bottom of trench	4.31	<6.95	1.05	1.08	3.58
Q	East Side	3.01	<5.27	0.966	1.0	1.62
Q	West Side	4.47	<5.37	1.07	1.08	1.65
R	Bottom of trench	2.75	<6.11	1.11	1.12	3.3
R	East Side	5.4	<4.23	1.1	.926	49.3
R	West Side	4.29	<4.24	1.47	.914	1.74

(a) Note all results are in pCi/g
< Indicates the result was non detect and the value listed is the detection limit.



PROCESS SEWER LINE
CONFIRMATION SAMPLE LOCATIONS

FIGURE 5-1

REPORT NO.: DOE/OR/21548-564		EXHIBIT NO.: A/VP/016/0296	
ORIGINATOR: MAP	DRAWN BY: GLN	DATE: 2/8/95	

TABLE 5-2 Chemical Results of Process Sewer Confirmation Soil Samples[a]

MAP LOCATION	SAMPLE SITE	ARSENIC	CHROMIUM	LEAD	THALLIUM	PCBs[b]	PAHs[c]	TNT
A	Bottom of trench	5.2	12.0	10.9	<0.2	<0.1	<1	<0.02
A	East Side	6.0	12.3	11.1	<0.2	<0.1	<1	<0.02
A	West Side	6.3	13.1	10.3	<0.2	<0.1	<1	<0.02
B	Bottom of trench	6.3	13.6	2.7	<0.2	<0.1	<1	<0.02
B	East Side	7.6	11.2	13.1	<0.3	<0.1	<1	<0.02
B	West Side	2.3	13.1	8.2	<0.2	<0.1	<1	<0.02
C	Bottom of trench	7.2	19.3	9.4	<0.8	<0.04	<1	<0.3
D	Bottom of trench	3.8	31.0	5.4	<0.3	<0.2	<1	<0.02
D	East Side	5.3	30.8	11.4	<0.3	<0.2	<1	<0.02
D	West Side	7.6	33.2	5.4	<0.3	<0.2	<1	<0.02
E	Bottom of trench	11.4	40.8	27.1	<0.3	<0.2	<1	<0.02
E	East Side	1.7	26.8	2.2	<0.3	<0.2	<1	<0.02
E	West Side	10.5	24.6	8.5	<0.3	<0.2	<1	<0.02
F	Bottom of trench	0.6	7.2	23.5	<0.3	<0.2	<1	<0.02
F	East Side	7.3	20.2	12.9	<0.2	<0.2	<1	<0.02
F	West Side	2.7	12.5	8.9	<0.2	<0.2	<1	<0.01
G	Bottom of trench	3.0	6.9	7.0	<0.2	<0.2	<1	<0.02
G	East Side	6.0	9.3	8.5	<0.2	<0.2	<1	<0.02
G	West Side	3.8	8.0	17.4	<0.3	<0.1	<1	<0.02
H	Bottom of trench	5.1	6.3	8.4	<0.2	<0.1	<1	<0.02
H	East Side	1.3	6.1	9.0	<0.2	<0.1	<1	<0.02
H	West Side	0.4	3,6	4.6	<0.2	<0.1	<1	<0.02
I	Bottom of trench	4.3	9.7	9.2	<0.2	<0.1	<1	<0.02
I	East Side	9.4	9.2	18.6	<0.2	<0.1	<1	<0.02
I	West Side	5.5	5.4	9.2	<0.2	<0.1	<1	<0.02
J	Bottom of trench	5.1	10.4	12.1	<0.2	<0.1	<1	<0.02
J	East Side	3.0	13.2	14.9	<0.2	<0.1	<1	<0.02
J	West Side	2.3	12.0	9.8	<0.2	<0.1	<1	<0.02

TABLE 5-2 Chemical Results of Process Sewer Confirmation Soil Samples (Continued)

MAP LOCATION	SAMPLE SITE	ARSENIC	CHROMIUM	LEAD	THALLIUM	PCBs[b]	PAHs[c]	TNT
K	Bottom of trench	4.5	7.9	8.1	<0.3	<0.1	<1.0	<0.02
K	East Side	4.1	9.4	10.8	<0.3	<0.1	<1.0	<0.02
K	West Side	2.4	8.9	10.2	<0.2	<0.1	<1.0	<0.02
L	Bottom of trench	2.0	13.2	8.1	<0.2	<0.1	<1.0	<0.02
L	East Side	4.4	10.5	9.2	<0.3	<0.1	<1.0	<0.02
L	West Side	2.7	8.7	12.0	<0.2	<0.1	<1.0	<0.02
M	Bottom of trench	2.7	6.3	8.7	<0.2	<0.1	<1.0	<0.01
M	East Side	2.4	12.6	3.6	<0.2	<0.1	<1.0	<0.02
M	West Side	6.2	13.4	9.6	<0.2	<0.1	<1.0	<0.01
N	Bottom of trench	1.9	7.0	10.3	<0.2	<0.1	<1.0	<0.01
N	East Side	4.4	15.0	8.4	<0.3	<0.1	<1.0	<0.02
N	West Side	3.7	9.0	9.2	<0.2	<0.1	<1.0	<0.02
O	Bottom of trench	2.6	19.6	12.5	<0.2	<0.1	<1.0	<0.02
O	East Side	8.1	13.3	9.3	<0.2	<0.1	<1.0	<0.02
O	West Side	3.6	8.4	9.9	<0.2	<0.1	<1.0	<0.01
P	Bottom of trench	6.3	12.6	15.5	<0.2	<0.1	<1.0	<0.02
P	East Side	4.7	9.0	21.8	<0.2	<0.1	<1.0	<0.02
P	West Side	5.2	11.9	25.5	<0.3	<0.1	<1.0	<0.02
Q	Bottom of trench	4.1	12.9	8.3	<0.3	<0.1	<1.0	<0.02
Q	East Side	4.5	8.3	11.6	<0.3	<0.1	<1.0	<0.02
Q	West Side	4.4	11.3	16.0	<0.3	<0.1	<1.0	<0.02
R	Bottom of trench	5.3	10.2	31.2	<0.2	<0.1	<1.0	<0.02
R	East Side	3.9	8.2	11.0	<0.2	<0.1	<1.0	<0.02
R	West Side	5.3	8.9	12.3	<0.3	<0.1	<1.0	<0.02

(a) Results are in mg/kg
(b) The concentration and detection limit listed is a summation of Aroclor 1248, 1254, and 1260.
(c) The detection limit listed is a summation of the separate detection limits for the PAHs of concern listed in Table 2-1.
< Indicates the result was non detect and the value listed is the detection limit.

5.2 Structure 427

Ten sample locations were collected on each excavation wall (i.e., side slope) from the excavation floor to a height of 10 ft. The soil samples were homogenized to make one composite sample for each side wall. The sample area was approximately 60 m^2. The floor of the Imhoff tank excavation was sampled in four locations and composited. The excavation floor was approximately 130 m^2. The samples were sent to an independent laboratory for radiological and chemical analysis. The radiological and chemical results are listed in Table 5-3 and Table 5-4, respectively. Compositing four samples into one representative sample for 130 m^2 does not exactly meet the residual concentrations guideline for radioactive material in soil averaged over 100 m^2 specified in DOE Order 5400.5, Radiation Protection of the Public and the Environment. However, the gamma radiation walkover survey did not reveal any above background levels and the soil sample results indicated background concentrations except for U-238 reported at 1.8 pCi/g. This data supports that contamination above the ALARA goals in this area were not exceeded.

TABLE 5-3 Radiological Results of Building 432 and Structure 427 Confirmation Soil Samples [(a)]

BUILDING/ STRUCTURE	SAMPLE SITE	RA-226	RA-228	TH-230	TH-232	U-238
432	All sides and floor	1.2	1.4	1.1	1.1	1.4
427	North side	0.9	1.3	0.8	1.3	1.1
427	East side	0.3	1.6	0.4	0.9	0.8
427	South side	0.8	1.1	1.0	1.0	1.0
427	West side	1.1	1.4	0.7	0.9	1.2
427	Excavation floor	0.8	1.0	1.1	1.0	1.8

(a) Note: All results are in pCi/g.

After sampling, the excavation was backfilled to grade in approximate 6 ft lifts and compacted beginning with the deepest area (i.e., Imhoff tank). After each lift, the side walls were surveyed with a NaI gamma scintillation detector. All survey results were within the typical background range and averaged approximately 10,000 cpm.

5.3 Building 432

One sample from each excavation side wall and floor were collected and composited. The sidewalls were sampled approximately 2 ft from the excavation floor. The composite sample was sent to an independent laboratory for chemical and radiological analysis. The radiological and chemical results are listed in Table 5-3 and Table 5-4, respectively. All results were less than the ROD (Ref. 2) ALARA goals, which are summarized in Table 2-1.

TABLE 5-4 Chemical Results of Building 432 and Structure 427 Confirmation Soil Samples[(a)]

SAMPLE ID	SAMPLE SITE	ARSENIC	CHROMIUM	LEAD	THALLIUM	PCBs[(b)]	PAHs[(c)]	TNT
432	Floor, all sides	13.4	21.7	13.2	<0.8	<0.04	<0.03	<0.3
427	North side	5.9	26.0	16.0	<0.8	<0.04	<0.03	<0.3
427	East side	6.1	12.6	18.8	<0.8	<0.04	<0.03	<0.3
427	South side	6.4	14.2	16.6	<0.8	<0.04	<0.03	<0.3
427	West side	8.5	17.3	20.7	<0.04	<0.04	<0.03	<0.3
427	Excavation Floor	6.0	13.4	8.7	<0.8	<0.04	<0.03	<0.3

(a) All results are in mg/kg
(b) The concentration and detection limit listed is a summation of Aroclor 1248, 1254, and 1260.
(c) The detection limit listed is a summation of the separate detection limits for the PAHs of concern listed in Table 2-1.
< Indicates the result was non detect and the value listed is the detection limit.

5.4 Unexcavated Section of Process Sewer LIne

As discussed in Section 4 of this report soil samples were collected in the pipe channel upstream and downstream of the water mains. The results indicated background concentrations for U-238, Ra-228, Th-230, and Th-232. Ra-226 concentrations were slightly above background levels with a maximum concentration of approximately 3.2 pCi/g. The process sewer outfall was a sample point for National Pollutant Discharge Elimination System (NPDES) compliance and was sampled on a quarterly basis. Periodically during sampling, water was found to trickle from just below the pipe. Also, removal of the process sewer both upstream and downstream of the water mains revealed that the floor (i.e., undisturbed clay) of the original pipe excavation was a conduit for rain/groundwater. Therefore, if a leak in the process sewer had occurred the waste would have been channelled along the floor of the original excavation to the outfall, resulting in significant soil contamination. The data indicates that the process sewer waste stream did not contaminate, above the subsurface clean-up criteria, the soils surrounding the process sewer line from the Imhoff tank to the outfall.

Surface activity measurements using a Geiger-Mueller detector were made on the interior of the process sewer pipe. The section of pipe surveyed indicated up to approximately 27,000 disinergrations per minute (dpm) per 100 cm^2 (dpm/100 cm^2) on the interior surface. The elevated readings were at the bottom of the pipe in the flow channel. Also, a removable alpha radioactivity swipe survey was performed on the flow channel of the pipe. The sample was collected by rubbing a piece of cloth (i.e., smear) over an approximately 100 cm^2 area and counting it with a Ludlum Model 2000 alpha scintillation detector. The results indicated 11 dpm/100 cm^2 total removable alpha radioactivity. Core type samples that represent the entire wall thickness were taken on the inlet and outlet of the remaining 80 ft section of process sewer pipe. Samples were collected from the flow channel and above the flow channel. The sample results are shown in Table 5-5. The concentrations of the chemical contaminants of concern are below the cleanup criteria and are summarized in Table 5-6.

Sample 2001, 2002, and 2004 were collected in the flow channel (i.e., lower quarter) of the pipe. This area of the pipe included about an 0.5 in. deep and 4 in. wide deposit of process waste sediments that had adhered to the pipe. Sample 2003 was collected above the flow line of the pipe. Pending verification by Oak Ridge Institute of Science and Education (ORISE) on the confirmation status of the process sewer line, the pipe will be filled with grout. This will eliminate any surface activity concerns and prevent reuse of the pipe in the future. However, since it is possible that the pipe might be removed and crushed in the future, calculations were performed to determine average contamination levels. To determine the average contamination levels for the pipe first the below flow line samples (i.e., 2001, 2002, and 2004) were averaged and then that result was averaged with the above flow line result using a weighted means of one quarter (i.e., below flow line) to three quarters (i.e., above flow line). The final weighted averages for the pipe are as follows:

- U-238 4.3 pCi/g
- Ra-226 4.0 pCi/g
- Ra-228 1.7 pCi/g
- Th-230 3.0 pCi/g
- Th-232 0.4 pCi/g

These results are below the cleanup criteria and do not take into account the volume of the grout.

TABLE 5-5 Radiological Results of the Process Sewer Pipe

		SAMPLE CONCENTRATIONS (pCi/g)				
SAMPLE I.D.	**LOCATION**	**U-238**	**RA-226**	**RA-228**	**TH-230**	**TH-232**
2001	Outlet below flow line	66.8*	28.6	2.3	3.8	0.5
2002	Inlet below flow line	4.2	2.9	1.5	2.6	1.7
2003	Inlet above flow line	0.9	1.5	1.7	3.2	0.3
2004	Outlet below flow line	6.0	3.3	1.3	0.9	0.8

* Result given is for total uranium. U-238 concentration would be approximately 50% of total uranium concentration. Reanalysis and other representative samples indicated that natural uranium was present.

TABLE 5-6 Chemical Results of the Process Sewer Pipe[a]

SAMPLE ID	ARSENIC	CHROMIUM	LEAD	THALLIUM	PCBs[b]	PAHs[c]	TNT
2001	3.4	21.1	7.8	<0.5	0.7	0.03	<0.1
2002	7.1	29.3	8.6	<0.6	0.3	0.2	<0.1
2003	4.8	22.1	5.8	<0.6	<0.1	<0.001	<0.1
2004	4.4	18.0	15.6	<0.1	<0.1	<0.001	<0.1

(a) All results in mg/kg
(b) The concentration and detection limit listed is a summation of Aroclor 1248, 1254, and 1260.
(c) The detection limit listed is a summation of the separate detection limits for the PAHs of concern listed in Table 2-1.
< Indicates the result was non detect and the value listed is the detection limit.

6 REFERENCES

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5400.5, *Radiation Protection of the Public and the Environment*

PROCEDURES

ES&H 2.3.8 *Contamination Survey*
ES&H 2.5.1 *Radiological Soil Sampling*
ES&H 2.5.2 *In Situ Radiation Measurements*
ES&H 2.5.5 *Sample Preparation Procedure for Radiological Soil Samples*
ES&H 2.5.8 *Th-230 Determinations in Soils by the UNC Method*
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