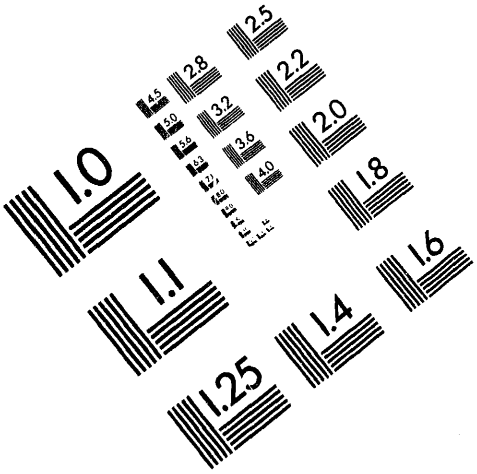

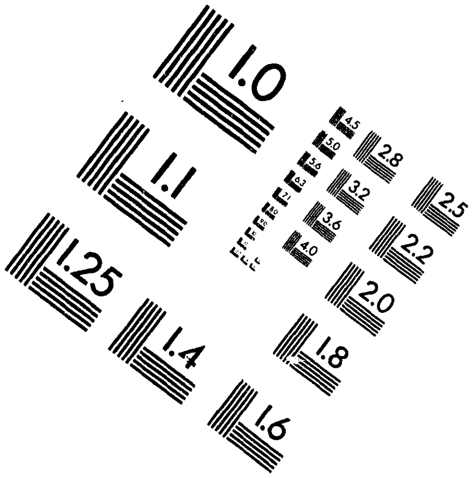

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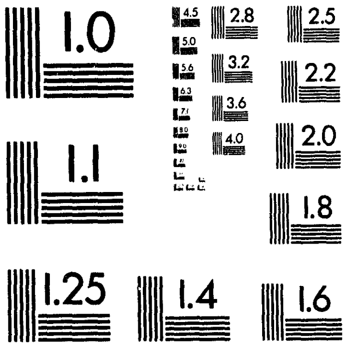

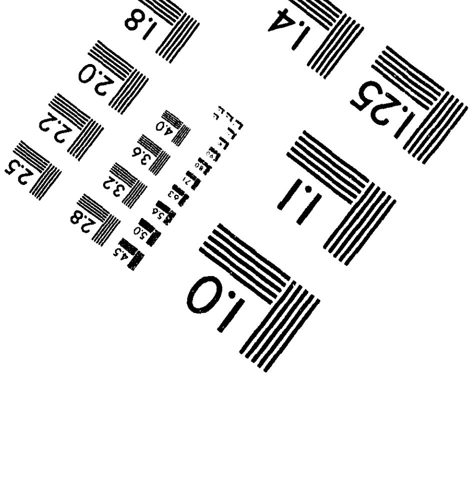

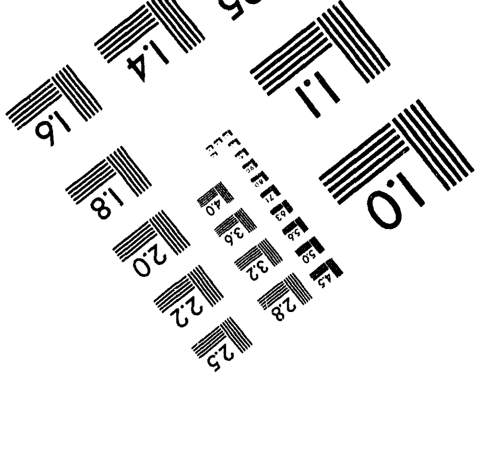

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DOE/RL-94-43
Revision 0

UC-630

118-B-1 Excavation Treatability Test Plan

Date Published
July 1994

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

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1.0 INTRODUCTION

The 100 Area of the Hanford Site has been divided into 25 Resource Conservation and Recovery Act (RCRA) Past Practice and Comprehensive Environmental Response Compensation and Liability Act (CERCLA) operable unit (OU) sites based mainly on location. These sites are very similar in the types of contaminants expected and methods of disposal used. The *Hanford Site Past-Practice Strategy* (DOE/RL 1991a) and the *Hanford Federal Facility Agreement and Consent Order Change Package* (Ecology et al. 1991) define an aggregate approach to the 100 Area that would evaluate groups of sites based on their similarity, instead of their location or OU designation. This approach supports integration of RCRA and CERCLA units as demonstrated in the 1994 Hanford Federal Facility Agreement and Consent Order revisions.

Remediation alternatives have been developed and screened in the *100 Area Feasibility Study Phases I and II* (DOE/RL 1993a). Currently, treatability data is needed to support Phase III, Detailed Analyses. The *Treatability Study Program Plan* (DOE/RL 1992) outlines treatability studies to support remediation of the 100 Area. This plan discusses the near-term need to test excavation and sorting systems to support waste excavation and disposal.

The Hanford 118-B-1 Burial Ground Treatability Study has been required by milestone change request #M-15-93-04, dated September 30, 1993. The change request requires that a treatability test be conducted at the 100-B Area to obtain additional engineering information for remedial design of burial grounds receiving waste from 100 Area removal actions.

1.1 PURPOSE

This treatability study has two purposes: (1) to support development of the Proposed Plan (PP) and Record of Decision (ROD), which will identify the approach to be used for burial ground remediation, and (2) to provide specific engineering information for receiving waste generated from the 100 Area removal actions. Data generated from this test also will provide critical performance and cost information necessary for remedy evaluation in the detailed analysis of alternatives during preparation of the focused feasibility study (FFS). This treatability testing supports the following 100 Area alternatives: (1) excavation and disposal, and (2) excavation, sorting (treatment), and disposal.

1.2 SCOPE

This treatability investigation focuses on the feasibility of excavating, analytical screening, and handling waste materials in the 118-B-1 General Purpose Burial Ground. The 118-B-1 Burial Ground consists of approximately 20 trenches in a 7-acre parcel. The test plan integrates the Streamlined Approach for Environmental Restoration (SAFER), a U.S. Department of Energy (DOE) initiative based on both the Data Quality Objective (DQO) process and the observational approach. The tri-parties, consisting of the DOE Richland Operations Office (DOE/RL), the U.S. Environmental Protection Agency (EPA), and the State of Washington Department of Ecology (Ecology), have endorsed this trial application of SAFER at Hanford to identify data needed to support the decisions to be made and to optimize the management of uncertainty during data collection and engineering. This test plan is the first at Hanford to use the SAFER approach.

Six scoping meetings were held by the tri-parties between January 13 and February 15, 1994, to define required treatability test DQOs and data needs. The scope of work agreement and the DQOs resulting from these meetings are included in Appendix A. These DQOs serve as the basis for this treatability test plan.

The general scope of the treatability test plan includes excavating five trenches within the 118-B-1 Burial Ground area, with the guideline of excavating 5,000 to 10,000 cubic yards of waste material. The goal of the treatability test is to gather data regarding the effectiveness of excavating, analytical screening, and handling waste materials. Specifically, one of the goals of the test is to demonstrate the feasibility of separating waste forms into the following four categories:

- **Containers** include any enclosed receptacle that may contain other waste materials. A container may be constructed of any material, including metal, cardboard, or plastic. Cardboard boxes are the only container type that is considered not to contain free liquids.
- **Soil** includes all naturally inorganic materials, such as earth and rock.
- **Hard Waste** consists of all metallic and reasonably incompressible solids.
- **Soft Waste** consists of all nonmetallic and compressible solid wastes.

All excavated materials, except free or organic liquids, will be replaced in the burial ground.

The results of the treatability test will be used to determine the feasibility of performing excavation, analytical screening, and handling of burial ground materials. However, there exists the possibility that performance testing of these operations will not yield quantitative nor transferrable data.

1.3 BACKGROUND

Solid low-level radioactive wastes and other debris and trash associated with the reactor operations were disposed in 28 burial grounds in the 100 Area during the period between 1944 and 1973. The majority of waste generated from routine reactor operations was placed in seven primary burial grounds. One of these burial grounds, the 118-B-1 Burial Ground, has been selected as the location to perform this treatability test because of the availability of historical data for this site and because it is thought to be representative of other primary-use burial grounds in the 100 Area. The 118-B-1 Burial Ground was used primarily for radiologically contaminated wastes from the 105-B Reactor.

Historical records indicate the 118-B-1 Burial Ground contains a great variety of waste forms. Some of the wastes were segregated into specific trenches during disposal. Typical wastes reported to be included in the burial ground include aluminum tubing; gloves, booties and other personal protective clothing; lead and steel piping; lead shielding and bricks; splines; and paper and cardboard.

The 118-B-1 Burial Ground is located in the 100 B/C Area of the Hanford Site (Figure 1-1), in the 100-BC-2 Operable Unit (Figure 1-2).

1.4 OVERVIEW OF TREATABILITY TEST PLAN

The remainder of this treatability test plan is organized into the following sections:

- **Section 2**—Conceptual Model. The conceptual model for the site includes a summary of the background and expected conditions at the site.

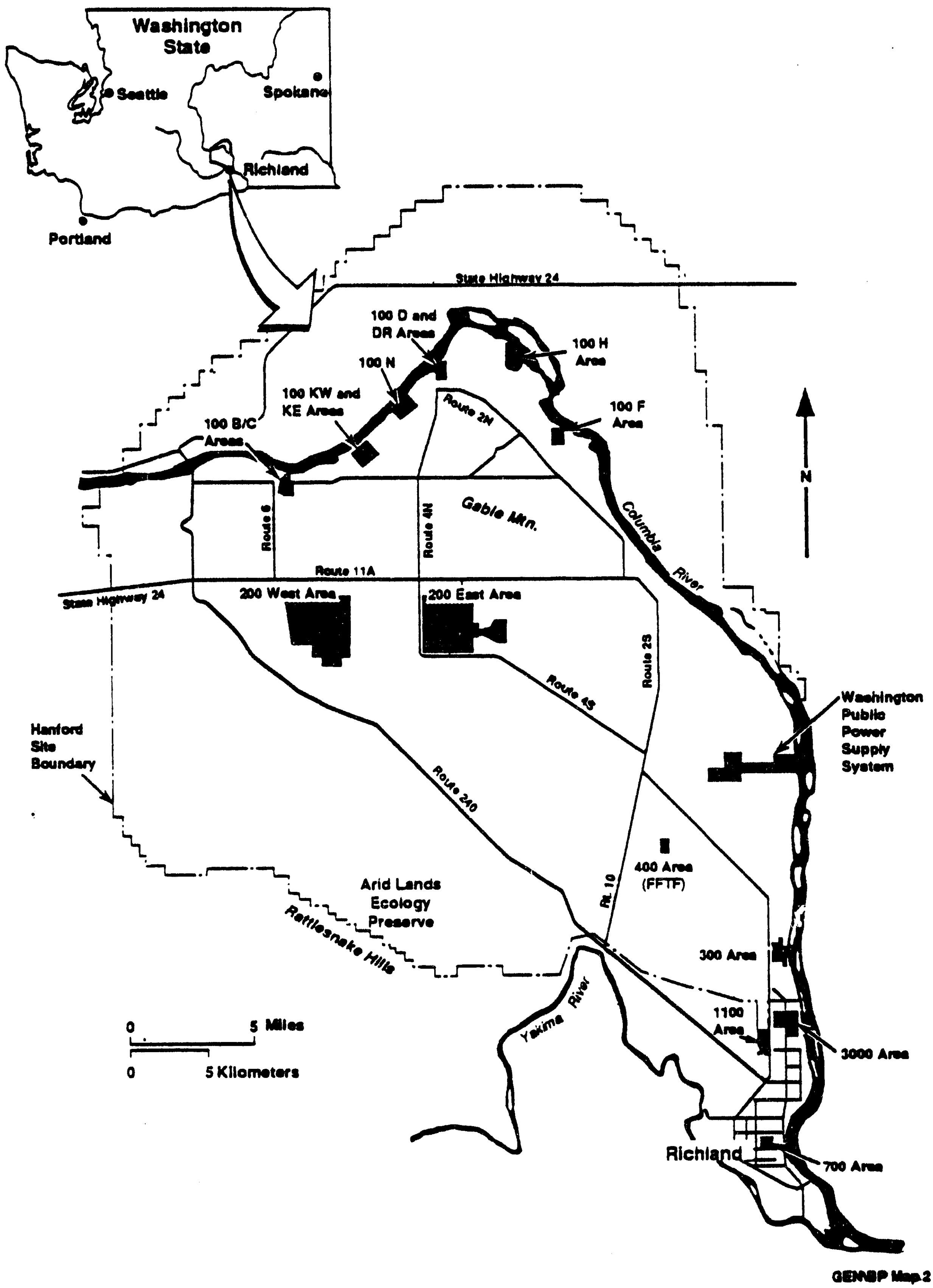
- **Section 3**—Treatability Test Objectives and DQOs. This section presents the overall test objectives and describes the evaluation criteria and data requirements to properly evaluate the objectives. This section refines and expands the DQOs developed during the tri-party scoping meetings.

- **Section 4**—Experimental Design and Specification. This section establishes a framework for the implementation of the treatability test. The central issues addressed in this section include guidelines for the following activities: (1) selection of the trenches to be excavated for the treatability testing; (2) assurance that sufficient data are collected to satisfy the excavation, screening, and handling DQOs; (3) overburden removal and stockpiling; and (4) trench closure. This section also presents an uncertainty management table for each of the field operations. The uncertainty management tables indicate expected and probable conditions, uncertainties, observations, and contingencies.

- **Section 5**—Equipment and Materials. This section presents an equipment and materials list, along with brief text explaining why those pieces of equipment and materials will be needed to implement the treatability test.

- **Sections 6 through 10**. These sections provide supporting documentation, reports, treatability test schedule, program organization, and references, respectively.

Figure 1-1. Location of the 100 B/C Area.



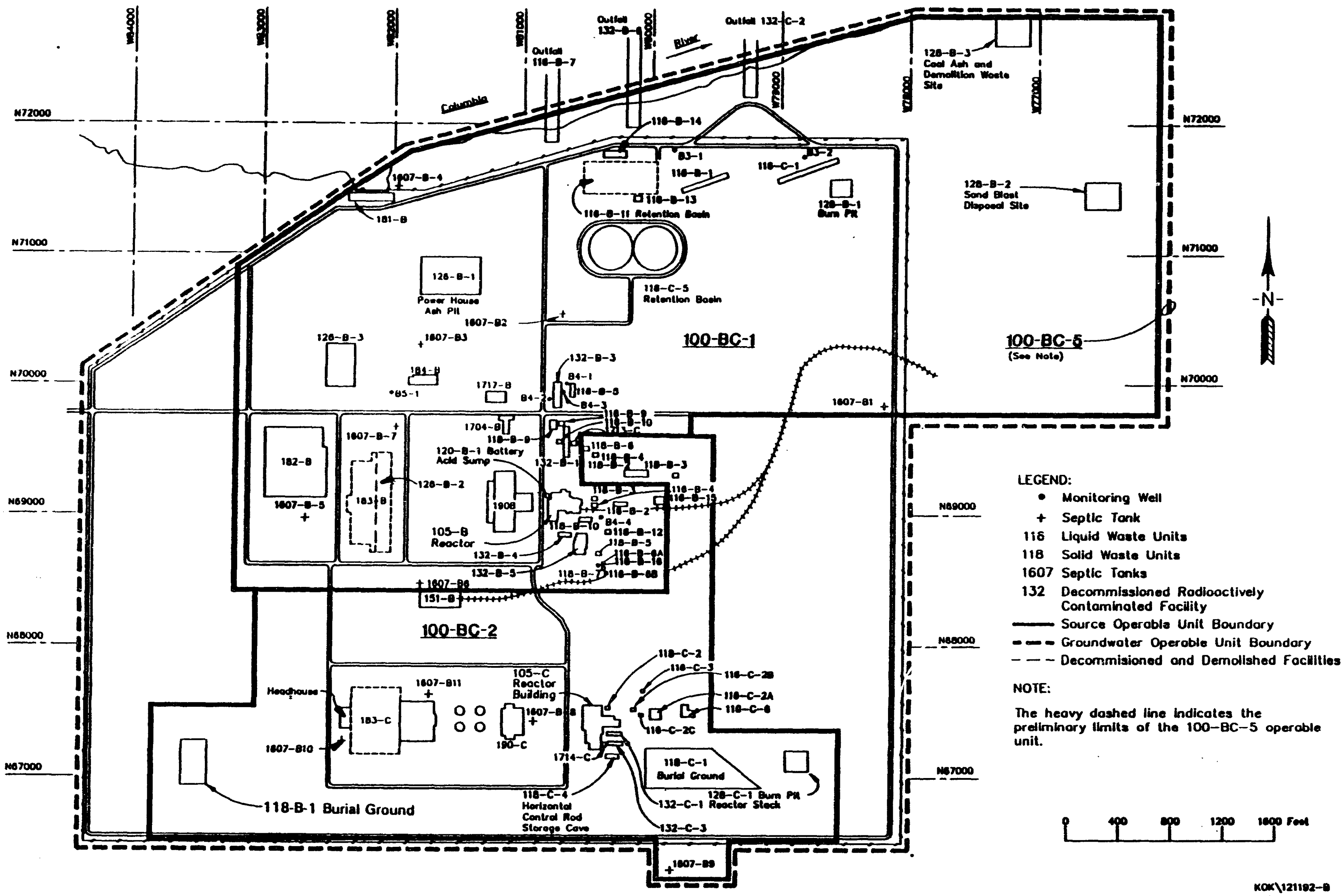


Figure 1-2. 100-BC-2 Operable Unit Map

2.0 CONCEPTUAL MODEL

This section includes an expanded description of the burial ground site and site history, a discussion of the expected waste types and their chemical and radiological compositions, and a discussion of the expected excavation conditions. The purpose of this section is to provide sufficient information to formulate a conceptual model of the burial ground conditions. This model is used to determine deviations and contingencies for the treatability test.

2.1 SITE DESCRIPTION AND HISTORY

A total of 28 burial grounds were utilized in the Hanford 100 Area for direct burial of solid low-level radioactive waste associated with reactor operations. Seven of these specifically supported reactor operations and are considered primary burial grounds. The 118-B-1 Burial Ground supported reactor 105-B from approximately 1944 through 1973. It was the primary burial ground for 105-B Reactor wastes, but also received waste from the 100-N Reactor and the Tritium Separation Program (P-10 Project). The 118-B-1 Burial Ground has also been referred to as the 105-B Burial Ground, the 105-B Solid Waste Burial Ground, and the Operations Solid Waste Burial Ground. During the 1950s, two other burial grounds were added adjacent to the 118-B-1 Burial Ground (WHC 1994). These additions were originally known as the 108-B Solid Waste Burial Ground and the Extension to Burial Ground No. 1. The 118-B-1 Burial Ground consists of the 105-B Burial Ground and these two additions.

The 118-B-1 Burial Ground is located in the 100 B/C area of Hanford, about 3,000 feet due west of the 105-C reactor. Its dimensions are about 1,000 feet long running north and south, by 320 feet wide running east and west. Historical records indicate that the trenches were typically 300 feet long, 20 feet wide, and 20 feet deep, and were separated by 20-foot spaces (Stenner et al., 1988). It is believed that the burial ground contains 21 trenches running east-west and 3 trenches running north-south (see Figure 2-1). Wastes typically were covered with 4 feet of clean soil.

The vicinity of the 118-B-1 Burial Ground is characteristic of the Hanford area and consists of a flat, semi-arid bench, south of the Columbia River. The burial ground is distinguished from its surroundings by 4 to 5 feet of fill (sandy gravel with cobbles) above natural ground level. The resultant mound contains no vegetation. Concrete posts surround the perimeter of the mounded area and are presumed to indicate where the trenches are located. Additional signs reading "Caution: Underground Radioactive Material" are posted around the site. Blue and green survey stakes have also been placed around the perimeter on 10-foot centers for the purpose of orientating the ground-penetrating radar (GPR) survey conducted in 1993.

In 1950, the 108-B Burial Ground extension was added adjacent to and south of the original 118-B-1 Burial Ground site (Heid 1956, DOE/RL 1993b). It contained 3 trenches (P-1, P-2, and Trench 13) that are now covered with 6 feet of soil. A second extension was

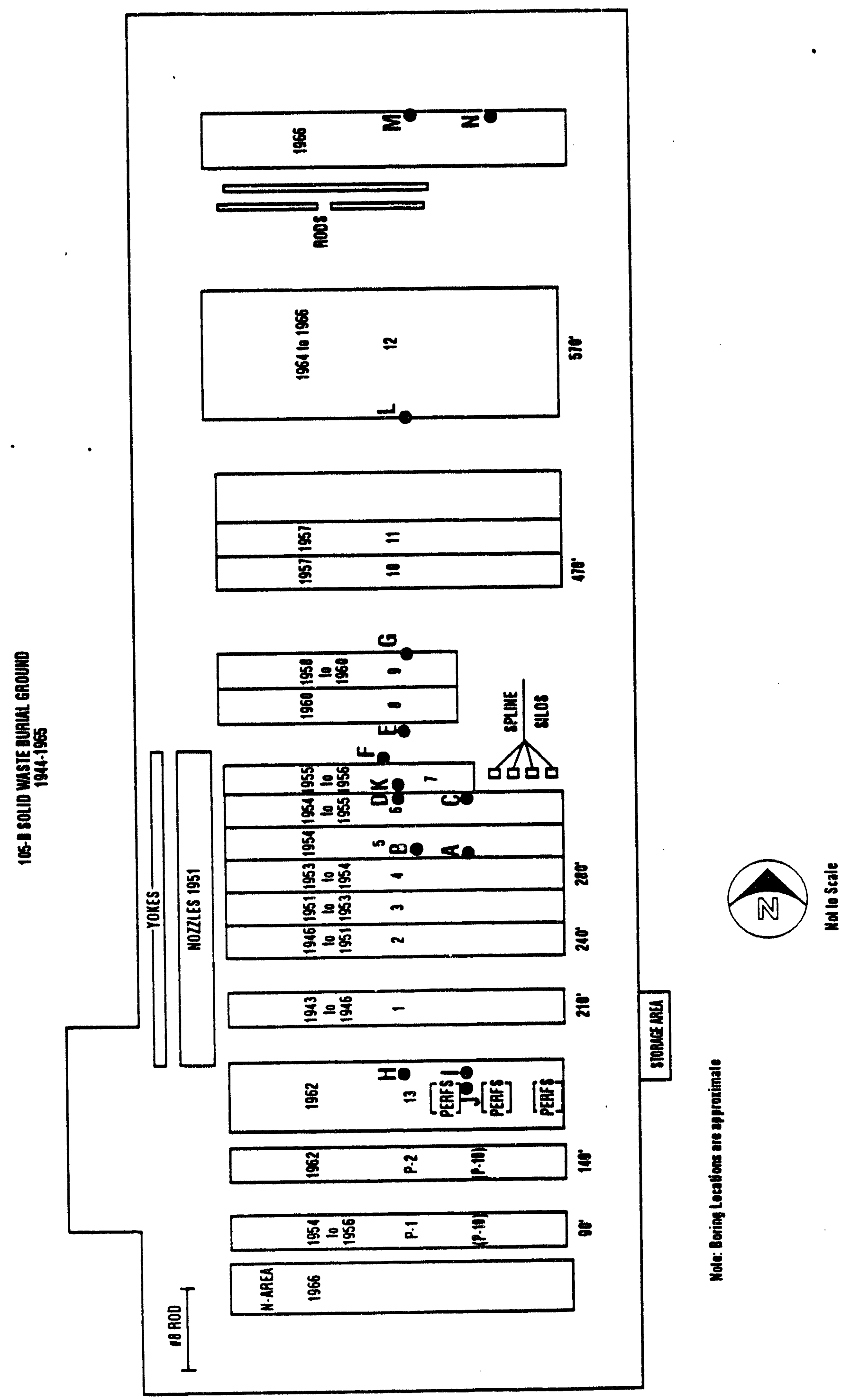


FIGURE 2-1
118-B-1 Burial Ground
(Dorian and Richards, 1978)

added to the middle of the west side of 118-B-1 in 1956. This extension is about 200 feet long by 50 feet wide, and is located where the yokes and nozzles are indicated on Figure 2-1.

A subsurface investigation was conducted at the 118-B-1 Burial Ground in 1976 (Dorian and Richards, 1978). The purpose of this investigation was to identify radionuclides; quantify radionuclide concentrations and vertical and horizontal distribution; and measure specific activities in various trenches. Fourteen borings were advanced through various trenches. The trenches used before 1956 showed little radionuclide contamination, while more recent trenches produced samples that had activities exceeding 80,000 counts per minute measured with an in situ Gieger-Mueller (GM). The highest dose reading during the sampling effort was 300 mR/hr. Samples recovered included pieces of wood, plastic, sheet cadmium, cardboard, steel tubing, and reactor poison, which is a piece of reactor hardware for absorbing neutrons. Concrete debris was found in Boring L (located in Trench 12) at 23 feet below the existing ground surface (see Figure 2-1).

A geophysical survey of the 118-B-1 Burial Ground was conducted in 1993. The purpose of this investigation was to locate primary concentrations of buried waste and possibly determine trench locations. Ground-penetrating radar and electromagnetic induction were the two techniques used in the investigation. Twenty-two zones were identified as containing high concentrations of debris (Bergstrom et al. 1993).

2.2 WASTE TYPES

The types of waste disposed in the 118-B-1 Burial Ground can be grouped into four general categories: soft waste (trash), miscellaneous waste, metallic waste, and special waste. Trash or soft waste consists of contaminated paper, plastic, rags, and clothing packaged in cardboard boxes and is estimated to make up more than 75 percent of the waste volume (Dorian and Richards, 1978). Metallic waste consists of reactor hardware, equipment, and tools that had been disposed due to excessive radiation levels or because they were worn out or broken. Special waste consists of items disposed from the tritium separation project or the N-reactor.

2.2.1 Soft Waste

Soft waste (referred to as trash in the *105-B Burial Ground Log*) is expected to be the primary waste in the burial ground. There is no documentation regarding what was disposed as trash, but Dorian and Richards (1978) suggest that most of the soft waste consists of the following:

- Kraft paper reinforced with tar and nylon (used like plastic sheeting today) was used to mask reactor surfaces during operation and maintenance, cleanup of spills, and outages in the reactor. Hence, the kraft paper contains residual radiological contamination.

- Step-off pads, worn-out personal protective clothing, and rags

- Broken and worn-out disposables such as sampling pumps and hose, underwater lights, and rope

The soft and miscellaneous wastes typically were placed in cardboard boxes 4.5 cubic feet in size and estimated to average 25 pounds.

The disposal log lacks inventory information for soft wastes disposed in some of the earlier years of operation. For example, during the period from 1950 and 1960, entries regarding disposal of trash boxes are absent from the log. However, during 10 months of operation in 1965, the log indicates that approximately 4,000 cubic feet (almost 1000 boxes) of trash were generated and disposed. During that same period, other types of disposed wastes amounted to about half of the volume, or 2,000 cubic feet.

Review of the 105-B Burial Ground Log indicates that, at times, some effort was made to separate the soft waste from the other types of waste. Review of an aerial photograph indicates that several trenches were open at the same time and that some segregation was evident. It also appears that the boxes of trash were dumped randomly, as opposed to stacking.

2.2.2 Miscellaneous Waste

Miscellaneous waste consists of those items, such as concrete, wood, and other construction materials, that do not necessarily fit into one of the other categories. Although these types of waste materials were listed sporadically in the burial log, they typically were disposed in large volumes. In addition, some of the samples recovered from the subsurface investigation conducted in 1976 consisted of concrete and wood pieces. Therefore, it is anticipated that these types of materials will be found in the trenches during the treatability test.

2.2.3 Metallic Waste

Metallic waste refers to the typical metallic hardware, tools, and equipment used during normal operation, maintenance, and repair. The burial records primarily focused on the metallic waste types because they generally contained the most radiological activity. Table 2-1 presents a summary of the types and sizes of metallic wastes expected at 105-B-1, based on the 105-B Burial Ground Log and *Estimates of Solid Waste Buried in 100 Area Burial Grounds* (Miller and Wahlen, 1987). While the number of pieces and the total estimated disposed weight may conflict with other references, the table provides an indication of the relative magnitude of metallic waste disposal by type. For example, there is a higher probability that spacers rather than gun barrels will be encountered during the treatability test.

Limited information was recorded with respect to miscellaneous metallic wastes such as valves, pumps, pipe, tools, and other contaminated/broken items that necessarily result from 22 years of reactor operation. It should be recognized that the reactor hardware was more closely tracked because of operation costs. Reactor hardware materials typically had a higher level of contamination, and some was presumed to have the potential for reuse in the

Table 2-1. Metallic Waste Inventory.

Material Name	Material Type	Diameter or Dimensions (inches)	Approximate Length (feet)	Approximate unit weight (lbs)	Approximate No. of Units	Approximate Total Weight (tons)	Reference
Spacer/Dummy	Aluminum	1.4	0.67	0.5	517,000	129	1
Spacer/Dummy	Lead	1.4	0.67	4.0	41,300	83	1
Spacer/Dummy	Steel	1.4	0.67	1.5	6,540	5	1
Poison	Lead-Cadmium	1.4	0.5	3.4	7,220	12	1
Process Tubing	Aluminum	1.75	40	19	4,270	41	2
Nozzles and Pigtails	Steel/Aluminum	N/A	N/A	12	4,500	27	1 & 2
Gunbarrels	Steel	2	7.6	27	75	1	2
VSR & HCR Thimbles	Aluminum	3.5	35	90	26	1	1
VSRs	Steel	3	32	83	36	1.5	1 & 2
HCRs	Aluminum	3.5 X 1.5	40	88	17	0.75	1 & 2
Bricks	Lead	N/A	N/A	25	N/A	0.2	2
Sheets	Lead and Cadmium	N/A	N/A	N/A	N/A	13	2
Graphite Dust		N/A	N/A	N/A	N/A	0.2	2
Splines	Aluminum/ Boron	1/2 X 1/16	30	1	26,000	13	2
Ball 3X System Balls	Boron/Carbon Steel	0.375	--	N/A	N/A	N/A	3

References:
1. 105-B Burial Ground Log
2. Estimates of Solid Waste buried in 100 Area Burial Grounds, Miller & Wahlen, WHC-EP-0087, 1987.
3. Summary of 100 B/C Reactor Operations and Resultant Wastes, Gerber, WHC-SD-EN-RPT-004, 1993.

Notes:
1. N/A indicates information is not available.
2. Valves, pumps, pipe; tools; scaffolding; and ladders were all mentioned in the 105-B burial ground log; however, there is insufficient information to estimate a quantity of material.
3. VSR = Vertical Safety Rod
4. HCR = Horizontal Control Rod

future. Consequently, other materials not specifically accounted for in the burial ground records may be encountered during the treatability test.

2.2.4 Special Waste

Special wastes consist of those materials that were disposed in the burial ground as a result of a particular project or program. These wastes are anticipated to be confined to a specific trench or trenches, rather than distributed in trenches throughout the burial ground. The special wastes include metals, glass, and other miscellaneous materials disposed from N-Reactor and the Tritium Separation Program. The special wastes are also presumed to include liquid tritium waste that was sealed in carbon steel pipes and buried. The quantity of liquid tritium buried is not known. The inventory of materials expected from these sources is summarized in Table 2-2.

2.2.5 Radiological Composition

The radiological composition of the 118-B-1 Burial Ground is described in two documents: *Radiological Characterization of the Retired 100 Areas* (Dorian and Richards, 1978) and *Estimates of Solid Waste Buried in 100 Area Burial Grounds* (Miller and Wahlen 1987). The Dorian and Richards document presents sample analysis taken from bore holes in the 118-B-1 Burial Ground and is the only source of empirical radiological data from samples collected in the 118-B-1 Burial Ground. The Miller and Wahlen document uses sample information from the Dorian and Richards document and process knowledge of 100 Area reactor operations to derive an estimate of the 100 Area burial ground waste volume and inventory. This estimate is considered the most accurate description available of the burial ground's inventory.

MICROSHIELD[1], a dose modeling program, was used to estimate the dose rates from the different waste types listed in Miller and Wahlen. Input to the model consisted of the radionuclide inventory from Table 2-3 and the assumed waste configuration. The results are presented in Table 2-4, which lists the expected dose rates from individual waste types without contribution from any other material. The materials are listed below in descending order of dose rate (see Table 2-4):

- Aluminum tubes
- Miscellaneous waste
- Soft waste
- Lead brick
- Aluminum/boron splines
- Graphite
- Lead/cadmium poison pieces
- Lead sheet
- Desiccant

[1] MICROSHIELD is an industry standard radiation dose modeling software package.

Table 2-2. Special Waste Inventory.

Material Name	Material Type	Diameter or Dimensions (inches)	Approximate Length (feet)	Approximate unit weight (lbs)	Approximate No. of Units	Approximate Total Weight (tons)
N-Reactor:						
Cooling Tubes	304 Stainless Steel	5/8"	100	260	1,920	270
Tritium Separation Program:						
Containers	Lithium-Aluminum Alloy	N/A	N/A	N/A	N/A	19
					7,500	15
Pots	Lead	N/A	N/A	N/A	N/A	1
Pumping Material	Mercury	N/A	N/A	N/A	N/A	1.3
Piping	Glass	N/A	N/A	N/A	N/A	1.5
Target	Aluminum Cladding	0.35 thick	0.33	0.1	N/A	
None Identified	Palladium	N/A	N/A	N/A	N/A	Trace

Reference:

1 Estimates of Solid Waste buried in 100 Area Burial Grounds, Miller & Wahlen, WHC-EP-0087, 1987.

Note:

1 N/A indicates that information is not available.

2 T[illegible]pler pumps were mentioned in the reference above; however, there is insufficient information to estimate a quantity of material.

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Table 2-3. 1994 Radionuclide Composition of Waste Buried in the 118-B-1 Burial Ground.

Material	Weight[B] (tons)	Volume[B] (m^3)	^{3}H	^{14}C	^{60}Co	^{63}Ni	^{59}Ni	^{137}Cs	^{90}Sr	^{152}Eu	^{154}Eu	^{108m}Ag	^{133}Ba
			(Ci/m^3)[C]										
Aluminum Spacers	55.25	18.78			0.0002								
Lead/ Cadmium Poison Pieces	209	16.72			0.0357							0.5181	0.0188
Aluminum/ Boron Splines	10.5	3.6			0.12								
Graphite	0.08	0.03	8.1	5.8		0.28				0.040	0.317		0.0186
Aluminum Process Tubes	40.57	13.7			6.65	14.9	0.124	0.0124	0.0123	0.113	0.059		
Desiccant	1.50	0.91	0.81	0.044									
Lead (brick and sheet)	30.0	2.42	0.0279	0.0414	0.0165					0.0290	0.0476		
Miscellaneous[A]	21.5	2.80			3.98	12.3	0.107						
Cadmium sheet	0.05	0.005											
Soft Waste	248	225.4			0.023	0.0528							
Thermocouples	0.03	0.003											
Stainless Steel Steam Generator Tubes	250	57.5	Total radionuclide inventory of ^{93}Zr, ^{93}Mo, ^{94}Nb, and ^{99}Tc estimated to be <0.01 Ci (Miller and Wahlen, 1987).										
Tritium Separations Project - Glass Line Waste	37.6	11.28	226.8										

[A] Includes: gunbarrels, thimbles, horizontal control rods, vertical safety rods, nozzles/pigtails, and tools.
[B] Radionuclide composition based on material disposed to the 118-B-1, -2, -3, -4, and -5 burial grounds (Miller and Wahlen Tables 9, 10, 11, 12, and B-1).
[C] Concentrations derived from total curies in the burial ground (decayed to 1994) divided by total volume for each waste type.

Source: Miller and Wahlen, 1987.

Table 2-4. Estimated Dose Rates for Burial Ground Waste Types.

Waste Type	Size (LxWxD)[a]	Bulk Void Volume[b]	Contact Point	Estimated Contact Dose Rate (mR/hr)[c]
Aluminum Spacers	2' x 2' x 1.125'	50%	Top Center	0.19
Lead/Cadmium Poison Pieces	Sphere 2' diameter	50%	Sphere Surface	33.5
Aluminum/Boron Splines	Sphere 5.37' diameter	30%	Sphere Surface	136
Graphite (broaching)	2' x 2' x 1.125'	30%	Top Center	37.1
Aluminum Process Tubes	2' diameter x 3' long cylinder	50%	Side Center	6,401
Desiccant	1.5' diameter x 2.27' long cylinder with 0.035" steel wall	20%	Side Center	[d]
Lead Brick	2" x 4" x 8"	0%	Top Center	171
Lead Sheet	2' diameter x 3' long cylinder	40%	Side Center	7.68
Miscellaneous	2' x 2' x 1.125'	50%	Side Center	1,652
Cadmium Sheet	Insufficient Data	N/A	N/A	No radionuclide data
Soft Waste	2' x 2' x 1.125'	60%	Side Center	234
Thermocouples	Insufficient Data	N/A	N/A	No radionuclide data
Stainless Steel Steam Generator Tubes	Insufficient Data	N/A	N/A	Negligible - total inventory estimated as <0.01 Ci.
Tritium Separations Project - glass line waste	Insufficient Data	unknown	N/A	unknown[d]

[a]Size assumed based on professional judgement. 2'x 2'x 1.125' is the assumed size of cardboard boxes. Cardboard boxes have a wall thickness of 0.125 inches.
[b]Void volume assumed based on professional judgement.
[c]Estimated dose rate from MICROSHIELD calculation based on material inventory (Table 2-3), size, void volume, and measurement point.
[d]Beta radiation only; dose rate negligible.
N/A = Not Applicable

2.2.6 Chemical Composition

Because of the lack of data on chemical constituents, little information exists on the chemical composition of the 118-B-1 Burial Ground wastes. However, it is likely that the following chemical contaminants are present in the 118-B-1 Burial Ground:

- Mercury from manometers and P-10 (tritium) project wastes
- Lead brick and sheet from used shielding or shielded waste packages
- Boron, lead, and cadmium from used aluminum/boron splines and lead/cadmium poison pieces

This list is based on a review of the available data: the 118-B-1 Burial Ground Log, Miller and Wahlen (1987), and conversations with personnel present during 118-B-1 operations.

Containerized liquids and gases are not expected in the burial ground because standard practices did not involve disposal of containerized free liquid or spent gas cylinders. Aerosols were used in this time period and they could be a potential source of VOCs and free liquids in the burial ground. Liquid wastes were usually sent to cribs for disposal. Spent hydraulic oil, contained in drums, and mercury are the only potential liquid wastes in 118-B-1; however, the available data does not indicate that hydraulic oil was disposed in the burial ground.

Burial grounds are not expected to contain contamination by volatile organic compounds (VOCs) for the following reasons:

- Little if any volatile organic solvents were used in 100 Area operations.
- Liquids generally were not buried in the 118-B-1 Burial Ground.
- The material was deposited no later than 1973–thus, if any noncontained VOCs were originally present, they are expected to have at least partially evaporated.

2.3 EXPECTED EXCAVATION CONDITIONS

This section describes the expected excavation conditions based on review of the documents referenced in this section and speculation on how the materials weathered in the burial ground over the years. Some of the locations referenced within the burial ground are shown in Figure 2-1.

In general, it is expected that most of the trenches consist of waste that was dumped in an open trench. The burial log indicates that during trench filling, soil cover was used only when the waste emitted an unacceptable level of radiation at the trench edge. Therefore, it is expected that most of the time, the interface from the waste trench to the native soil will be discernable. However, it is also likely that portions of the trench will consist of waste forms mixed into the soil, making it very difficult to discern the trench limits.

Based on review of the *Full-Scale Retrieval of Simulated Buried Transuranic Waste* (Valentich 1993), it is expected that a trackhoe equipped with a thumb is the best equipment for the burial ground excavation. This document describes the capabilities of different equipment used in a simulated waste excavation. Although the simulation consisted of nonhazardous and nonradioactive materials, the test demonstrated the ability of the trackhoe with thumb to segregate and remove various waste forms in a simulated burial ground. The conditions expected at the 118-B-1 Burial Ground are worse than those encountered during the full-scale simulation in terms of the native soil type, the variety of waste forms, and the safety concern of unearthing a piece of contaminated waste; however, it is expected that the trackhoe with thumb will be able to perform the bulk removal and segregation to some degree of proficiency. If the equipment does not perform as expected, the test should not be considered a failure because the information learned will be valuable for the remedial design and for implementation of the remedial action.

As mentioned earlier, the soft waste is expected to be contained in cardboard boxes and occasionally in barrels. It is expected that the cardboard boxes have been crushed by the weight of the overburden, and that they are fragile and possibly partially disintegrated. Historical data suggest that the soft waste was mixed with other types of waste and soil, and that the boxes were randomly dumped on top of one another. Where notes of soft waste exist in the burial log, they indicate that the burial locations tended to be near the eastern ends of the trenches.

Unboxed, contaminated miscellaneous wastes should be expected in most trenches. In some trenches, the miscellaneous waste is expected to be fairly well centralized in pockets having a reasonably large volume.

The metallic waste is expected to be found in somewhat segregated piles. Some of the burial log entries indicate that some of the metallic waste was grouped into areas. Historical data suggest that spacers were dumped directly into the trench and covered with soil. There is an indication in the 105-B Burial Ground Log for 1962 that three railroad tie cribs measuring 8 feet square and 20 feet deep would be constructed for spacers, and a historical photograph confirms the construction of these cribs. The burial log indicates that spacers/dummies were disposed loose (measured in buckets); it is presumed this means that spacers were dumped by the bucketful, rather than actual buckets full of spacers being disposed in the burial ground.

In 1951, nozzles, yokes, steel dummies, and lead dummies were placed in north-south trenches along the western edge of the burial ground. Splines were chopped into short lengths (about 1.5 inches) as they were withdrawn from the pile. They were then dropped into shielded casks and buried in the burial ground near the reactor (Gerber 1993). Other records indicate that splines were coiled instead of chopped prior to disposal. Vertical safety rods and horizontal control rods supposedly were placed adjacent to the northernmost trench.

Objects identified in the GPR survey indicate that the rods were not cut. Aluminum process tubes were cut to about 3-foot lengths and bundled or disposed loose. The burial logs indicate that a bundle of tubes measured approximately 10 cubic feet in size. Split tubing was sometimes wrapped in paper and bundled in smaller sizes. At least one burial log entry indicates that pigtails and nozzles were boxed at least once.

The special waste is expected to be present in the three southern trenches of the burial ground. The trench marked N-Area is expected to contain about 270 tons of 5/8-inch stainless steel tubing from the N Reactor. Trenches P-1 and P-2 are expected to contain the wastes from the tritium separation program, with P-2 containing more of the waste as a result of the demolition of the process equipment. Trench P-1 is expected to contain more of the reactor hardware parts described previously.

It is expected that some of the trenches located near the center of the burial ground are located in close proximity to one another, with little clean soil separating them. It is also expected that the later trenches (post-1960s) are wider and deeper than the earlier trenches, and that the north-south trenches may consist of several smaller-aligned trenches.

It is expected that Figure 2-1 is not accurately drawn to scale. The best information for locating trenches includes the burial ground trench markers, the geophysical survey map (Figure 4-1), the 1956 maps labeled "105-B Burial Ground" and "108-B Burial Trench," and the June 1962 map labeled "100-B Burial Trench." These last three maps are included in Appendix B.

3.0 TREATABILITY TEST OBJECTIVES AND DQOs

This section establishes the objectives of the 118-B-1 Excavation Treatability Test and describes the types and quality of data necessary to achieve the objectives. The core of this section is contained in three tables summarizing the project DQOs. Each table links the project objectives to the data requirements.

The original DQOs specified in the Hanford 118-B-1 Burial Ground Treatability Study Scope of Work Agreement were numbered sequentially to allow them to be cross-referenced with those described in this section (the original, the scope-of-work-based DQOs, and the numbering system are shown in Appendix A). The original DQOs are referenced by number in the DQO tables included in this section.

3.1 OVERVIEW OF TREATABILITY TEST OBJECTIVES

The goals of the treatability test are summarized in six objective statements, as presented in Table 3-1. The objectives are grouped according to the three operations being investigated as a part of this treatability test: excavation, screening, and handling.

Table 3-1. Treatability Test Objectives.

Operation	Test Objective
Excavation	Compare effectiveness of the top-down and side removal approaches.
	Identify waste forms requiring special excavation equipment and their frequency of occurrence.
Screening	Determine implementability of screening for currently established preliminary waste acceptance criteria for an environmental restoration disposal facility (ERDF) during bulk removal using field instruments and visual observations.
	Determine if contents of containers meet ERDF preliminary waste acceptance criteria using field instruments and visual observation.
Handling	Determine feasibility of segregating waste forms into categories during excavation using a backhoe with thumb.
	Determine feasibility of sorting waste forms into categories using a grizzly screen, disc screen, manual raking, and hand picking.

The following subsections further describe the test objective statements by defining the basis of comparison. The top-down and side removal approaches are presented, the ERDF preliminary waste acceptance criteria are defined, and the waste categories for segregation and sorting are discussed.

3.1.1 Excavation Operation: Removal Approaches

The excavation objectives are intended to determine the effectiveness of various waste form removal approaches and to identify those waste forms that are not amenable to removal using the designated standard excavation equipment (i.e., a trackhoe with a thumb). This treatability test considers three waste form removal approaches:

- **Top-Down, Beside Trench.** This excavation approach assumes the trackhoe will operate with its tracks parallel to the side of the trench and that the trackhoe will move forward and backward parallel to the trench. The waste material will be excavated or segregated from above so that, under normal circumstances, the operator generally will be looking down into the trench; thus, waste removal will be performed below operator eye-level. For trenches deeper than approximately 20 feet, the top-down/beside trench approach will include excavation in lifts. The advantages of this approach include a relatively stable platform for the trackhoe and a relatively large bucket swing range for removal and placement of excavated materials. Potential disadvantages of this approach include relatively poor operator visibility and limited reach to waste materials on the far side of the trench. Figure 3-1 illustrates the top-down/beside trench excavation approach.

- **Top-Down, Over Trench.** This excavation approach assumes the trackhoe will operate atop the unexcavated or backfilled trench material, and that the trackhoe will move forward and backward along the axis of the trench. Because the waste material has been in place for many years and covered with several feet of overburden, the waste is assumed to be mostly compressed and stable. Therefore, the equipment should be able to work close to the edge of the excavation. As with the beside trench approach, the waste material would be excavated or segregated from above so that the operator generally would be looking down into the trench; thus, waste removal would be performed below operator eye-level. Advantages of this approach include a relatively large bucket swing range for in-trench segregation and placement of materials. Potential disadvantages include a relatively unstable platform of compressible waste and limited reach inside the trench for removal of materials. Figure 3-2 illustrates the top-down/above trench excavation approach.

- **Side, Within Trench.** This excavation approach assumes the trackhoe will be excavating from within the trench with the boom extended toward the side. The movement of the excavator would be forward and backward along the axis of the trench. The waste material would be excavated or segregated above operator eye-level. Advantages of this approach include good operator visibility, with the most delicate operations being performed at eye-level, and a relatively large bucket swing range for in-trench segregation and placement of materials. Potential disadvantages include the need to "ramp in" and "ramp

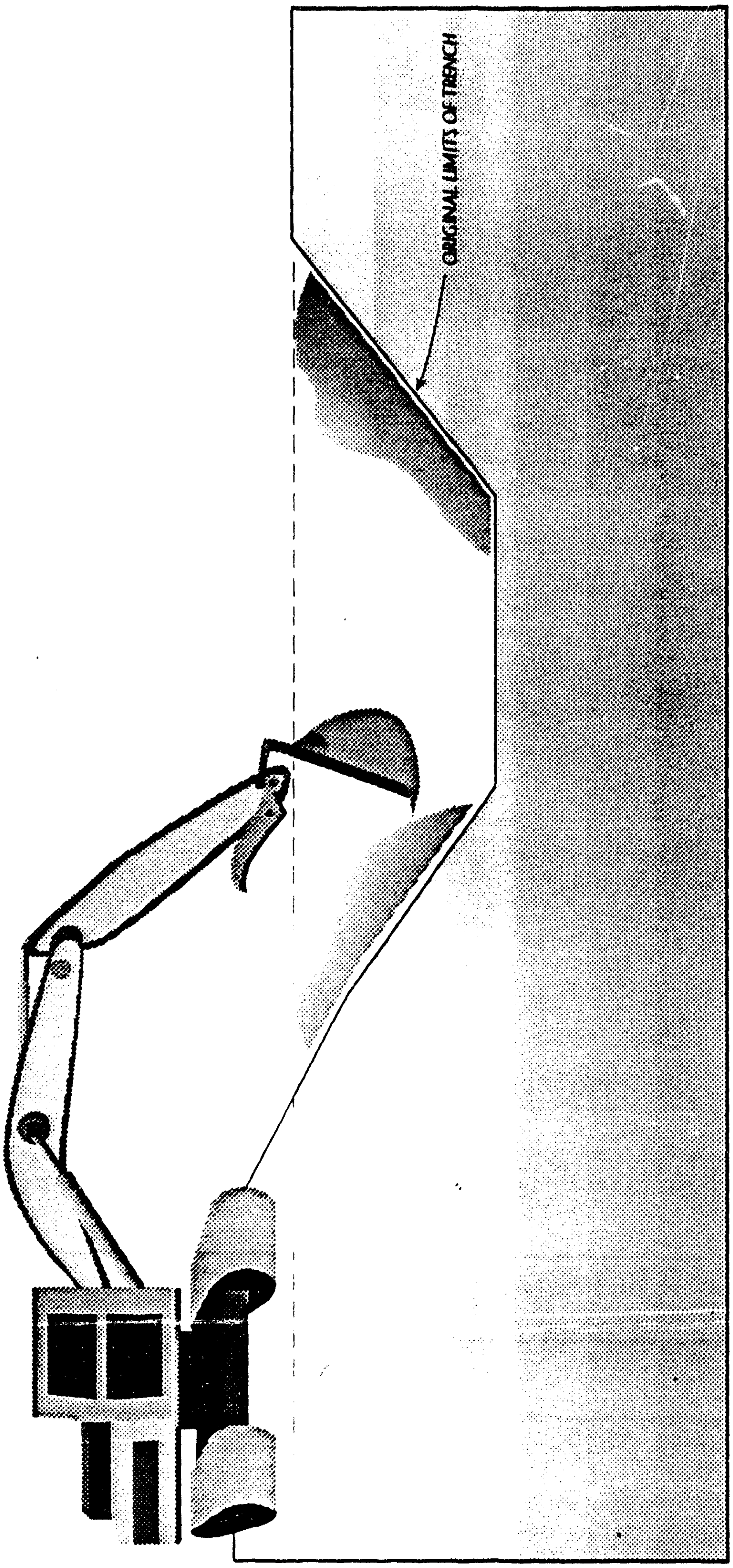

FIGURE 3-1
TOP-DOWN EXCAVATION APPROACH - BESIDE TRENCH

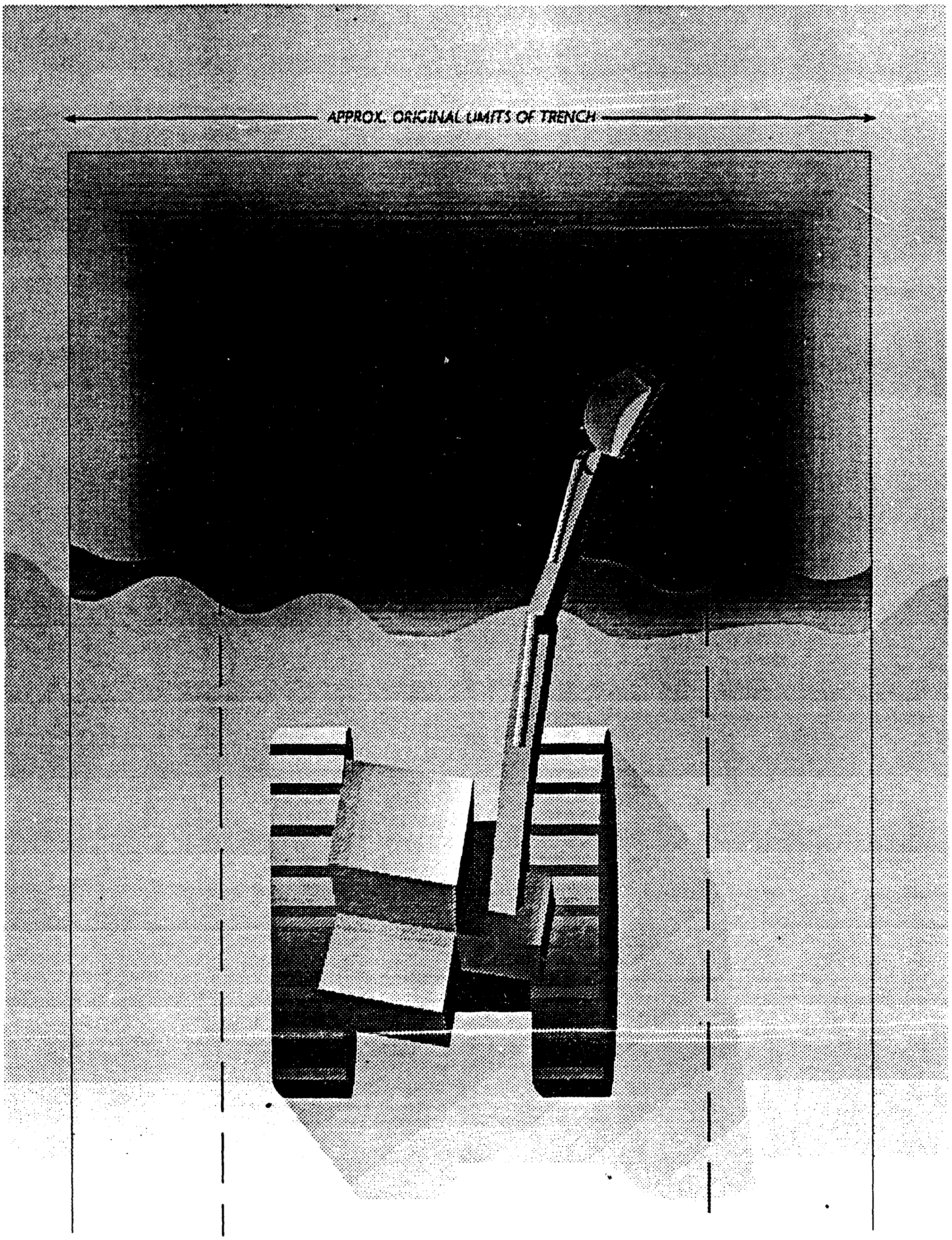

FIGURE 3-2
TOP - DOWN EXCAVATION APPROACH - OVER TRENCH

out" of the excavation (requiring additional excavation), the need to operate in a relatively confined work area without an easy escape route, and equipment limitations if the width of the excavator track exceeds the width of the bottom of the trench. This removal approach is disadvantaged in this test, because at full production scale, more room would be made available for the equipment to operate within the trench. Figure 3-3 illustrates the side/within trench excavation approach.

3.1.2 Screening Operation: ERDF Preliminary Waste Acceptance Criteria

The preliminary waste acceptance criteria are defined by what the ERDF will not accept. These materials are as follows:

- Radioactive waste greater than Category 3, as defined in *Hanford Site Solid Waste Acceptance Criteria* (WHC 1993)

- Transuranic (TRU) waste

- Waste with organic contamination greater than 10 percent by volume from a liquid source

- Free liquids

3.1.3 Handling Operation: Segregation and Sorting

The handling operation consists of two functions as defined below:

- **Segregation**–The separation of waste forms within the trench using a trackhoe with thumb

- **Sorting**–Manual or mechanical separation of waste forms after they have been excavated and bulk removed from the trench

3.1.4 Handling Operation: Waste Categories

An objective of this treatability test is to determine the feasibility of segregating and sorting the waste forms into four waste categories: containers, soil, hard waste, and soft waste. These categories were selected because they are readily distinguishable in the field and because they have differing characteristics with respect to their capacities for recycling, treatment, and disposal. A brief discussion of each of the waste categories is presented below:

- **Containers.** Containers may contain materials that require separate segregation into free and organic liquids, soil, hard waste, and soft waste. Consequently, different data are needed to evaluate the feasibility of segregation when containers are and are not visible in the waste materials. These are addressed

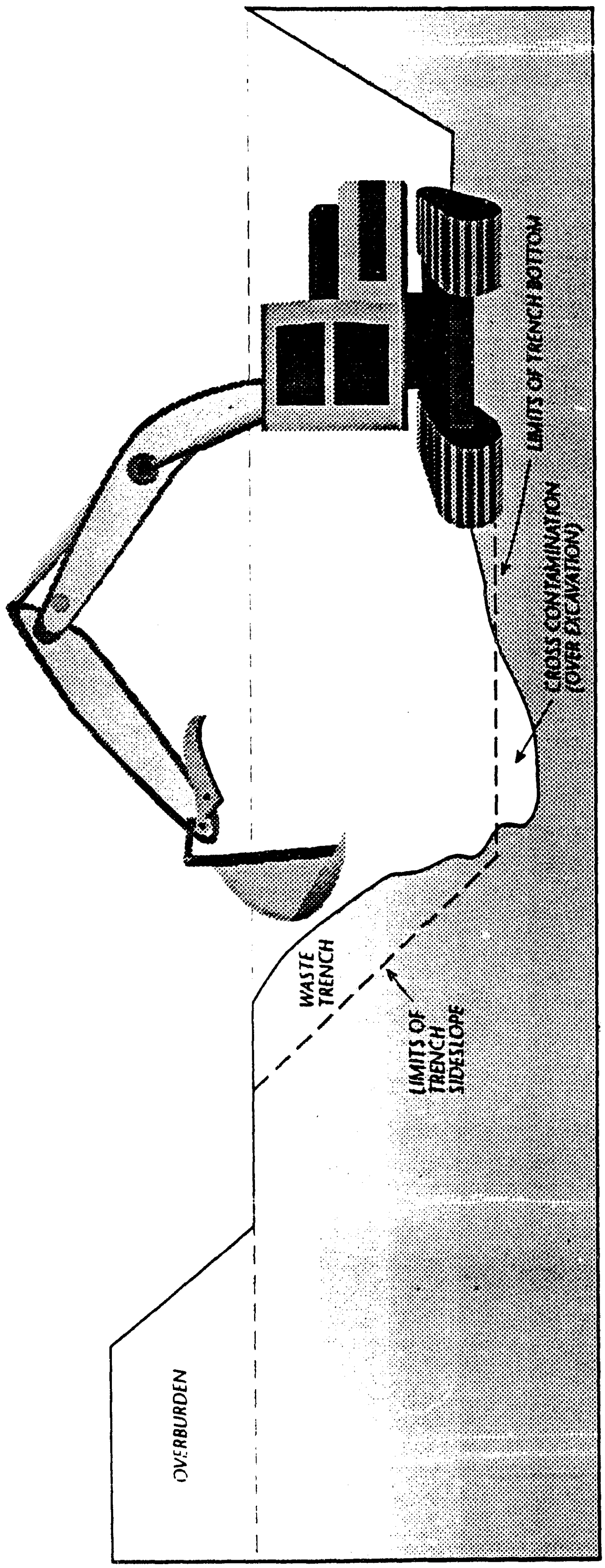

FIGURE 3-3
SIDE EXCAVATION APPROACH

later in Section 3.5. (It is important to note that the scope of work agreement mandates that closed containers, if found, be treated as if they contained free or organic liquids until the contents can be documented by some form of inspection. Because a breach of a closed container could result in an uncontrolled release to the environment of a free or organic liquid, waste materials with visible containers will be handled with an added level of care.) For the purposes of this test, it was agreed by the stakeholders (DOE, EPA, and Ecology) that cardboard boxes will not be considered sealed containers that contain free liquids. Some minimum number of cardboard boxes will be opened and inspected; however, not all removed cardboard boxes will be required to be opened. The purpose of this clarification is to limit the time spent opening cardboard boxes.

- **Soil.** It is expected that soil and rock will be mixed in with most of the waste materials. For the purpose of this treatability investigation, soil is defined as all naturally occurring inorganic materials. This includes cross-contaminated soil from the trench bottoms and sidewalls and cross-contaminated overburden from above the waste trenches.

- **Hard Waste.** Hard wastes are assumed to include all metallic and reasonably noncompressible solids. Examples of hard wastes are aluminum tubing, spacers and dummies, lead shielding and bricks, miscellaneous metal parts, and glass. Rock is defined as soil, not as hard waste.

- **Soft Waste.** Soft wastes are defined to include all nonmetallic and compressible solid wastes. Examples of soft wastes are paper, cardboard boxes, plastics, personal protective clothing such as gloves and booties, and office wastes.

3.2 DQO TABLES

The treatability test objectives are grouped according to the three primary operations–excavation, screening, and handling–and DQO tables have been prepared for each operation. This section discusses the organization of the DQO tables.

The tables are arranged with the project objectives and evaluation criteria on the left and the specific data needs on the right. The project objectives are subdivided according to evaluation criteria and anticipated operational conditions. The data requirements are subdivided according to data needs, measurements for the data, and the level of data quality necessary to adequately evaluate each criterion. The following describe each column of the DQO tables:

- **Operation.** The objectives of each operation of the treatability test are presented in the first column of the DQO tables. (All six of these objectives are presented together in Table 3-1.)

- **Evaluation Criteria.** The objectives evaluation information is divided into two columns: Criteria and Condition. The first column presents the evaluation criteria that will be used to evaluate each test objective. The purpose of the criteria is to identify and begin to quantify the important components of each treatability test objective. The original DQOs specified in the Hanford 118-B-1 Burial Ground Treatability Study Scope of Work Agreement are referenced by number (e.g., 1.2, 1.3) in the DQO tables included in this section. Refer to the original DQOs shown in Appendix A for cross referencing.

- **Evaluation Condition.** The second column under the Objective Evaluation header lists the operational conditions that will be investigated to help identify the most effective operational variation.

- **Data Needs.** For every evaluation criterion and condition there are certain data that must be collected to satisfy the requirements of the evaluation criteria and conditions. The Data Needs column provides a guide to help ensure that appropriate data are collected for each objective.

- **Data Measurement.** The Data Measurement column describes how the data needs will be quantified.

- **Data Quality.** The Data Quality column indicates the minimum level of precision that should be achieved when performing the specified measurement. The levels shown in this column reflect a combination of reasonably achievable data quality and precision.

3.3 DQOs: EXCAVATION

Table 3-2 presents the DQOs necessary to satisfy the two excavation objectives:

- Compare the effectiveness of the top-down and side removal approaches

- Identify waste forms requiring special excavation equipment and their frequency of occurrence

This section includes a brief discussion of these objectives.

Table 3-2. DQOs: Excavation Operations.

Sheet 1 of 2

Operation Objective	Objective Evaluation: Criterion	Objective Evaluation: Condition	Data: Needs	Data: Measurement, Observation, or Research	Data: Quality
Compare effectiveness of the TOP-DOWN and SIDE removal approaches	SLOPE STABILITY = (1.2) Stability of the surface of the trench to support the chosen; and (1.5) Determine lay-back angle for the top-down excavation approach	TOP-DOWN (beside trench) TOP-DOWN (over trench)	Maximum stable slope angle for soil and waste.	MEASURE: Angle of slope at failure measured from the horizontal using an Abney	Five (5) degrees less than the slope that sloughs. Sloughing is indicated by the formation of tension cracks, a circular slope slippage, and ravelling greater than 6-inches deep.
			Nature of materials in slope	OBSERVE: Soil and waste type	Description of soil or waste type: Soil (Unified Soil Classification System); Waste
			Location of excavator with respect to slope	MEASURE: Minimum workable distance of trackhoe from slope face	Nearest foot
		SIDE (within trench)	Maximum stable slope angle for soil and waste.	MEASURE : Angle of slope at failure measured from the horizontal using an Abney	Five (5) degrees less than the slope that sloughs. Sloughing is indicated by the formation of tension cracks, a circular slope slippage, and ravelling greater than 6-inches deep.
			Nature of materials in slope	OBSERVE: Soil and waste type	Description of soil waste type: soil (USCS) waste.
	CROSS-CONTAMINATION = (1.1) quantity of cross contamination	TOP-DOWN (beside trench) TOP-DOWN (over trench) SIDE (within trench)	Degree to which native material is mixed into waste material	MEASURE: Depth of uncontaminated soil excavated	Nearest increment of 6 inches averaged over the excavated portion
			Source of uncontaminated interface material	OBSERVE: Location of uncontaminated soil relative to trench materials	Record location in trench (sidewall or bottom). Use relative soil density as indication of native or fill materials.
			Nature of materials being removed	OBSERVE: Waste composition	Description of waste type
	SPILLAGE VOLUME = (1.4) spillage volume contribution	TOP DOWN (beside trench) TOP DOWN (over trench) SIDE (within trench)	Nature of materials being removed	OBSERVE: Waste composition	Description of waste type
			Spill volume	MEASURE: Volume of materials dropped during one hour of excavation or at least 30 cycles. One cycle defined as time to excavate one bucket-load of materials, dump it, and return to the trench ready to load another bucket.	Nearest 1/2-cubic yard spilled, on average, over the observation period
			Reasons for spills	OBSERVE: Reasons for spill	Description of problem (e.g. steep bucket angle, weak thumb grip, operator dependent, etc.)
	SWELL = (1.6) determine the expansion of waste volume caused by excavation	N/A	Percent swell over a segment of trench. Swell is defined as the incremental increase in volume after trench backfilling divided by the original in-place trench volume	MEASURE: Cross-section profile before excavation (after removal of overburden)	Survey surface elevation of breaks in slope along a cross-section to the nearest 0.1-foot. Obtain cross-sections at 25 foot spacing over the applicable segment of trench.
				MEASURE: Cross-section profile after trench excavation	Survey trench elevation of breaks in slope along a cross-section to the nearest 0.1-foot.
				MEASURE: Cross-section profile after trench backfilling.	Survey trench elevation of breaks in slope along a cross-section to the nearest 0.1-foot.
				MEASURE: Volume of liquid containers	Nearest liter

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Table 3-2. DQOs: Excavation Operations.

Operation Objective	Objective Evaluation		Data		
	Criterion	Condition	Needs	Measurement, Observation, or Research	Quality
Identify waste forms requiring special excavation equipment and their frequency of occurrence	WASTE FORM REMOVAL = (1.3 and 1.8) waste forms that can't be removed using standard equipment.	N/A	Cycle times	MEASURE: Time it takes to excavate one bucket of material, dump it, and return to the trench ready to fill another bucket.	Time in seconds
			Bucket/thumb utilization	MEASURE: Fraction of end effector capacity for bucket dependent removal and thumb dependent removal.	Fraction of capacity in 25% increments (i.e. 0, 25, 50, 75, or 100%). Capacity is defined as that volume of ideal materials that can be reasonably handled by the end effector (e.g., a 2-cubic-yard bucket = 2.25 cubic yards of heaped soil
			Nature of materials being removed	OBSERVE: Waste composition and arrangement	Description of waste type
			Reasons for inefficient removal	OBSERVE: Reasons for inefficient removal	Description of problem (e.g., too large for bucket or thumb, operator dependent, etc.)
	LIKELIHOOD OF WASTE FORMS = (1.7) determine how "likely" waste forms requiring special equipment	N/A	Waste forms expected to require special equipment	MEASURE: List of waste forms from WHC-EP-0087 Document entitled "Estimates of Solid Waste Buried in 100 Area Burial Grounds"	List of waste forms, separated by category and physical character.
			Waste forms actually requiring special equipment	OBSERVE: Types of waste forms not easily removed with bucket and thumb	Description of waste forms including category and character
			Frequency of occurrence of waste forms requiring special equipment	MEASURE: Number of waste forms not easily removed with a bucket and thumb	Number of waste forms, separated by category and physical character
	DOWN-TIME = (1.9) determine down-time to change-out special equipment	N/A	Identification of special equipment potentially capable of removing waste forms not able to be removed by a trackhoe with a bucket and thumb	RESEARCH: Potential capability of equipment to remove troublesome waste forms	Conversations with equipment vendors, solicitation of vendor references, equipment specifications and design capacities. Limit search to robust equipment, or focus on equipment capable of removal of the most frequently occurring waste forms
			Equipment substitution or replacement cost	RESEARCH: Net present worth of equipment substitution or replacement costs	Cost of labor for equipment replacement, personnel training, procurement and administration, and to purchase or lease the equipment. Plus 50% minus 30% level of detail
			Equipment substitution or replacement time	RESEARCH: Additional time invested for equipment substitution or replacement	Procurement, mobilization, change-out, training time, etc. Expressed in terms of duration and equivalent full time employees

Note: Photographs or video may be used to supplement data collection when descriptions are required.

3.3.1 Comparison of Top-Down and Side Removal Approaches

The top-down and side removal approaches will be evaluated and compared on the basis of the criteria described in the following sections.

3.3.1.1 Slope Stability. Slope stability is a function of the waste materials in the slope and the location of the excavator with respect to the slope. Slope stability is an important factor for ensuring excavator operator safety, minimizing the amount of cross contamination (i.e., clean trench sidewall or bottom material integrated into the waste materials), and maximizing equipment effectiveness. For example, regarding operator safety, slope failure while excavating using the top-down approach could result in the excavator slipping or falling into the trench, which could result in operator injury. Regarding minimization of cross contamination, a steeper maximum slope angle could allow excavation to the limits of the trench without concern for whether slope failure might result in portions of the excavated trench being buried by material from a failed slope above. For the top-down approach, a steeper slope allows more material to be reached from one location, impacting the effectiveness of that removal approach.

3.3.1.2 Cross Contamination. The amount of cross-contaminated material resulting from each excavation approach is a function of the source of the clean interface materials (trench sidewall, bottom, or overburden) and the amount of clean material mixed into the contaminated material. The concept of cross contamination is illustrated in Figure 3-3, presented earlier, which depicts potential areas for cross contamination while using the side removal approach. It is clear that the greater the volume of cross contamination, the greater the total volume of material requiring handling, and the more costly and time-consuming the handling operation will be. It is expected that some excavation approaches will result in more cross contamination than others due to poor operator visibility or the physical limitations of the excavation equipment. The amount of cross contamination also will be a function of the trench condition and the materials being removed.

3.3.1.3 Spillage Volume. Spillage volume refers to the average volume of materials that falls from the end effector (bucket or thumb) during performance of one cycle of some operation, such as bulk removal or segregation. Spillage is a function of the excavation condition, the nature of the materials being removed, and the dependency of the operation on either the bucket or the thumb end effector. Other causes for spillage may be specific to certain approaches and these should be described as well. Generally, the greater the average spillage volume, the less efficient the operation and the more time it will take to complete the operation.

3.3.1.4 Swell. Swell refers to the relative expansion of waste volume caused by excavation and generally is expected to be independent of the excavation approach used. Swell is determined as a function of the trench cross-section profile before and after excavation, and after trench backfilling. The swell concept is illustrated in Figure 3-4. Although the excavation approach could indirectly impact the swell based on the degree to which cross contamination is introduced into the waste materials, the difference in swell due to cross contamination is

$$\text{PERCENT SWELL} = \frac{\text{DIFFERENCE IN VOLUME BETWEEN A \& C PLUS D}}{\text{DIFFERENCE IN VOLUME BETWEEN A \& B}} \times 100$$

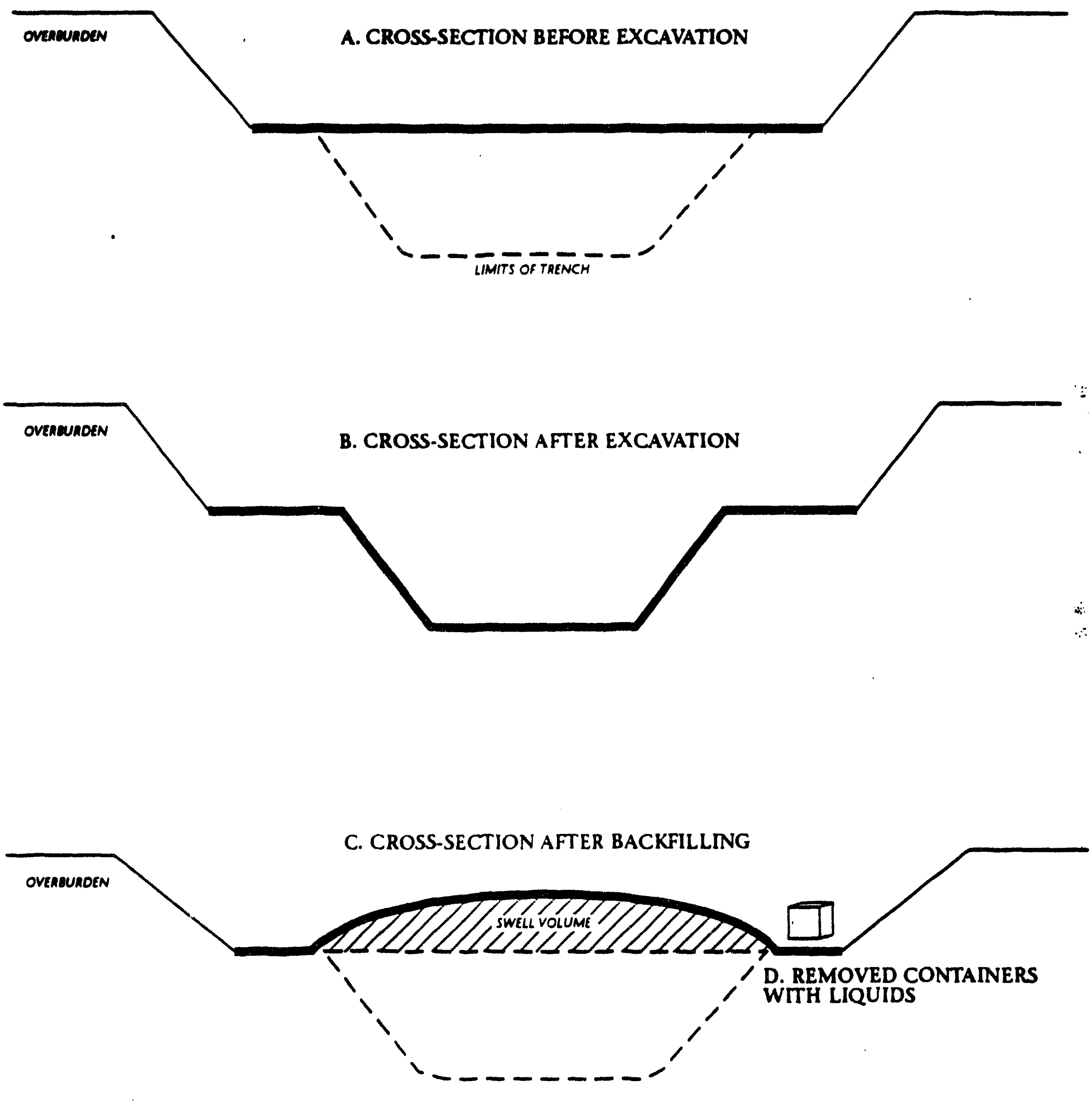


FIGURE 3-4
ILLUSTRATION OF PERCENT SWELL EVALUATION

expected to be negligible between the excavation approaches. In this sense, swell is an ancillary evaluation criterion that is important to the overall excavation operation, but not as important to the evaluation of the top-down versus side removal approaches. Swell also will be measured on materials that are removed from the trench and stored in an uncompacted pile.

3.3.2 Identification of Waste Forms Requiring Special Equipment

The identification of waste forms requiring special equipment and the frequency of occurrence of those waste forms will be evaluated on the basis of the criteria described in the following sections.

3.3.2.1 Waste Form Removal. The capability of the excavation equipment and excavator operator to remove different waste forms is assumed to be independent of the removal approach. Ease of removal for each waste form can be somewhat quantified based on the bucket cycle time, the estimated utilization of the end effector, and the nature of the materials being removed. A description of factors affecting waste form removal should be included to simplify comparison of removal efficiency of certain waste forms.

3.3.2.2 Likelihood of Waste Forms. Of general interest when identifying ways to improve the findings of the treatability test is the presence of waste forms that are difficult to handle using the trackhoe with bucket and thumb. Two information sources help determine the likelihood and frequency of various waste forms that require the use of special excavation equipment: (1) a literature search of pertinent background documents, and (2) confirmation of the literature search findings during implementation of the treatability test.

3.3.2.3 Down-Time Resulting from Special Equipment. After the need for special excavation equipment is established at the conclusion of the treatability test, it is appropriate to identify and evaluate the special equipment or trackhoe accessories available that could excavate the difficult-to-handle waste forms. Evaluation of the identified equipment would be based on cost and the time required to substitute or replace the equipment. (Note: None of the special equipment identified as potentially applicable will be physically tested as part of the treatability test.)

3.4 DQOs: ANALYTICAL SCREENING

There are two analytical screening objectives:

- Determine implementability of screening for currently established ERDF preliminary waste acceptance criteria during bulk removal using field instruments and visual observations.

- Determine whether the proposed screening methodology is appropriate and feasible.

- Determine whether the contents of containers meet ERDF preliminary waste acceptance criteria using field instruments and visual observation.

There are separate test objectives for bulk removal and container management because containers interfere with visual determination of waste type.

Table 3-3 presents the DQOs for primary analytical screening. Primary screening is expected to identify all materials in the 118-B-1 Burial Ground. However, if primary screening fails, then secondary screening is available.

3.5 DQOs: HANDLING

Table 3-4 addresses the two handling DQOs:

- Determine the feasibility of segregating waste forms into categories during excavation using a backhoe with thumb.
- Determine the feasibility of sorting waste forms into categories using a grizzly screen, disc screen, manual raking, and hand picking.

The following sections provide a brief discussion of these objectives.

3.5.1 Feasibility of Segregation Using a Trackhoe with Thumb

The feasibility of waste material segregation within the trench using a trackhoe with a thumb will be evaluated based on the ability to separate materials into the four categories: containers, soil, hard waste, and soft waste. These categories are defined in Section 3.1.2. There will be two approaches to in-trench segregation: one for wastes with visible containers, and one for those without. Each situation is described below. (Note: Any containers that are encountered during the excavation and segregation process will be treated as categorical wastes. No attempt will be made to segregate the contents of the containers further unless a container breach occurs during handling. Data collection will focus on categorizing the waste forms encountered and noting the ease and accuracy of segregation.)

3.5.1.1 Segregating Waste With Visible Containers. Maintaining container integrity will be the focus of segregation operations for bulk waste containing visible containers. Attention will be paid to identifying the container forms encountered and noting those that require special equipment to segregate without sacrificing container integrity.

3.5.1.2 Segregating Waste Without Visible Containers. Effective segregation by category will be the focus of segregation operations for bulk waste materials not including visible containers.

Table 3-3. DQOs: Primary Analytical Screening.

OBJECTIVE	EVALUATION		DATA		
	Criteria	**Condition**	**Needs**	**Measurement**	**Quality**
Determine implementability of screening for currently established ERDF preliminary waste acceptance criteria during bulk removal using field instruments and visual observation.	Does material exceed ERDF preliminary waste acceptance criteria?	> Category 3	Count Rate • gamma	mR/hr	10% of critical value[b] using ion chamber
			• beta	mR/hr or counts/second[b]	10% of critical value[b] using ion chamber or GM
			Spectral • gamma	^{60}Co, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{133}Ba. • Presence and identification of others.	10% peak area of critical value[b] to obtain MICROSHIELD concentration to nearest 50 keV.
		TRU	Count Rate • neutron	counts/second	10% of critical CPS using large volume scintillator
		Organic Vapors	VOC	Total volatile organic concentration in ppm	N/A[c]
		Liquid	Free Liquids	Visual observation	N/A
			> 10% organics[a]	Visual observation	N/A

[a] Defined as organic contamination from liquid storage containers. To be determined visually by observing waste material.
[b] Critical values are either the expected dose rate or Category 3 dose rate.
[c] Data quality varies by analyte.
Note: Photographs or video may be used to supplement data collection when descriptions are required.

Table 3-4. DQOs: Handling Operations.

Handling Operation Objective	Objective Evaluation		Data		
	Criteria	Condition	Needs	Measurement or Observation	Quality
Determine if segregation of waste forms into categories during excavation is feasible using a trackhoe with a thumb.	CATEGORIES = (2.1) list of waste forms in each category (container, soil, hard waste and soft waste)	VISIBLE CONTAINERS: Waste containing visible containers	Container form types encountered	OBSERVE: Types of container forms encountered	Description of container forms
			Container forms requiring special excavation equipment and procedures in order to maintain container integrity.	OBSERVE: Types of container forms requiring special equipment	Description of container forms
			Reasons for difficulty in maintaining container form integrity	OBSERVE: Reasons for difficulty in maintaining container form integrity during segregation	Description of problem (e.g. poor operator visibility, incompatibility of bucket and thumb to container material, etc.)
		NO VISIBLE CONTAINERS: Waste without visible containers	Waste forms identified and grouped by category	OBSERVE: Types of waste forms encountered	Description of waste form grouped according to category (i.e. hard, soft, soil, containers) and waste form type (e.g. physical characteristics, size, and shape)
			Effectiveness of segregation	OBSERVE: Ease of segregation of waste forms into categories	Comparative description of categories in terms of ease of segregation (i.e. relatively easy to segregate, moderately easy to segregate, relatively difficult to segregate)
			Accuracy of segregation	MEASURE: Fraction of waste forms that were improperly segregated	Nearest 10 percent increment by category. Specify whether volume based (soil) or unit based (hard, soft and container).
			Reasons for inaccurate segregation	OBSERVE: Reasons for improperly segregated waste forms	Description of problem (e.g. waste form not easily separated into a category by visual means, waste form too small to be handled effectively by excavation equipment, etc.)
			Rate of production by segregation equipment	MEASURE: Number of cubic yards segregated in a 30 minute period.	Nearest bulk cubic yard per hour, in place
Determine if sorting of waste forms into categories is feasible using a grizzly screen, disc screen, manual raking, and manual picking	CATEGORIES = (2.3) list of waste forms in each category (container, soil, hard waste and soft waste)	VISIBLE CONTAINERS: Waste containing visible containers	Container form identified	OBSERVE: Types of container forms encountered	Description of container forms (e.g. size, shape, and physical characteristics such as drums, paint cans, etc.). Description of physical condition of container.
			Container forms requiring special handling in order to maintain container integrity.	OBSERVE: Types of container forms requiring special handling	Description of container forms (e.g. size, shape, and physical characteristics such as drums, paint cans, etc.)
			Reasons for difficulty in maintaining container form integrity	OBSERVE: Reasons for difficulty in maintaining container form integrity during sorting	Description of problem (e.g. container integrity sacrificed during excavation, mechanical equipment too rough, a separation process, etc.)
		NO VISIBLE CONTAINERS: Waste without visible containers	Waste forms identified and grouped by category	OBSERVE: Types of waste forms encountered	Description of waste form grouped according to category (i.e. hard, soft, soil, containers) and waste form type (e.g. physical characteristics, size, and shape)
			Effectiveness of mechanical sorting	OBSERVE: Relative effectiveness of mechanical sorting into soil and non-soil categories	Comparative description of categories in terms of ease of mechanical sorting (i.e. relatively easy to sort, moderately easy to sort, relatively difficult to sort)
			Accuracy of mechanical sorting	MEASURE: Number of non-soil waste forms appearing in soil receptacle per unit volume of soil sorted	Nearest 5 non-soil waste forms per cubic yard of soil
			Reasons for inaccurate mechanical sorting	OBSERVE: Reasons for improperly mechanically sorted waste forms	Description of problem (e.g. waste cross section smaller than smallest diameter mechanical screen, screen overflow into soil receptacle, etc.)
			Rate of production by mechanical sorting equipment	MEASURE: Number of cubic yards of through-put for the Grizzly Screen and the Disc Screen in up to a 2 hour period	Nearest bulk cubic yard per hour
			Effectiveness of hand sorting	OBSERVE: Ease of hand sorting of waste forms into categories	Comparative description of categories in terms of ease of sorting (i.e. relatively easy to sort, moderately easy to sort, relatively difficult to sort)
			Accuracy of hand sorting	MEASURE: Fraction of waste forms in each category that were improperly sorted	Nearest 10 percent increment by category. Specify whether volume based (soil) or unit based (hard, soft, and container).
			Reasons for inaccurate hand sorting	OBSERVE: Reasons for improperly hand sorted waste forms	Description of problem (e.g., waste form inadvertently swept into incorrect receptacle, difficulty categorizing waste form, etc.)
			Rate of production by hand sorting	MEASURE: Number of or fraction of equivalent cubic yards hand sorted in up to a 2 hour period by one person.	Nearest bulk cubic yard per hour.

Note: Photographs or video may be used to supplement data collection when descriptions are required.

3.5.2 Feasibility of Sorting Using a Grizzly Screen, Disc Screen, Manual Raking, and Hand Picking

The feasibility of sorting waste materials outside of the trench following bulk removal will be evaluated based on the ability to sort materials according to category. The categories are the same as for the segregation process: containers, soil, hard waste, and soft waste. However, the separation of containers will be performed to minimize the possibility of breaching a container and spilling a free liquid. Consequently, two approaches are necessary to evaluate this objective: one for waste with visible containers, and one for waste without. Descriptions of the sorting process and equipment are presented in Section 4.0.

3.5.2.1 Sorting Waste Material With Visible Containers. The focus of sorting operations for waste containing visible containers will be maintaining container integrity and identifying the presence of free or organic liquids. Visible containers will be sorted and extracted from the surrounding bulk waste materials. These containers will then be manually opened and screened for the presence of liquids. If liquids are present, the container will be set aside for special handling and disposal.

3.5.2.2 Sorting Waste Material Without Visible Containers. The focus of sorting operations for bulk waste materials that do not include visible containers will be on the effectiveness of sorting into categories using the grizzly screen, disc screen, and manual raking or picking. More details of the mechanical sorting equipment and process are presented in Section 4.4.2. Separate data will be collected for mechanical and manual sorting to evaluate the effectiveness and accuracy of each.

3.6 Potentially Applicable or Relevant and Appropriate Requirements (ARARs)

CERCLA Section 121(d) requires that remedial actions at National Priority List sites comply with applicable or relevant and appropriate requirements (ARARs) of federal and state environmental laws. CERCLA also requires inclusion of to-be-considered (TBC) information in the evaluation of ARARs.

Table 3-5 lists potential ARARs and TBCs that may be relevant to this treatability study and that may be needed for comparing treatability test results. These were taken from the *100 Area Feasibility Study Phases 1 and 2* (DOE/RL 1993a). A more thorough discussion is included in the feasibility study (FS). The 100 FS ARARs will be subject to detailed analysis in future feasibility studies.

Table 3-5. Potential Requirements for Comparing Excavation Treatability Test Results.

Regulation	Citation
Federal	
Radiation Protection Standards	40 CFR Part 191
U.S. Nuclear Regulatory Commission Standards for Protection Against Radiation	10 CFR Part 20
Resource Conservation and Recovery Act	40 CFR 260-268
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50
National Emissions Standards for Hazardous Air Pollutants	40 CFR Part 61
Radiation Protection for Occupational Workers	10 CFR Part 835
Radioactive Waste Management	DOE 5820.2A
Residual Radioactive Material as Surface Contamination	NRC Guide 1.86
Radiation Protection of the Public and the Environment	DOE 5400.5
State	
Benton-Franklin-Walla Walla Counties Air Pollution Control Authority	General Req. 80-7
Air Pollution Requirements	WAC 172-300
Nuisance Dusts	WAS 296-62-07509
Total Particulate	WAC 296-62-07510
Emission Limits for Radionuclides	WAC 173-480
Hazardous Waste Management Act	WAC 173-303

All material removed from the 118-B-1 Burial Ground that is not processed in the sorting test will remain within the area of contamination and will be replaced within the excavation upon completion of the treatability testing. Waste sorting for size segregation will be used on 1 to 10 percent of the excavated material. The sorted material will be managed as Investigation Derived Wastes or returned to the excavation upon completion of the treatability testing. All liquid recovered from the trenches will be handled as a waste per guidance of WHC-CM-7-7, EII 4.3, Investigation Derived Wastes.

The Federal Facility Agreement and Consent Order Change Control Form M-15-93-04 approved by EPA, Ecology, and DOE/RL states the following: "The waste generated from the test pits will be managed as 'investigation-derived-waste' or returned to the excavation in a manner that will facilitate final remediation."

Because this is an interim action and ARARs will be addressed in the final action, untreated wastes may be returned to the excavation upon completion of treatability testing.

4.0 EXPERIMENTAL DESIGN AND SPECIFICATION

This section describes the treatability excavation test in terms of the three primary operations: excavation, analytical screening, and handling. Discussion is also provided for the selection of trenches and for closing and backfilling the trenches.

4.1 TRENCH SELECTION

This section discusses the trench selection criteria and identifies potential trench locations that appear to meet those criteria. The primary basis for selecting these locations is historical records that may not be accurate. Therefore, while an attempt will be made to test a reasonable variety of conditions at the burial ground, it is not possible to guarantee that all the different expected conditions will be encountered during the test.

4.1.1 Trench Selection Criteria

The purpose of the 118-B-1 Excavation Treatability Test is to achieve the excavation, analytical screening, and handling objectives described in Section 3.0. However, the appropriateness of the data collected is somewhat contingent on the nature of the wastes encountered. It is the intent of the treatability test to evaluate a reasonable range of waste conditions based on the historical information–not to test every waste or trench condition or conduct a representative sampling.

Five trench locations were selected based on the following criteria, listed in order of importance:

1. The five trenches should reveal a variety of conditions, including various waste forms (hard, soft, containers, and soil) and placement variables (homogeneous, heterogeneous, random, and various sizes and depths)

2. The five trenches should reveal variability with respect to time of burial

3. The trenches should be spatially located to avoid excavating similar materials as a result of a systematic burial regimen

4. The trench locations should minimize the probability of a condition being missed altogether

5. The trench locations should minimize the amount of overburden removed

4.1.2 Trench Selection

This section presents the rationale that was used to select each of the primary and alternate proposed trench excavation locations. Figure 4-1 presents the selected locations superimposed on the GPR survey map. These locations are proposed based on review of the information made available for this test plan; however, the field team leader (FTL) should be given the flexibility to modify the locations to improve safety or better achieve the test objectives. The grid shown on the map is tied into stakes and markers at the site. (Refer to Figure 2-1 for the historical record of trench locations and trench numbering.) The trench locations are based primarily on the existing trench markers in the burial ground, as shown on the GPR Survey Map (Figure 4-1). There are markers indicating the locations of trenches P-1, P-2, 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 14, and 15. Trenches P-1 and P-2 may contain liquid tritium waste. Procedures for handling tritium waste will be developed at a later time. Therefore, trench locations P-1 and P-2 will not be excavated during this test.

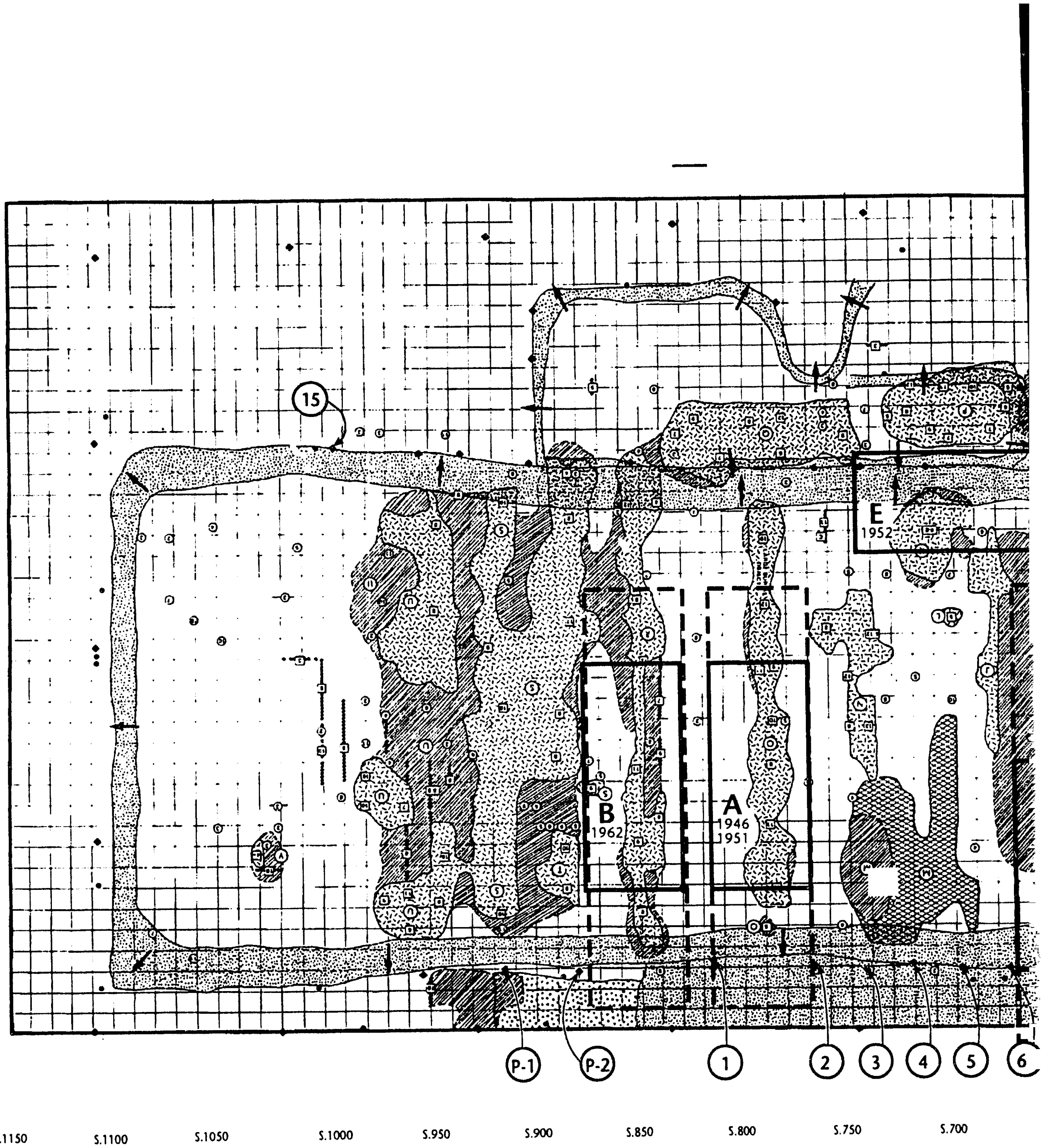
Location A was selected because it is positioned over what is believed to be Trench 2. Trench 2 was filled in the late 1940s and is believed to contain metals, soft waste, and miscellaneous waste. Spacer recovery was attempted from this trench in 1957. The center section of this trench was chosen because it appears that trash was disposed on the east end and metallic wastes were deposited on the west end. Although the trench is marked, the actual location could correspond to Trench 1 or Trench 3, which also would be acceptable because the same time period would be evaluated.

Location B was selected because it is presumed to be positioned over a trench filled in 1962. This trench is expected to be wider and deeper than the earlier trenches and include railroad tie cribs that contain spacers. It is presumed that this trench also contains a mixture of soft, hard, and miscellaneous waste. The trench is marked, but the actual location could vary from the markers. The trenches on either side consist of a 1962 trench to the south (P-2) and a late-1940s trench to the north.

Location C was selected because it is presumed to be positioned over Trench 7, which was filled in the late 1950s, and because it corresponds to the spline silos. This trench is presumed to contain metal, spline silos, soft, and miscellaneous wastes. This trench is monumented in the field. An unnamed trench to the north and Trench 6 to the south also were used during this time period.

Location D was selected because it is presumed to be positioned over Trench 12, which was filled between 1964 and 1966. This trench is expected to be much wider and possibly deeper than most other trenches and is presumed to contain a variety of wastes. The western end of this trench will be investigated.

Location E was selected to investigate the conditions of the north-south trenches. It is possible that this particular trench contains lead and steel spacers, nozzles, and yokes. It could also contain water sampling pumps, piping from Ball 3-X system, duct work, scrap metal, and gunbarrels. Excavation will proceed south if waste is not found at the planned location.



LEGEND:

PRIMARY TRENCH LOCATION

ALTERNATE TRENCH LOCATION

(P-1) EXISTING TRENCH MARKER

HEAVIEST CONCENTRATION OF ANOMALIES

MODERATE CONCENTRATIONS OF ANOMALIES

ZONE WITH STRONG REFLECTOR AT ABOUT 4' BELOW THE SURFACE, POSSIBLY MASKING DEBRIS BELOW

Note: GPR survey map is from Bergstom, et al. 1993

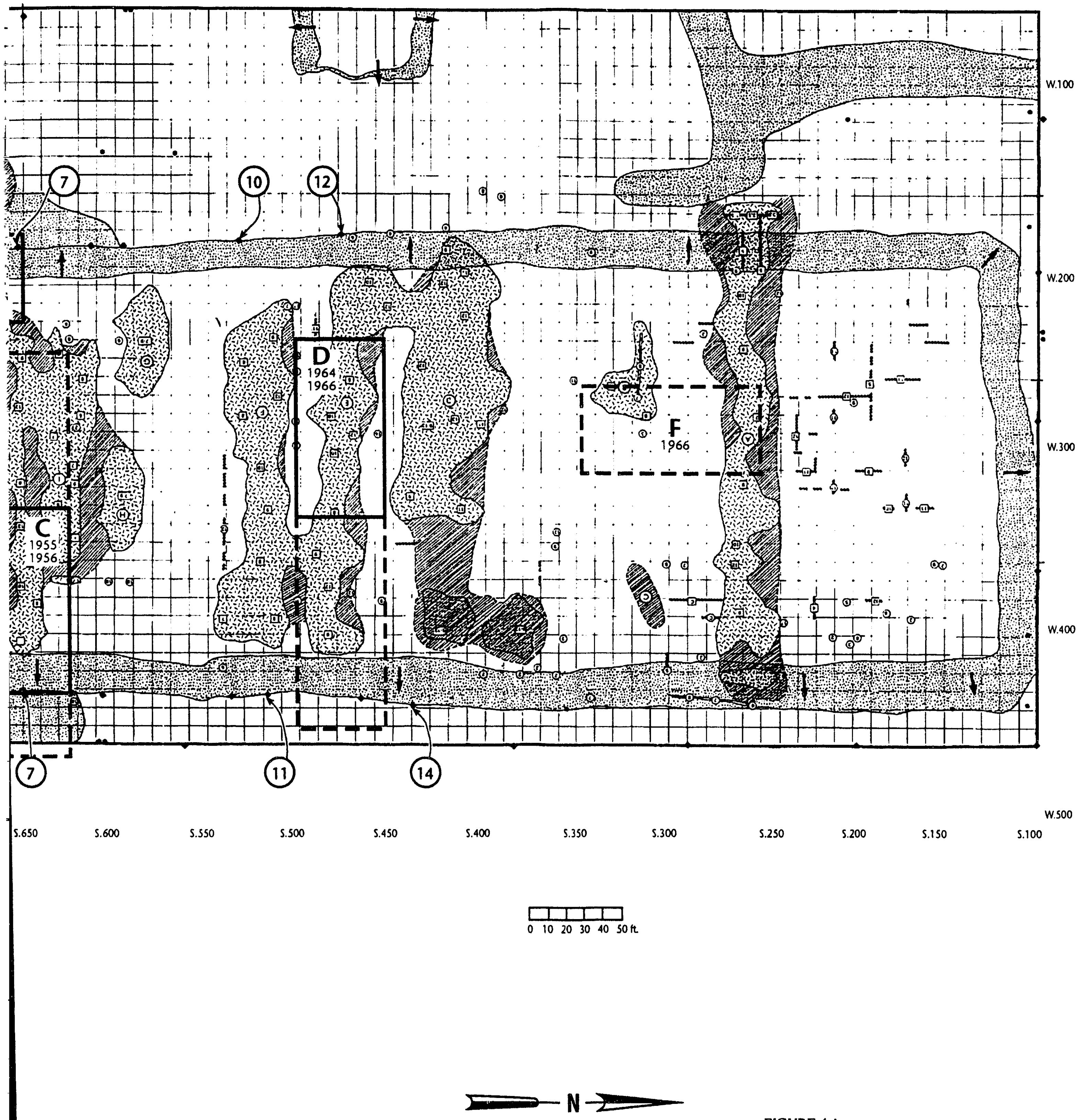


FIGURE 4-1
PROPOSED TRENCHES FOR TREATABILITY TEST

The alternate location, Location F, is presumed to be situated over a general trench filled during 1966 and another trench where horizontal control rods and vertical safety rods are believed to be buried. The trench at Location F has strong GPR geophysical indications.

4.2 OVERBURDEN REMOVAL AND EXCAVATION

This section contains general descriptions of the overburden removal and excavation operations of the treatability test. These descriptions are specific enough to provide a framework for writing the test procedures, yet flexible enough to allow field operators to make adjustments as necessary to maximize safety, increase the efficiency of operation, or improve test results. This section is presented in three parts: overburden removal and stockpiling, conceptual excavation overview, and comparison of excavation approaches.

4.2.1 Overburden Removal

Overburden is defined as the soil between the ground surface and 1 to 2 feet above the waste top. Overburden removal is not considered trivial since preliminary estimates indicate that the volume of overburden to be removed can range from one to three times the trench excavation material, depending on which trench locations are selected and how they are configured. Removal of overburden will include the following elements: defining an overburden removal area and implementing the removal operation.

4.2.1.1 Defining an Overburden Removal Area. Defining the area of overburden to remove requires consideration of two factors: the depth of the overburden, and the work area necessary to perform the other test operations. Within this site area, the overburden is estimated to be between 5 and 10 feet deep. This estimate is based on historical records indicating that 4 feet of cover was placed over the trenches initially, and that an additional 4 to 5 feet of fill was placed over the burial grounds in recent years to stabilize the area and provide shielding.

The work area necessary to perform the treatability test operations depends on the type of equipment used, the operations performed within the area, and the amount of waste removed and stockpiled adjacent to the trench. Considerations should include the amount of room necessary to build access roads to the work area from the overburden and for the overburden cut slope to lay at an appropriate angle. This angle will be determined during the test procedures and will be a function of depth, the materials expected to be encountered, and the anticipated top of trench loading/access conditions.

4.2.1.2 Implementing Operations. Trench depth and location are two uncertainties that will need to be managed during the implementation of overburden removal and stockpiling. Either of these uncertainties could impact the area required for overburden removal. The decision rules provided in Table 4-1 will govern when a contingency is implemented.

Table 4-1. Uncertainty Management/Decision Table for Excavation.

Sheet 1 of 3

Area of Uncertainty	Expected Conditions	Uncertainties	Observations to Detect Uncertainties	Decision Rule/Contingency
Overburden	5 to 10 feet of overburden.	Overburden depth/volume.	Direct Observation	Excavate overburden to original ground level, and begin test excavation, if overburden is greater than 2' in depth strip additional overburden to 2' depth and begin excavation. Stray pieces of debris in overburden will not be considered the upper limit of the trench.
Trench Location Limits	GPR, historical records, and field markers define trench location limits.	The actual location/limits of the trench.	Direct Observation	Excavate area that is suspected of being the trench. If waste is not found, proceed to excavate in a direction which has the highest probability of intersecting a trench.
Determining Trench Limits	Determining the edge of the trench during excavation will depend on the trench condition and how materials were disposed.	Visual determination of the edge of the trench.	Direct Observation	If trench conditions are such that it is difficult to determine where the trench ends, then note the reason why and the location. Also, note that determination of cross-contamination may not be possible in this type of trench condition.
Trench Depth	Trenches are less than or equal to 20 feet deep from original ground level.	The actual depth of trench, greater than 20 feet.	Direct Observation	Be prepared to excavate trenches 25' deep. If trench is deeper, then excavate in lifts by benching.
Side Excavation Approach	Trenches are less than or equal to 20 feet deep from original ground level.	Ability to bulk remove out of trench.	Direct Observation	It is recognized that the side removal approach may be more effective and productive in a full-scale project because the excavation will be larger to allow equipment and transport vehicles to support side excavation within the trench. Bulk removal within the trench will simulate this production rate. Bulk removal out of trench will not simulate this production rate and will be limited to trenches less than 10 feet deep for safety.

Table 4-1. Uncertainty Management/Decision Table for Excavation.

Sheet 2 of 3

Area of Uncertainty	Expected Conditions	Uncertainties	Observations to Detect Uncertainties	Decision Rule/Contingency
Excavation Volumes	The percentage of total excavation necessary to collect sufficient data for each approach is preliminary and subject to modification in the field.	Excavation volume percentages. Actual volume necessary to evaluate each excavation approach.	Are DQOs being met?	Bulk removal out of trench, bulk removal within the trench, segregation, and sorting volume allocations were estimated to balance level of effort expended on test objectives. If one operation requires three times as long as planned volume allocations should be reevaluated.
Slope Stability	Stable slope angles will vary with nature and condition of slope material. Slopes greater than 1.5:1 will not be required. Slope angles will not vary greater than 5 degrees from an average.	Number of slope stability measurements that are necessary.	(See DQO Table 3-2)	Obtain at least one slope stability angle measurement for each slope condition encountered up to a maximum of 10 conditions. Slope conditions are a result of the type of material, its size, stacking orientation, and relative density. If the stable slope angle does not vary more than 5 degrees under varying conditions after four measurements, then only measure slope stability on slopes that have stable angles less than this 5 degree range.
Cross-Contamination	Cross-Contamination will depend mostly on excavator position but may vary slightly with nature of the waste in trench.	Number of cross-contamination measurements that are necessary.	(See DQO Table 3-2)	Obtain at least one estimate of cross-contamination for each excavation approach along the bottom and sides of trench for each trench condition. If cross-contamination depths under similar trench conditions for each excavation approach do not vary more than 6 inches after 4 measurements, then reduce frequency of estimates to once per trench.
Spillage Volume	Spillage will vary with the nature of the waste being removed.	Number of spillage evaluations that are necessary.	(See DQO Table 3-2)	Obtain one spillage estimate for each type of trench condition and excavation approach. If spillage volumes are less than 1 CY per 250 CY of excavation for a variety of trench conditions, then reduce observations to twice per trench.

Table 4-1. Uncertainty Management/Decision Table for Excavation.

Sheet 3 of 3

Area of Uncertainty	Expected Conditions	Uncertainties	Observations to Detect Uncertainties	Decision Rule/Contingency
Waste Form Removal	All types of waste forms can be removed from the trench using the excavator with thumb. Some waste forms will be removed more efficiently than others.	Trench conditions and waste forms that are more difficult or impossible to excavate.	(See DQO Table 3-2)	Collect data in DQO Table for a period of 20 minutes at least once for each type of trench condition. If sequential cycle times consistently vary by more than 50% when compared to each other, then extend duration of observation to 60 minutes. If waste forms/conditions are encountered that increase typical cycle times by 100%, then extend duration of observation to 60 minutes and supplement data collection with video tape.
Swell Volume	Swell volume will depend on the nature and condition of the waste.	Which trench areas to be used to measure swell volume.	Direct Observation	Perform initial cross-section profiles on every trench excavated until the following three trench conditions have been encountered. A trench consisting of primarily hard waste and soil, a trench consisting of primarily soft waste, containers and soil, and trench with a mixture of hard, soft containers and soil. If one trench has very similar conditions as a trench previously evaluated for swell, then the swell evaluation can be omitted for that trench.

4.2.2 Excavation Overview

The excavation operation is key to this test plan. The objectives of the excavation operation include comparing excavation approaches and supporting other test evaluations.

For the purposes of this test, excavation is defined as (1) material removed from the trench or (2) material that is segregated within the trench. As a general guideline, the treatability test will involve the excavation of 5,000 to 10,000 cubic yards of waste material. All excavation will be performed with an excavator with bucket and thumb attachment. Excavation will occur in five trenches.

The excavation is envisioned to consist of the following operations:

- Bulk removal out of and within the trench (70 to 75 percent of total excavation volume)
- Segregation within the trench (20 to 25 percent)
- Bulk removal and sorting out of the trench (1 to 10 percent)

These operations and allocated fractions of the total volumes are based on the data needs to meet the test objectives, minimize inefficient operations, and balance the level of effort expended on relatively complex versus simple test operations.

The excavation of each trench is expected to begin with the removal of overburden down to the original ground level. If the remaining overburden is greater than 2 feet thick, additional overburden will be removed so that approximately 2 feet of soil cover the trench. At this point, a cross-section profile should be obtained over a portion of the trench to evaluate swell volume. Bulk removal using the top-down approach should be used initially. Analytical screening the waste for radionuclides, organics, and free liquids will be implemented during bulk removal. Cross-contamination, spillage volume, and waste form removal data should be collected. If the excavated material is judged to be sortable by mechanical means (see Section 4.4), and sorting material is needed to achieve the test objectives, the material will be transported to the sorting area. The excavation will continue until at least one side slope and the bottom of the trench have been uncovered. At this point, the slope stability angle will be determined based on the greatest average stable slope measured.

After approximately 10 percent of the total planned volume for the trench has been excavated, or at the discretion of the FTL, bulk removal could be performed using the side approach. The parameters to be monitored during bulk removal include the amount of cross-contamination, the spillage volume, waste form removal, and slope stability. The side approach could then be used until approximately 20 percent of the total planned volume for the trench had been excavated. At this point, five combinations of operations could be used to excavate the remainder of the trench volume: segregation using the top-down or side removal approaches, bulk removal in the trench using the top-down or side approaches, and bulk removal and sorting using the top-down approach.

The conceptual overview of the excavation described above provides a preliminary framework for the treatability test and indicates where likely decision points will be reached and measurements made. However, it is unlikely that the test will be implemented as described without some modification. Deviation from this overview is expected because of the inherent uncertainties associated with the burial ground. Operational decisions such as equipment limitations, safety, high or low production rates, and accessibility to the trenches may govern the implementation aspects of the testing. Some of these uncertainties can be managed through the SAFER approach; others will require technical judgment during field operations. Table 4-1 lists how anticipated uncertainties will be addressed during implementation of the treatability testing. Should a situation occur in the field that is not addressed explicitly, the field decision should be related to data required by the test objectives presented in Section 3.0.

4.2.3 Comparison of Excavation Approaches

One of the primary objectives for this treatability test is to compare the top-down and side removal approaches and decide which, if either, approach is most appropriate. If neither approach is effective, special equipment may be required.

The evaluation of the top-down and side removal approaches will be made based on four criteria: the resulting slope stability, cross-contamination, spillage volume, and waste form removal. Swell volume is considered independent of removal approach and is not considered a relevant criterion for the comparison.

During the collection of data to determine slope stability, cross-contamination, spillage volume, and waste form removal, it is necessary to evaluate when data collection can stop or when additional data collection is needed. The uncertainties associated with these decisions are presented in Table 4-1. Section 3.0 defines the data needs, data measurement, and data quality required for comparing these approaches, while this section focuses on how data should be collected during the test performance.

4.3 ANALYTICAL SCREENING

This section provides a description of the analytical screening process. The analytical screening process is included in this treatability test to demonstrate its ability to determine if burial ground waste exceeds the ERDF preliminary waste acceptance criteria. A major uncertainty of analytical screening is the final ERDF waste acceptance criteria. The analytical screening process presented below is based on the currently available draft preliminary waste acceptance criteria. Table 4-2 summarizes the uncertainties associated with the analytical screening methodology, including observations to detect uncertainties and contingencies for each condition.

Table 4-2. Uncertainty Management/Decision Table for Analytical Screening.

Area of Uncertainty	Expected Conditions	Uncertainties	Observations to Detect Uncertainties	Decision Rule/ Contingency
General field screening	ERDF Preliminary Waste Acceptance Criteria are achieved	ERDF Preliminary Waste Acceptance Criteria are not achieved	None	None
Presence of ERDF category wastes	No waste is > Category 3	Waste > Category 3 exists	See Figure 4-2 and Table 4-4.	**If waste is > Category 3:** • Move material to known location in the excavation, or leave in place and mark, and contact DOE and regulators. If waste is not identifiable (may be > Category 3): • Operational decision to perform additional radionuclide screening. • May collect sample for lab analysis if secondary screening fails.
	No TRU waste	No TRU waste	See Figure 4-2 and Table 4-4.	If Waste is TRU: Handle material as required by *Hanford Site Solid Waste Acceptance Criteria* (WHC 1993).
	No volatile organics	Volatile organics found	See Figure 4-2 and Table 4-4.	Document location, look for source, use absorbants and/or remove if free liquid, remove absorbed free liquid for disposal.
	No free liquids	Free liquids found	See Figure 4-2 and Table 4-4.	Document location, look for source, use absorbants and/or remove if free liquid, remove absorbed free liquid for disposal.

Based on information from Miller and Wahlen (1987), buried waste in the 118-B-1 Burial Ground does not contain sufficient radionuclides to be greater than Category 3 waste, as defined by the *Hanford Site Solid Waste Acceptance Criteria* (WHC 1993). According to the *Estimates of Solid Waste Buried in 100 Area Burial Grounds* (Miller and Wahlen 1987) only four types of waste are greater than Category 1: graphite (^{14}C), aluminum process tubes (^{137}Cs and ^{90}Sr), desiccant (^{14}C), and lead (^{14}C). However, the ^{14}C in desiccant and lead are barely above the Category 1 limit. Table 2-3 lists the waste types buried in the 118-B-1 Burial Ground, with their radionuclide concentration in Ci/m^3. The Category 3 limit for each radionuclide is presented in Table 4-3 for comparison. (Note: Some radionuclides do not have a Category 3 limit.)

Field measurements of dose rates during the treatability test should effectively screen the burial ground material for the following reasons:

- All waste types except graphite, process tubes, desiccant, and lead are expected to be below the Category 1 limit.
- All waste types except for desiccant and lead have easily measured, penetrating, gamma-emitting constituents.
- Both desiccant and lead waste can be visually identified, thus ensuring that any material that could exceed the Category 3 limit can be detected.

These conclusions are based on the following information from Miller and Wahlen (1987):

- Cobalt-60 is a constituent of most of the materials listed in Table 2-3 and it emits easily measured gamma radiation. Two materials do not have ^{60}Co: graphite and the desiccant. The graphite is essentially pure ^{14}C, but the desiccant contains ^{137}Cs, ^{152}Eu, and ^{154}Eu–all of which are gamma emitters.
- In no case will alpha-emitting radionuclides approach Category 1 limits. There is no reason to expect that Category 1 or the transuranic limit of 100 nCi/g will be exceeded. As shown in Figure 4-2, neutron detection is used as a primary screen for TRU.
- In no case will tritium exceed Category 1 limits. Likewise, none of the weak (<300 keV) beta emitters except ^{14}C in graphite are expected to exceed Category 1 either singly or in combination with other radionuclides, and graphite is easily identifiable. Even $^{90}Sr/Y$ is found mixed with gamma emitters in all cases.

Section 4.3.1 presents the implementation of the analytical screening process. The analytical screening process itself is described in Section 4.3.2 and presented in Figure 4-2 and Table 4-4.

Table 4-3. Radionuclide Category 1 and 3 Limits.

Sheet 1 of 2

Nuclide	Activity Limits (Ci/m^3)	
	Category 1	Category 3
^{3}H	5.0 E+06	
^{10}Be	1.0 E+00	2.2 E+02
^{14}C	4.0 E-02	9.1 E+00
^{14}C^{a}	4.0 E-01	9.1 E+01
^{36}Cl	4.0 E-04	8.3 E-02
^{40}K	1.7 E-03	3.4 E-01
^{60}Co	7.7 E+01	
^{59}Ni	4.0 E+00	8.3 E+02
^{59}Ni^{a}	4.0 E+01	8.3 E+03
^{63}Ni	4.8 E+00	1.7 E+04
^{63}Ni^{a}	4.8 E+01	1.7 E+05
^{79}Se	3.8 E+01	8.3 E+01
^{90}Sr	4.3 E-03	1.5 E+04
^{93}Zr	2.7 E+00	5.9 E+02
^{94}Nb	2.6 E-04	5.6 E-02
^{94}Nb^{a}	2.6 E-03	5.6 E-01
^{93}Mo	3.0 E-01	7.1 E+01
^{99}Tc	5.6 E-03	1.2 E+00
^{107}Pd	4.8 E+00	1.0 E+03
^{113m}Cd	2.0 E-01	
^{121m}Sn	6.3 E+00	2.0 E+05
^{126}Sn	1.8 E-04	
^{129}I	2.9 E-03	5.9 E-01
^{133}B	7.7 E-01	
^{135}Cs	1.9 E-01	4.2 E+01
^{137}Cs	6.3 E-03	1.3 E+04
^{147}Sm	1.6 E-02	3.4 E+00
^{151}Sm	3.8 E+01	1.8 E+05
^{150}Eu	1.6 E-03	7.7 E+02
^{152}Eu	8.3 E-01	
^{152}Gd	6.3 E-03	1.3 E+00
^{187}Re	5.3 E+00	1.1 E+03
^{209}Po	2.9 E-02	7.7 E+01
^{210}Pb	1.0 E-02	5.6 E+05

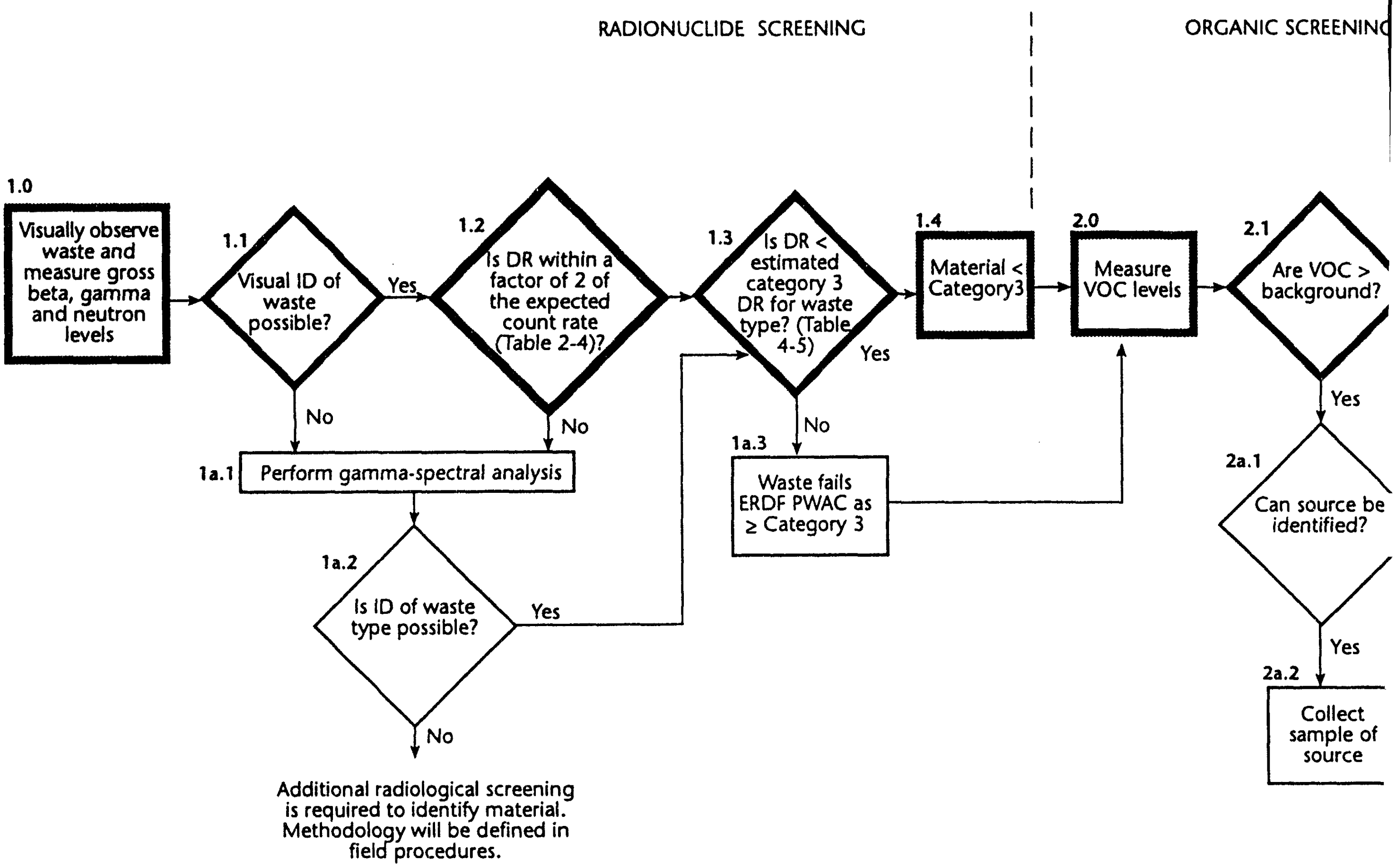
Table 4-3. Radionuclide Category 1 and 3 Limits.

Sheet 2 of 2

Nuclide	Activity Limits (Ci/m³)	
	Category 1	**Category 3**
^{226}Ra	1.4 E-04	3.6 E-02
^{228}Ra	1.9 E+01	
^{227}Ac	4.5 E-03	3.2 E+05
^{229}Th	4.8 E-04	1.1 E-01
^{230}Th	2.1 E-03	1.3 E-01
^{232}Th	1.2 E-04	2.2 E-02
^{231}Pa	1.6 E-04	3.3 E-02
^{232}U	5.3 E-04	4.0 E+00
^{233}U*	7.7 E-03	1.1 E+00
^{234}U	9.1 E-03	2.1 E+00
^{235}U	3.2 E-03	5.9 E-01
^{236}U	1.0 E-02	2.2 E+00
^{238}U	6.3 E-03	1.4 E+00
^{237}Np*	1.9 E-04	4.0 E-02
^{238}Pu*	9.1 E-03	4.5 E+01
^{239}Pu*	3.6 E-03	7.7 E-01
^{240}Pu*	3.6 E-03	7.7 E-01
^{241}Pu*	7.7 E-02	3.1 E+01
^{242}Pu°	3.8 E-03	8.3 E-01
^{244}Pu*	8.3 E-04	1.7 E-01
^{241}Am*	2.6 E-03	1.1 E+00
^{242m}Am*	2.6 E-03	2.4 E+00
^{243}Am*	1.3 E-03	2.8 E-01
^{243}Cm*	2.5 E-02	6.3 E+02
^{244}Cm*	2.3 E-01	2.9 E+02
^{245}Cm*	2.1 E-03	3.3 E-01
^{246}Cm*	3.3 E-03	7.7 E-01
^{247}Cm*	7.1 E-04	1.5 E-01
^{248}Cm*	9.1 E-04	2.0 E-01

° Limit for isotope in activated metal.
* Category 3 limit is the lower of this value and 100 nCi/g.

Source: WHC-EP-0063-4, WHC 1993.



PWAC = Preliminary Waste Acceptance Criteria
DR = Dose Rate

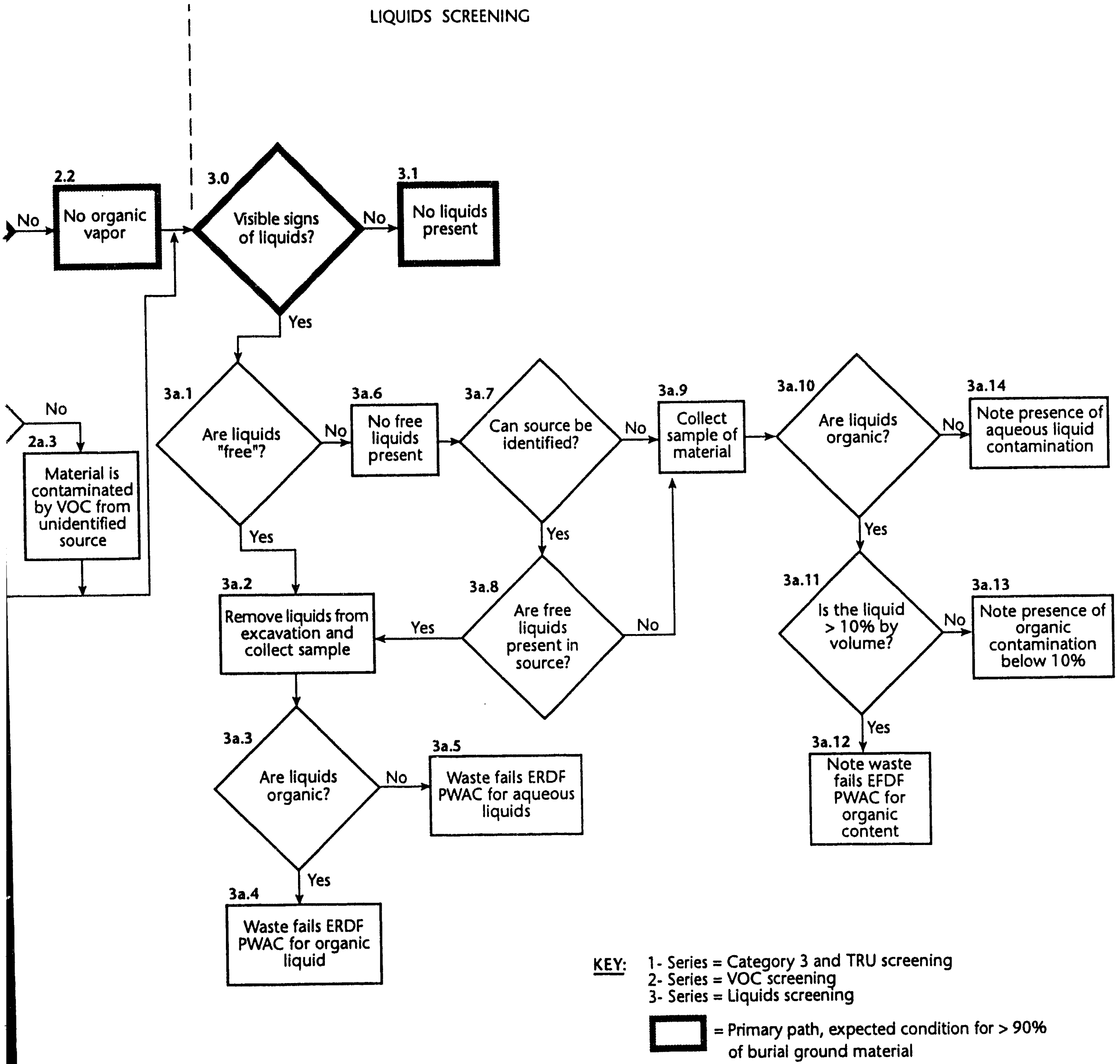


FIGURE 4-2
PRIMARY ANALYTICAL SCREENING PROCESS

Table 4-4. Primary Analytical Screening.

Step/Action
1.0 Visually observe waste and measure gross beta, gamma, and neutron levels. The waste is observed and field instrumentation are used to measure the gross beta/gamma, and neutron levels. These measurements are compared to the predicted levels for the identified waste type. Go to step 1.1.
1.1 Visual ID of Waste Possible? Visual observation is used to identify the type of waste (such as process tubes, soft waste, or graphite) for comparison to expected dose rate, to identify free liquids, and to identify the presence of liquids absorbed on waste. If the type of waste can be identified go to step 1.2, if not, go to step 1a.1.
1.2 Is the dose rate (DR) within a factor of 2 of the expected count rate, as shown in Table 2-4? If it is, go to step 1.3. If the count rate is > 2x the predicted rate, then the material requires further analysis. Go to step 1a.1.
1.3 Is the DR less than the estimated Category 3 DR for that waste type? The nuclide list is reviewed to determine if the material is less than the Category 3 limit (Table 4-5). If not, it is classified as greater than Category 3 (step 1a.3). If so, the material is classified as less than Category 3 and handled with the other waste material (step 1.4).
1.4 Material is < Category 3. Materials that contain radionuclides less than the Category 3 limit are designated as < Category 3. Most of the materials will not exceed the Category 1 limit, but the only required distinction is whether it is > Category 3, or not. Go to organic screening (step 2.0).
1a.1 Perform Gamma-Spectral Analysis. If the material cannot be identified in step 1.0, then the material will be subjected to a gamma spectral analysis using a sodium iodide probe. The objective is to identify all gamma emitters. Go to step 1a.2.
1a.2 Is Identification of Waste Type Possible? Using the radionuclides identified in step 1a.1, can the waste type be identified from the list of standard types? If so, go to step 1.3. If not, additional radiological screening is required to identify the material; this methodology will be defined in the test procedures. As stated in Section 2.2.5, no waste is expected to exceed the Category 3 limits; therefore, all wastes are expected to be identified by this point.
1a.3 Waste fails ERDF Preliminary Waste Acceptance Criteria for Category 3. Materials that contain radionuclides greater than their Category 3 concentration limits are given this designation. If Category 3 material is encountered, work should stop at that location, the material covered if necessary, the stakeholders notified, and work proceed at another location.
2.0 Measure VOC levels. Detection of organic vapors is performed using a PID or FID (WHC decision). Go to step 2.1.

Table 4-4. Primary Analytical Screening.

Step/Action
2.1 Are VOC > background? As stated in Section 2.2.5, VOCs are not expected in the burial ground and detection of VOCs above background requires a search for the source (assumed to be a breached container, see step 2a.1). If VOCs are not present above background, go to step 2.2.
2.2 No organic vapors. Go to liquids screening, step 3.0.
2a.1 Can source be identified? A search is made of the area to determine if the source of the VOC can be found. If so, go to step 2a.2. If not, go to step 2a.3.
2a.2 Collect a sample of the source. If the source can be identified, then a sample is needed to determine what material is vaporizing. Go to liquids screening, step 3.0.
2a.3 Material is contaminated by VOC from unidentified source. If the source of VOC cannot be identified, then this information is noted in the field log and the excavation continues. Go to liquids screening, step 3.0.
3.0 Are there visible signs of liquids? This applies to both conditions: where VOC are present (i.e., probably the source) and where VOC are not present (i.e., either non-volatile organics or aqueous liquids). These signs may range from discoloration of the waste material to liquid observed dripping off the waste. If visible signs are present then go to step 3a.1. If not, go to step 3.1.
3.1 No liquids present. Note that no liquids are present in the waste material.
3a.1 Are liquids "free." A liquid is free if it meets the Resource Conservation, and Recovery Act (RCRA) definition of a liquid (i.e., fails the paint filter test). If containers are identified, these must be handled to contain the liquid and transfer it, if needed, to sound containers for disposal. If the waste matrix is dripping liquid, then it must be containerized for treatment or disposal. See step 3a.2. If no free liquids are present, then go to step 3a.6.
3a.2 Remove liquids from the excavation and collect a sample. Liquids must be removed from the excavation. If a container exists, it may be sound enough to be moved to the staging area. If the container is not sound the liquid is transferred to a sound container, or the existing container is overpacked. A sample is collected either during transfer or at the staging area. This sample will be used to characterize the liquid. Go to step 3a.3.
3a.3 Are liquids organic? The liquid is determined to be either organic or aqueous by visual observation, field tests, or from the sample analysis. If the liquid is organic go to step 3a.4; if not, go to step 3a.5.

Table 4-4. Primary Analytical Screening.

Step/Action
3a.4 Waste fails ERDF Preliminary Waste Acceptance Criteria for organic liquids. Note, in the field log, that free organic liquids are present. It is important to describe the conditions that the liquids were found in, including: • what was the dominant waste type around the liquid? • what did the material look like? • where in the trench were the liquids found? • are these any other pertinent facts?
3a.5 Waste fails ERDF Preliminary Waste Acceptance Criteria for aqueous liquids. Note, in the field log, that free aqueous liquids are present. See step 3a.4 for required description of conditions.
3a.6 No free liquids present. Note in the field log book that liquid contamination is present, but no free liquids exist. See step 3a.4 for required description of conditions. Go to step 3a.7.
3a.7 Can source be identified? Search for the source of the liquid contamination. If it is found go to step 3a.8; if not, go to step 3a.9.
3a.8 Are free liquids present in the source? If free liquids are present in the source, then they must be handled as any free liquid (see step 3.2). If no liquids are present, then proceed to step 3a.9.
3a.9 Collect sample of material. A sample is collected to determine the identity of the liquid. Go to step 3a.10.
3a.10 Are liquids organic? If the analysis shows that the liquid contamination is organic go to step 3a.11; if not, go to step 3a.14.
3a.11 Is the liquid > 10% by volume? If the organic contamination is greater than 10% by volume of the waste matrix, then go to step 3a.12. If it is not, go to step 3a.13.
3a.12 Waste fails ERDF Preliminary Waste Acceptance Criteria for organic content. Note that the waste fails the preliminary waste acceptance criteria of the ERDF because organic contamination from a liquid source exceeds 10% by volume.
3a.13 Note presence of organic contamination below 10%. Note in the field log that organic contamination is present and its volume by percentage. This waste is acceptable at the ERDF.
3a.14 Note presence of aqueous liquid contamination. Note in the field log the presence of waste contaminated by the aqueous liquid. Also include the type of liquid.

4.3.1 Screening Implementation

The analytical screening methodology is used during both bulk removal and container monitoring phases of the treatability study. Both phases require screening; however, the container monitoring phase involves manually opening containers (such as cardboard boxes and drums) to determine void volume and identify any contained liquids. Implementation of the screening process for bulk removal and container monitoring is presented below.

4.3.1.1 Bulk Removal.

Visual Observation. Visual observation is the key screening step. It is used to identify free liquids, the presence of liquids absorbed onto waste, and the type of waste (such as process tubes, soft waste, or graphite) for comparison to expected dose rates.

As a comparison of Tables 2-3 and 4-3 shows, only graphite and aluminum process tubes are expected to potentially exceed the Category 1 limit. The radionuclide levels in these wastes may approach the limit between Category 1 and Category 3; therefore they should be screened for variations in radionuclide levels that may place the waste greater than Category 3. Both of these materials can be visually identified, ensuring that wastes are properly screened and classified.

Screening should be used to monitor all materials during bulk removal. Screening of materials may be performed in bulk, but some screening on individual pieces of waste will be necessary for comparison with the estimated dose rates and to ensure that the waste contains no anomalies. If anomalies are found, then the waste types with the anomalies should be identified for more careful screening during the remainder of the trench excavation. The following discussion presents the conceptual screening process. This screening methodology may change as data is obtained from test results.

Radionuclide Monitoring. Screening during bulk removal involves using gross beta/gamma and neutron probes to determine the dose rate (or count rate) of the material and then comparing that level to two screening levels. First, the measured dose rate should be compared to the Category 3 dose rates for each waste type, as shown in Table 4-5. If the dose rate is at or above this level, then the material is identified as "Category 3 or greater," placed in a known location in the excavation, and covered with soil or other shielding as required. Identification of this material is a regulator hold point, meaning that both DOE and the regulators should be contacted immediately if it is found, and work proceed at another location if possible. During excavation, bucket loads of homogeneous material may be screened against a single dose rate to expedite this step. The rate used should be the lowest dose rate possible for the bucket and is set at 110 mR/hr (i.e., for 3 yd^3 of graphite, as shown in Table 4-5).[1]

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[1] A single screening dose rate is given with some hesitancy. During excavation, it is crucial that operations personnel visually observe the material being removed. Any material that is unexpected or not accounted for in this plan must be screened individually to determine its radionuclide dose and possibly its constituents.

Table 4-5. Estimated Contact Dose Rates for Category III Wastes from the 118-B-1 Burial Ground.

Waste Type	r (defined below)	Original Dose Rate (R/hr)[a]	Category III Dose Rate (R/hr)[b]
Aluminum Spacers	[c,d]	1.9×10^{-4}	n/a
Lead/Cadmium Poison Pieces	[c,d]	3.4×10^{-2}	n/a
Aluminum/Boron Splines	[c,d]	1.4×10^{-1}	n/a
Graphite	2.24	3.71×10^{-2}	8.3×10^{-2}
Aluminum Process Tubes	8.5×10^{3}	6.4	5.4×10^{4} [d]
Desiccant	n/a	None[e]	None
Lead Brick	220	1.7×10^{-1}	37
Lead Sheet	366	7.7×10^{-3}	2.8
Miscellaneous	2.3×10^{4}	1.7	4.0×10^{4} [d]
Cadmium Sheet	n/a	None[f]	None
Soft Waste	8.1×10^{6}	2.3×10^{-1}	1.9×10^{6} [d]
Thermocouples	n/a	None	None
Stainless Steel Steam Generator Tubes	n/a	None[g]	None
Tritium Separations Project - Glass Line Waste	n/a	None[f]	None

Notes:

$$r = \frac{\text{Category III Concentration}}{\text{Original Concentration}} = \frac{\text{Category III Dose Rate}}{\text{Original Dose Rate}}$$

The Category 3 dose rate is calculated by holding the isotope ratios from Table 2-3 constant and increasing the concentrations by the factor r. The Category 3 dose rate is then calculated from the increased isotope concentrations.

[a] MICROSHIELD model results based on the actual radionuclide concentrations from Table 2-3.

[b] Category III dose rate (R/hr) = r x Original dose rate (R/hr)

[c] Radionuclides contained in this waste type have no Category III limits.

[d] Practical considerations such as the effects of external radiation and internal heat generation on transport, handling, and disposal will limit the concentration for these wastes (10 CFR 61, Table 2, Section 61.55).

[e] Beta radiation only; dose rate is negligible.

[f] No radionuclide data.

[g] Negligible, total radionuclide inventory < 0.01 Ci for 57.5 tons of waste.

n/a = Not Applicable.

Second, the measured dose rate should be compared to the expected dose rate for that material (Table 2-4). Materials that are within a factor of two of the expected beta/gamma rates are considered identified. It is expected that a great majority of the burial ground material will meet the expected condition; however, some material may not. Materials that do not match the expected waste types, or that have dose rates less than or greater than two times the expected rate, must undergo gamma-spectral analysis. Gamma-spectral analysis is used to determine which gamma-emitting radionuclides are present in the material. If a waste type is consistently found to exhibit a different dose rate than that expected, then the actual dose rate will replace the expected rate in the screening table. Thus, as the excavation proceeds, the expected conditions may change as data is collected.

The estimated dose rates presented in Tables 2-4 and 4-5 are based on a single waste form and simple configuration (i.e., single box or bundle). Thus, use of these dose rates is inappropriate for nonhomogeneous waste piles such as a bucket load of multiple waste forms. Nonhomogeneous waste piles must be segregated or otherwise excluded from measurement before using Tables 2-4 and 4-5.

If the material type cannot be reconciled from the gamma-spectral analysis, then additional screening is required to determine what the radionuclide inventory is. Additional screening may entail beta, and possibly alpha, spectral analysis. The FTL will determine whether additional screening will be performed and what it will entail.

Neutron detection will be performed with passive detectors. Materials having measurable neutron emissions potentially are TRU and must be set aside for detailed analysis or sampling for confirmation.

Materials identified for secondary analysis are expected to be few; therefore, this material will be moved offline to minimize interference with test operations. The FTL will make the decision whether or not to subject a material to secondary screening. Under some circumstances, secondary screening will not be desired–even though the material will not be identified. This situation may exist for a material that is not a normal waste form and with a dose rate too high to justify personnel exposure. However, the decision to not analyze a material must be made very carefully. These materials will have to be handled during remediation of the burial grounds; thus, information must be generated either during this test or at some other point before remediation.

If the gamma-spectral analysis shows the material's inventory exceeds the Category 3 limits, then the material should be identified as "greater than Category 3," placed in a known location in the excavation, and covered with soil or other shielding as required. Identification of greater than Category 3 material is a condition where DOE and regulators should be notified as soon as possible and work proceed in another location, if possible.

Organic Vapor Monitoring. Organic vapor screening is performed using a photo-ionization detector (PID) or flame-ionization detector (FID) to detect total VOCs. If

VOCs above background are detected, a search should be performed for the source and, if identified, a sample collected from it.

4.3.1.2 Container Monitoring. Screening during container monitoring will be identical to screening during bulk removal, except that personnel will open containers manually to determine if free liquids are present and, if so, their volume. Initially, all containers will be opened; however, once sufficient information is gathered on a type of container (such as cardboard boxes or drums), the frequency of sampling may be reduced to 10 percent. The FTL will determine when sufficient information exists. However, enough data must be collected to show that the waste form is consistent.

Table 4-2 summarizes the uncertainties associated with the analytical screening methodology, including observations to detect uncertainties and contingencies for each condition.

4.3.2 Screening Methodology

Table 4-4 describes the analytical screening process, step by step, as shown in Figure 4-2. (Note: The 1-series numbers pertain to Category 3 and TRU primary screening, the 2-series numbers pertain to VOCs screening, and the 3-series numbers pertain to liquids screening.)

4.3.3 Analytical Sampling

The field screening process defined in Sections 4.3.1 and 4.3.2 may not be sufficient to identify all materials encountered during the test. If such materials are encountered, then laboratory analysis is required. For this test, up to 20 grab samples may be collected during the excavation test for laboratory analysis. These samples will be collected at the direction of the field team leader based on the following:

- Material that cannot be identified by field screening
- Up to five samples from the bottom of trenches where the field screening instruments indicate clean soil (Note: it is not required to attempt to excavate to the trench bottom in every trench and samples are not required in every trench)
- One grab sample of graphite (^{14}C) for isotopic analysis to confirm the isotope ratios in Table 2-3 (if graphite is encountered)

Each grab sample will be analyzed for the following list of analytes from the burial ground waste site group, *100 Area Source Operable Unit Focused Feasibility Study Report, Volume I* (DOE/RL 1994).

- Radionuclides: ^{14}C, ^{137}Cs, ^{60}Co, ^{152}Eu, ^{154}Eu, ^{3}H, ^{63}Ni, ^{90}Sr
- Inorganics: Cadmium, Lead, Mercury
- Organics: No specific constituents identified

4.4 HANDLING: SEGREGATION AND SORTING

This section describes the segregation and sorting treatability test operations. These test operations will be implemented to evaluate the effectiveness of separating waste forms into the four waste categories: containers, hard, soft, and soil (including rock–see Section 3.0 for definitions of these categories). Segregation may be more effective than sorting for separation of waste forms. Therefore, segregation will be attempted on every type of trench condition that is encountered, while sorting will focus only on those trench conditions where segregation is ineffective or inefficient.

4.4.1 Segregation

Segregation assumes the use of a trackhoe with a thumb to separate waste forms within the trench into the four categories. Segregation will be implemented during the treatability test program whenever sufficient working area is available within the trench. The conceptual allocation volume for segregation is 20 to 25 percent of the total waste volume excavated. The focus of the segregation testing will be on the larger waste forms, but observations also will be made concerning how well smaller pieces are segregated.

Segregation should be attempted for each type of trench condition encountered. The trench condition is dependent on what types of waste forms are present (including size, shape, and physical characteristics), how the waste forms are orientated or stacked in situ, and how densely they are packed. Segregation will be tested using both excavation approaches: top-down and side.

Initially, segregation should be attempted for at least 30 minutes on each type of material consisting of more than one waste category. If the waste includes containers, the containers will be segregated first by picking, combing, or spreading. Picking is defined as grabbing the waste discretely using the bucket and thumb to separate the material. Combing is the process of dragging the bucket tines through the waste to separate the material. Spreading involves bulk excavation and dumping of the material over a wide area to expose and separate materials.

If segregation is causing free liquids to spill from containers, the containers will not be handled until they are screened. If a large number of containers filled with liquids are encountered, the trench will be closed and excavation will proceed at the next planned trench location.

The conceptual overview of the segregation testing as described above provides a preliminary framework for the treatability test and indicates where likely decision points and measurements will be made. However, it is unlikely that the test will be implemented as described without some modification. Deviation from this overview is expected because of the inherent uncertainties associated with the burial ground that could affect the implementation of segregation testing. Operational decisions such as equipment limitations, safety, high or low production rates, and accessibility to the trenches may govern the implementation of the testing. Some of these uncertainties can be managed through the SAFER approach; others will require technical judgment during the field operation. Table 4-6 lists how the anticipated uncertainties will be addressed during implementation of the treatability testing. Should a situation occur in the field that is not addressed explicitly, the field decision should be driven first by safety considerations and second by the data required to satisfy the test objectives. The data requirements are presented in Section 3.0.

4.4.2 Sorting

The sorting test operation is unique to this test plan because, unlike the other test operations, the equipment for sorting is not specified. This poses a dilemma in selecting equipment or designing a system for presumed conditions. While it is undesirable to procure an expensive piece of equipment for testing that may not be necessary or effective, it is difficult to evaluate sorting without some type of sorting equipment (recognizing that hand sorting is not practical). To balance these two concerns, the following were assumed:

- That the waste materials in the trenches are primarily mixed with soil.
- That sorting equipment could be evaluated based on expected conditions.
- That selected sorting equipment would be evaluated by batch-type processing.
- That the evaluation of sorting equipment would focus on the ability to separate soil from waste materials and separate soft and hard materials.

Because of the difficulties described above, the sorting portion of the treatability test program should be seen as a pilot test to evaluate the ability of a piece of equipment to separate materials, rather than a demonstration test to evaluate production rates and materials handling. The information learned from this testing will provide input for the development of a more complex sorting system. It must be recognized that production rates provided under these test conditions will not be applicable to a production-scale or full-scale operation. Furthermore, materials handling, storage, and transportation of the waste categories will not be evaluated as a part of this test program.

Sorting involves separating waste forms outside of the trench into the four waste categories. Initially, an excavator will be used to remove waste from the trench. Sorting will be implemented during the treatability test program whenever sortable material is encountered and is deemed appropriate to achieve the test objectives.

Table 4-6. Uncertainty Management/Decision Table for Handling.

Sheet 1 of 2

Area of Uncertainty	Expected Conditions	Uncertainties	Observations to Detect Uncertainties	Decision Rule/Contingency
Waste Segregation	Segregation is appropriate for large waste forms and trench conditions that consist of 2 or more waste categories.	Appropriate waste material that should be tested for segregation.	Direct Observation	If the waste material contains two or more waste categories and a similar material has not been previously tested, then attempt to segregate for at least 30 minutes.
Container Segregation	Segregation of large containers followed by bulk removal will facilitate field screening.	The ability to segregate visible containers.	Direct Observation	If the waste material contains visible containers, then attempt to segregate containers first.
Container Handling	Excavator with thumb will have ability to pick containers without sacrificing their integrity.	The ability to segregate containers without damaging the containers' integrity.	Direct Observation	If containers cannot be segregated by equipment without destroying the container causing spillage of liquids, then uncover containers to allow field screening prior to moving.
Presence of Liquid Containers	No containers contain free liquids.	Encountering containers with liquids.	Direct Observation	If more than 10 containers are found with liquid in the same trench section, then move to the next planned trench location.
Small Waste Form and Soil Segregation	Segregation of small waste forms and soil will not be effective.	Presence of small and unbundled waste forms, and soil.	Direct Observation	If the waste material contains small waste forms that cannot be segregated, then focus the segregation on the larger waste forms. Sort the smaller waste forms if segregation is not effective in the separation of the waste categories.
Large Waste Form Segregation	Segregation of large waste forms will be more effective than sorting.	The ability to segregate large waste forms.	Segregation Production Rate (See DQO Table 3.5).	If large waste materials average more than 5 minutes per cubic yard to segregate in a 30 minute period, then attempt to sort this material.
Waste Sorting	Sorting is appropriate for materials that are not segregatable.	Presence of non-segregatable wastes.	Direct Observation	If waste material is not segregatable because of small size or segregation is not effective, then attempt to sort 5 cubic yards of the material.

Table 4-6. Uncertainty Management/Decision Table for Handling.

Area of Uncertainty	Expected Conditions	Uncertainties	Observations to Detect Uncertainties	Decision Rule/Contingency
Container Sorting	Containers will be extracted during the first stage of sorting to facilitate field screening.	The ability to sort waste that includes containers.	(See DQO Table 3)	If sorting of waste including containers results in spillage of liquids (two occasions from same trench), then open containers, segregate, and field screen prior to moving.
Sorting Equipment Adjustment	The ability to sort will depend upon the type of material and the equipment operational settings.	Equipment settings that are best for certain types of materials.	Direct Observation	If sorting production rates or separation efficiency can be improved (based on observations) by adjusting sorting equipment (such as angle of grizzly screen, size of disc screen), then perform up to two additional sorting tests to evaluate these factors.
Hand Picking/Sorting	Hand picking/sorting is slow and labor intensive but accurate.	The ability to hand pick/sort in batch processing.	Direct Observation	Hand pick/sort for at least 30 minutes per sort test to determine feasibility of process.

The conceptual allocation volume for sorting is 1 to 10 percent of the total waste volume excavated. The intent of testing this volume is to sort each type of waste that is not readily segregatable. The ability to sort wastes into categories is considered to be independent of the excavation approach.

The conceptual sorting flow chart presented in Figure 4-3 illustrates a potential approach for the sorting test operation. It is assumed that 5 cubic yards of non-segregatable waste will serve as the model sorting volume. First, the material encounters a grizzly screen that initiates the sorting process. The grizzly screen is a static bar screen that separates containers, large rock, and large or long waste forms. The screen is slightly angled to allow large material to roll off the screen; however, some materials may have to be hand or machine picked off of the screen.

Material that passes through the grizzly screen may fall through a chute into a container or onto the ground (Figure 4-4). The minus material from the grizzly screen will be processed by one of two options: (1) a stationary disc screen, or (2) a disc screen inside the bucket of a front-end loader. The decision of which piece of equipment to test will be made during procurement and development of treatability test procedures.

The stationary disc screen is a mechanical screen comprised of an inclined box with a series of transverse shafts, each of which has a series of interleaved discs that create the screening space. The shafts rotate so that the discs move the material from the entry to the point of discharge. The screen size is adjustable and, depending on where the size adjustment is set, material is separated into a minus fraction and plus fraction containing materials sized less than and more than that set point, respectively. The plus fraction may contain pieces up to 6 inches in diameter, though longer pieces may exist. The minus fraction is expected to consist of soil and other waste types broken into small pieces. The plus fraction is expected to consist of large waste forms and rocks.

The bucket disc screen is an attachment that fits onto a front-end loader or trackhoe which facilitates screening (Figure 4-4). The screen/bucket combination allows the operator to fill the attachment with the waste material. Then, through the action of the disc screen and bucket, the minus material is shaken out of the attachment leaving the plus material inside. After the plus material has been separated out by the stationary or bucket disc screen, it may be placed on an inclined sorting table where hard waste, soil (including rock), and soft waste will be separated by hand and raking methods.

The conceptual overview of the sorting operations presented in Figure 4-3 provides a preliminary framework for the treatability test. Some of the uncertainties associated with sorting are presented in Table 4-5. Should a situation occur in the field that is not addressed explicitly, the field decision should be driven first by safety considerations and second by data required by the test objectives established in Section 3.0.

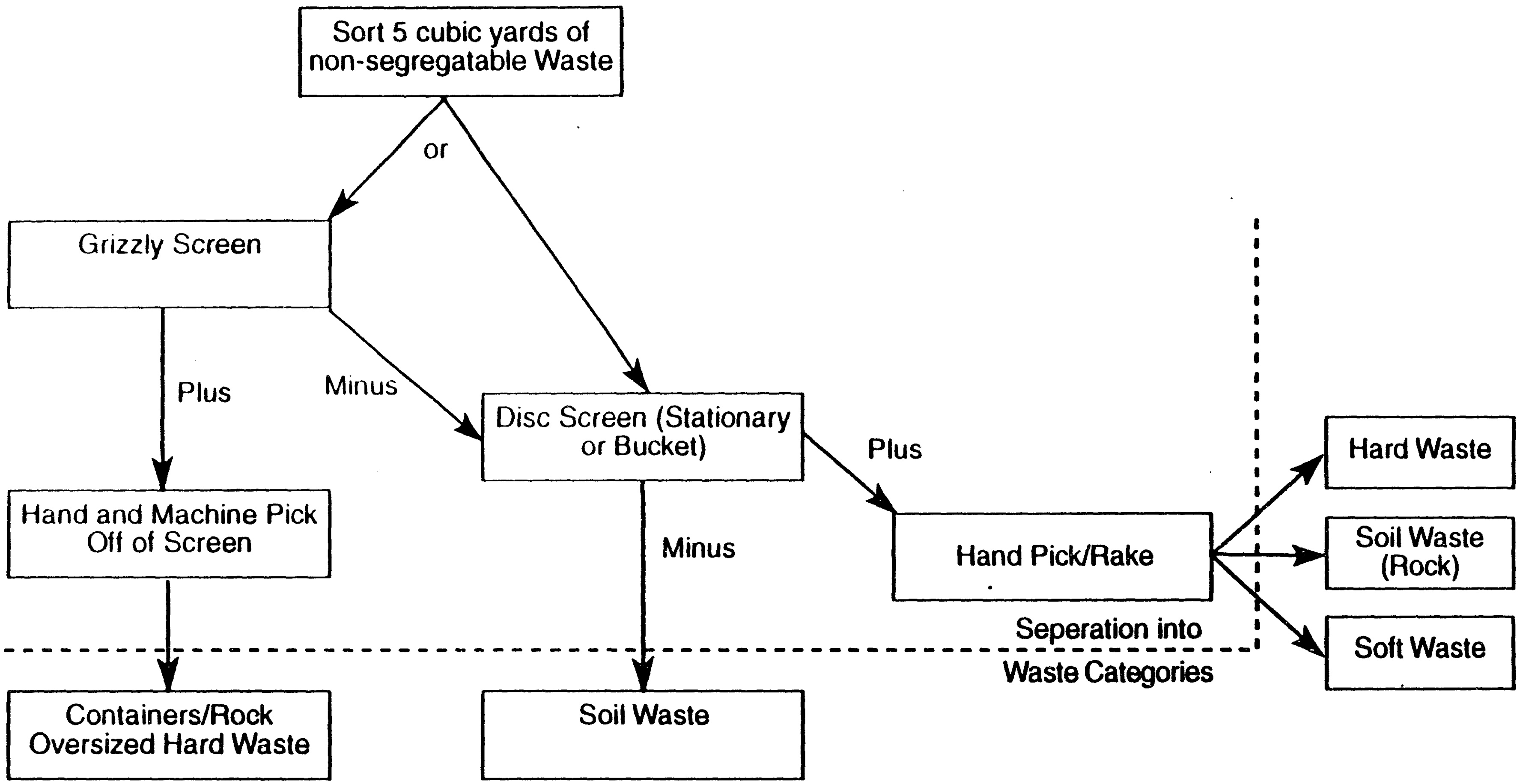
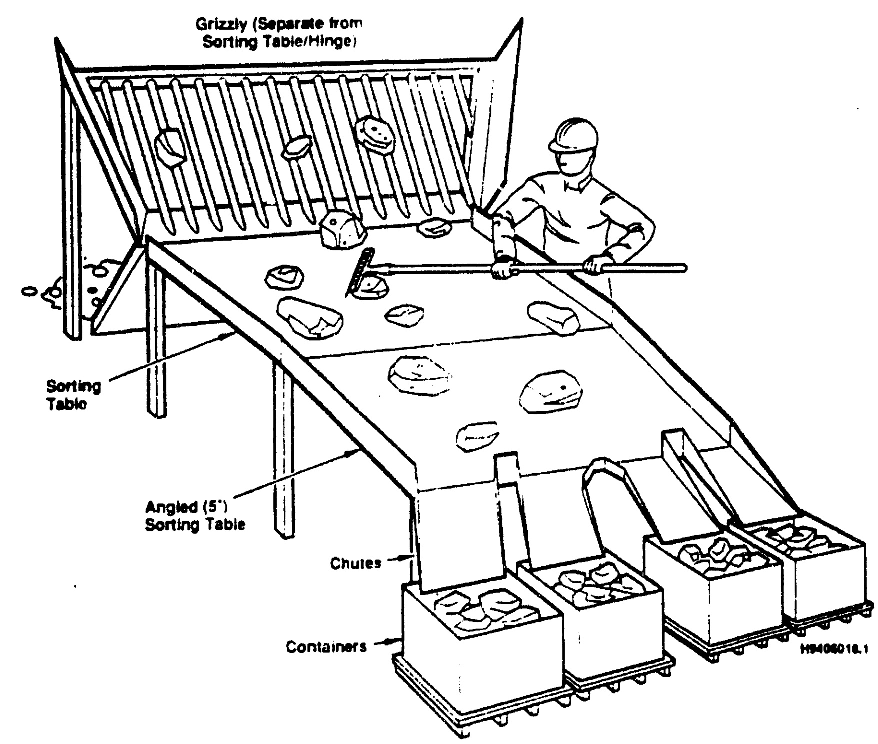


FIGURE 4-3
Conceptual Sorting Flow Chart

A Static (Grizzly) Screen



A Bucket Disc Screen

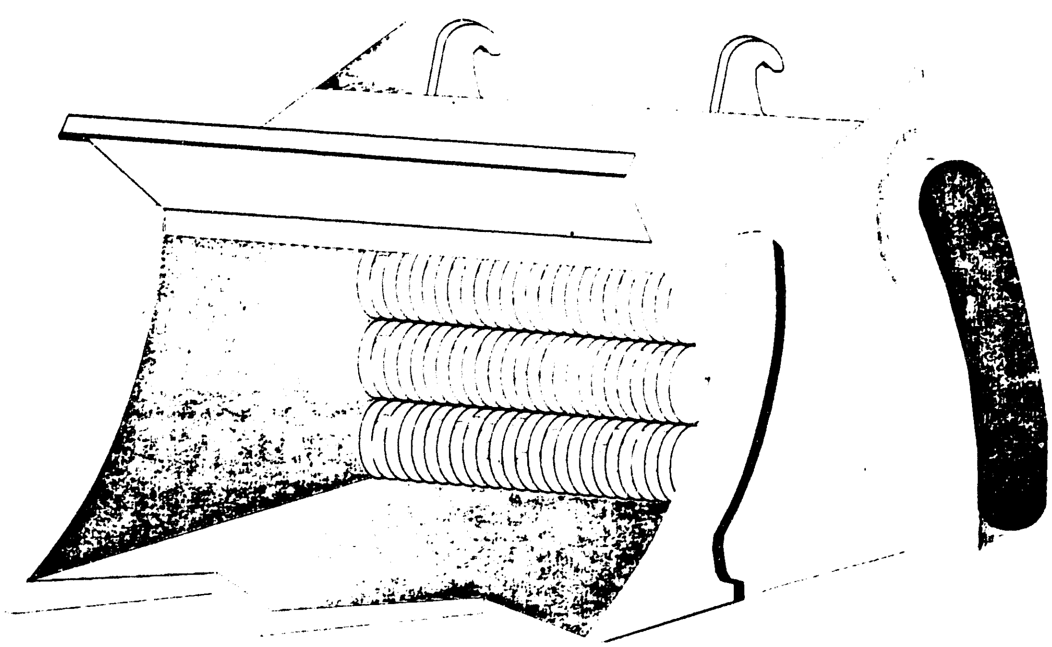


FIGURE 4-4
Sorting Equipment

4.5 TRENCH CLOSURE

This section summarizes the operations involved in closing the test trenches. The primary operations consist of documenting where materials are located, backfilling and compacting the waste in the trench, and replacing the overburden. All excavated material, except liquids, will be replaced in the burial ground. Each excavated trench will be closed prior to excavating the next trench.

4.5.1 Documentation of Material Locations

A general description and photographic record will be kept of the material excavated, segregated, and placed in the trench. The descriptive documentation should identify the waste category, contamination level, and appropriate trench location. Materials in the trench could be located by measuring off from existing burial ground markers. If burial markers have no unique identification, a sequential number will be permanently placed on the marker. Portions of the trench that consist of many different types of waste may be best described with photographs. At the FTL's discretion, a marker may be placed in the trench to identify the bottom or side of the trench for future reference.

4.5.2 Trench Backfilling

The operation of backfilling waste into the trench will proceed in a manner that minimizes dust generation and the possibility of destroying the integrity of containers. During backfilling, an effort should be made to keep waste categories separated as much as possible to simplify final remediation. Some form of compaction should be used to increase the relative density of the trench as it is being filled. This compaction could be accomplished by packing the waste with the backhoe bucket in lifts. After the waste trench has been backfilled and compacted to the point where overburden is required, a cross-section profile should be obtained for the swell volume evaluation.

4.5.3 Replacing Overburden

Overburden material should be placed over the trench to return to natural grade. Additional overburden material should be placed as required by health physics protocol to provide sufficient shielding. Excess overburden will be left in stockpiles, as necessary.

5.0 EQUIPMENT AND MATERIALS

This section provides a preliminary list of the equipment and materials required for conducting the treatability test.

5.1 EXCAVATION AND REMOVAL

The equipment required for excavation and removal is presented below:

- Trackhoe
- Front-end loader
- 10-yard dump trucks (preferably two)
- Water truck
- Dust control equipment
- Abney
- Automatic level
- Philadelphia rod
- 200-foot and 300-foot measuring tapes
- Miscellaneous tools to support equipment maintenance and minor repairs

The materials required for excavation and removal are presented below:

- Plastic sheeting
- Stakes and marking paint
- Materials for temporary storage
- Materials for decontamination
- Materials for health and safety
- Liquid waste disposable containers

5.2 ANALYTICAL SCREENING

The equipment required for analytical screening is presented in Table 5-1.

5.3 SEGREGATION AND SORTING

The equipment required for segregation and sorting, in addition to those items listed in Section 5.1, are presented below:

- Grizzly screen with adjustable frame
- Adjustable disc screen
- Sorting table (if needed)
- Rakes for hand sorting

The materials required for segregation and sorting, in addition to those items listed in Section 5.1, include containers to catch materials from the sorting table.

Table 5-1. Analytical Screening Instrumentation.

Purpose	Instrument
Dose Rate (beta/gamma) ≤ 5,000 mR/hr ≤ 200 R/hr	 Eberline RO-2 or equivalent Eberline RO-7-BM or equivalent[a]
Beta/gamma Ratios	See dose rate instruments above.
Gamma Spectral Analysis	Sodium-iodide should be sufficient (keep germanium in consideration)
Beta Spectral Analysis	Plastic scintillator
Alpha count[b]	Alpha scintillator, Eberline AC-3 connected to PAC-ISAGA or equivalent
Alpha/beta smear counter[b]	Eberline SAC-4 or equivalent
Alpha Spectral Analysis	Silicon dioxide[c]
Neutron	[d]
Organic Vapors	Photoionization detector using either a 10.6 or 11.8 eV lamp.

[a]Consider using 5-foot rigid extension (RO-7-RX5) or model 6150 ADT detector with 167-inch extension.
[b]These activities are not part of analytical screening, but these instruments may prove useful during field operations.
[c]SAIC has a hand-held variety that may be acceptable.
[d]This is usually not easy. May need to consider large systems used for barrel counting or the system employed by Battelle.

6.0 SUPPORTING DOCUMENTATION

The majority of the supporting documentation for this test plan is included in the 100-BC-1 and 100-DR-1 Operable Unit RI/FS Work Plans (DOE/RL 1991b, 1991c). While these RI/FS work plans primarily address Phase I Remedial Investigations (RIs), much of the supporting documentation is applicable to treatability testing. Supporting documents in the work plans include a Field Sampling Plan (FSP), a Quality Assurance Project Plan (QAPjP), a Health and Safety Plan (HSP), and a Data Management Plan (DMP). The DMP is supplemented by Environmental Investigation Instruction 14.1: Analytical Laboratory Data Management (WHC 1988). These supporting plans will be applicable to all work scope performed by WHC, including the collection of soil test samples and operation of the pilot-scale systems.

Testing and sampling procedures for the excavation treatability test will be prepared by WHC. The test procedures will use the work plan versions as a basis for procedure development, with test-specific modifications. All work performed on the Hanford Site will follow the site-specific QAPjP and procedures, although these may need to be modified to include test-specific requirements. The treatability-test-specific procedures specify the methods and procedures used and DQOs to ensure consistency. The QAPjP will meet the requirements of the *Environmental Engineering, Technology, and Permitting Function Quality Assurance Program Plan* (WHC 1990).

Community relations are performed in accordance with the Tri-Party Agreement, Section 10 (Ecology et al. 1989). Information regarding this study probably will be disseminated during the quarterly public information meetings. WHC will prepare a hazardous waste operations plan, radiation work permit, and Safety Assessment Plan prior to initiation of field activities. All activities are performed as specified in these documents.

7.0 REPORTS

Following completion of field testing, a report will be issued that summarizes the data collected, discusses the data in terms of the evaluation criteria and test objectives, provides a narrative of how the test was implemented, and presents conclusions and recommendations applicable to the full-scale remedial action. This report should include the following:

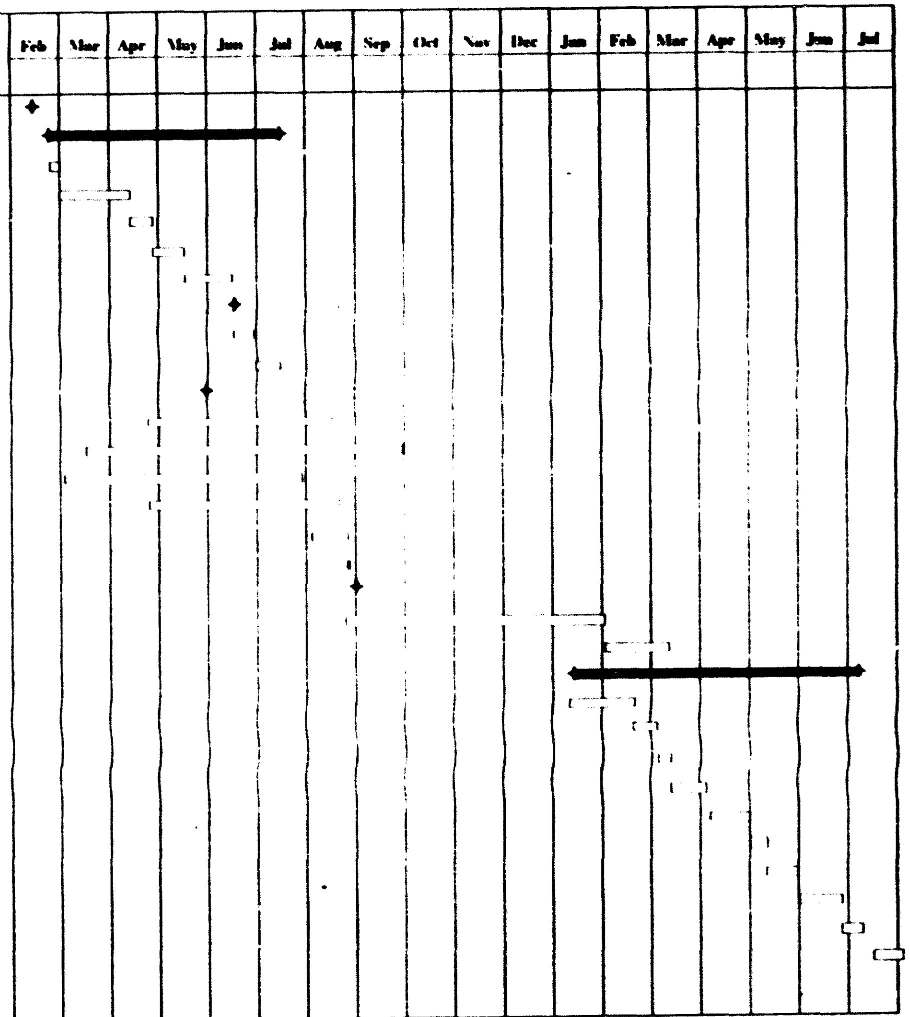
- A narrative of the treatability test
- A summary of the data collected
- An overview of the nature and type of waste materials encountered
- Discussion of which excavation removal approach was most appropriate and why
- Discussion of whether special equipment is needed
- Discussion of the capability of field instruments to perform screening during bulk removal
- Discussion of the adequacy and ability to screen containers
- Discussion of the feasibility of segregating waste forms
- Discussion of the feasibility of sorting waste forms using the treatability test equipment
- Provide recommendations for handling contingencies (specifically, provide a recommended secondary screening methodology, if used)
- Conclusions and recommendations for implementing the full-scale remediation

A recommended outline for treatability study reports is included in the *Guide for Conducting Treatability Studies Under CERCLA* (EPA 1989).

8.0 SCHEDULE

The schedule for planning, conducting, and reporting the 118-B-1 Excavation Treatability Test is shown in Figure 8-1. The treatability test planning began in early 1994, and the final test report is planned for May 1995.

#	Name	Duration	Scheduled Start	Scheduled Finished
1	Test Scoping Complete	0w	2/15/94	2/15/94
2	Prepare Test Plan	100d	2/23/94	7/14/94
3	Prepare Outline/WHC Agreement	1w	2/23/94	3/1/94
4	Write Plan	6.2w	3/1/94	4/12/94
5	Draft Test Plan to WHC	2.2w	4/12/94	4/26/94
6	Revise Document/WHC Comments	3.2w	4/26/94	5/17/94
7	Test Plan to DOE/Regulators	4.4w	5/17/94	6/14/94
8	Comments Due	0w	6/14/94	6/14/94
9	Comment Resolution/Doc. Rev	2.2w	6/15/94	6/28/94
10	Issue Final Test Plan	2.4w	6/28/94	7/13/94
11	MILESTONE: PROVIDE PLAN MAY 94	0w	5/31/94	5/31/94
12	Write Test Procedures	16.6w	4/26/94	8/18/94
13	Design/Build Sorting System	28w	3/16/94	9/29/94
14	Permits/Assessments	20.6w	3/1/94	7/28/94
15	Procurement/Aquisitions*	16.6w	4/22/94	8/18/94
16	Mobilization	3.2w	8/4/94	8/25/94
17	Pre Job Safety Meeting	0.4w	8/25/94	8/26/94
18	MILESTONE: INITIATE TEST AUG 94	0d	8/31/94	8/31/94
19	Initiate Excavation/Conduct Test	22.6w	8/31/94	2/3/95
20	Site Restoration	5.4w	2/3/95	3/13/95
21	Prepare Treat. Test Report	29w	1/12/95	7/5/95
22	Preparation	6.6w	1/12/95	2/27/95
23	Internal Review	2.2w	2/27/95	3/13/95
24	Comment Review	1.2w	3/13/95	3/20/95
25	Document Revision	2.2w	3/20/95	4/3/95
26	DOE Review	4.2w	4/3/95	5/1/95
27	Comment Resolution	1.2w	5/1/95	5/8/95
28	Revision	3.4w	5/8/95	5/30/95
29	Regulator Review	4.2w	5/30/95	6/27/95
30	Comment Resolution	1.8w	6/27/95	7/19/95
31	Revision	2.2w	7/19/95	8/2/95
32	MILESTONE: REPORT TO REG.	0w		



* Does not include any long lead procurement needs

Project: Critical Noncritical Progress Milestone Summary Rolled Up

Date 4/11/94

FIGURE 8-1
Excavation Treatability Test Schedule

9.0 PROGRAM ORGANIZATION

The program organization chart for the treatability test is shown in Figure 9-1. WHC Environmental Restoration Engineering will have direct responsibility for the planning, execution, and evaluation of the test. Other Westinghouse organizations will provide support as needed.

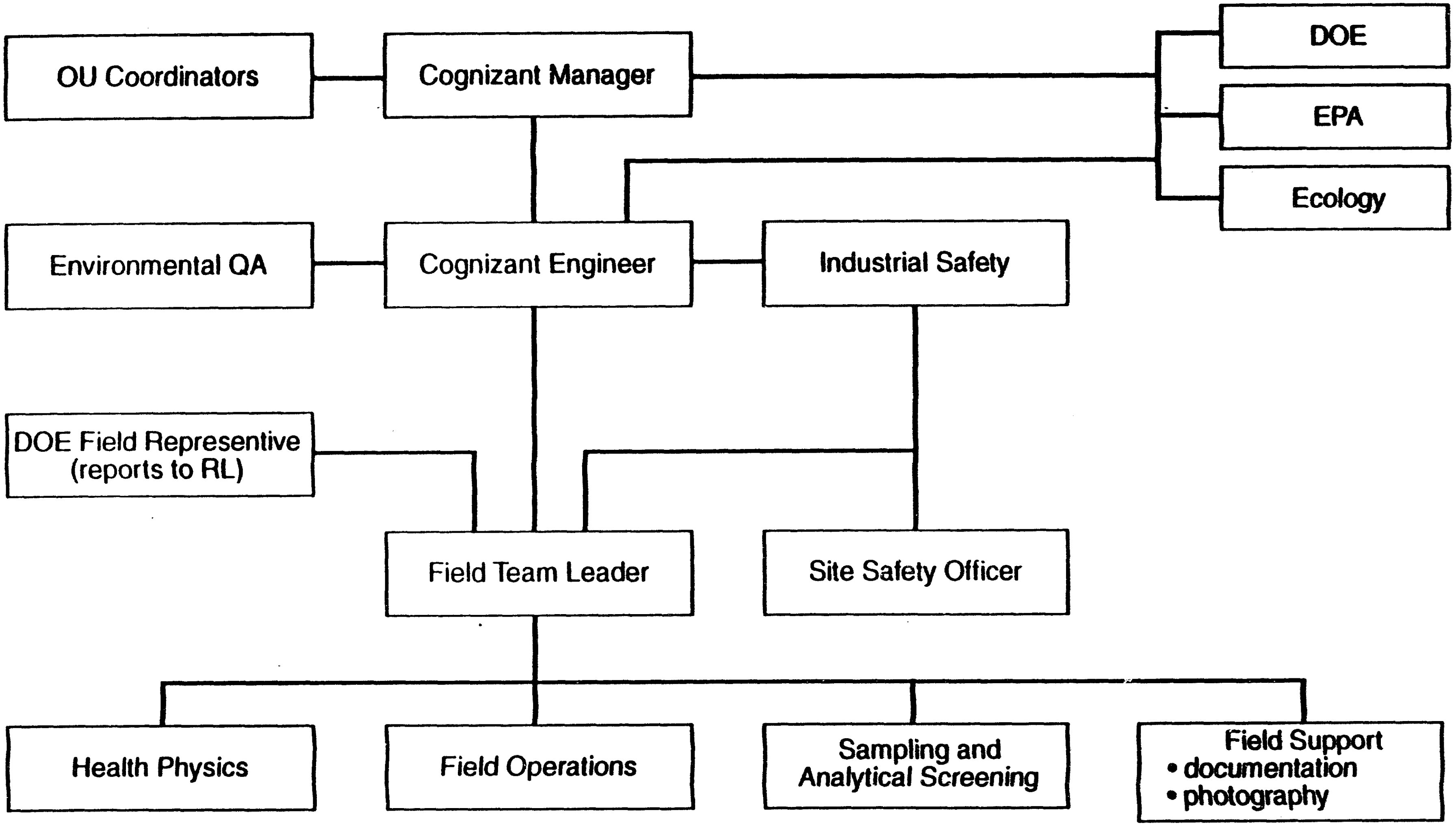


FIGURE 9-1
Program Organization Chart

10.0 REFERENCES

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105-B Burial Ground Log

APPENDIXES

APPENDIX A

118-B-1 BURIAL GROUND TREATABILITY STUDY SCOPE OF WORK AGREEMENT

HANFORD 118-B-1 BURIAL GROUND TREATABILITY STUDY

SCOPE OF WORK AGREEMENT

Purpose of Treatability Study Pursuant to the Hanford Federal Facility Agreement and Consent Order Change Control Form Change Number M-15-93-04 (Attachment 1), the purpose of this treatability test is to obtain additional engineering information for remedial design of burial grounds receiving waste generated from 100 Area removal actions. For this treatability study, the parties agree to remove 5,000-10,000 cubic yards of actual contaminated soil and waste material from the trench. This volume does not include the overburden.

This treatability study will be focused on the removal of waste from the 118-B-1 General Purpose Burial Ground in the 100 BC Area. The initial scope as defined in M-15-93-04 includes but is not limited to the following:

- Identification of types of waste media that will need to be addressed.
- Determining the amount of overburden covering trenches and the depth of waste material in trenches.
- Testing analytical screening techniques to be utilized during remediation.
- Identifying types of contamination for safety planning, removal and transportation equipment, data for treatment or immobilization considerations, and Waste Acceptance Criteria development.
- Identification of segregation, decontamination and volume reduction (compaction) needs.

Overall Information Use To support development of the Proposed Plan and Record of Decision which will identify the approach for burial ground remediation, and to provide specific engineering information to support development of design activities and implementation procedures.

Work Scope Definition Process To more clearly define the project work scope and arrive at a consensus the U.S. Department of Energy, Richland Operations Office (RL), the U.S. Environmental Protection Agency (EPA) and the State of Washington Department of Ecology (Ecology) have elected to use the Streamlined Approach For Environmental Restoration (SAFER). SAFER is a new Department of Energy (DOE) initiative based on both the Data Quality Objective (DQO) process and the Observational Approach. Both EPA and Ecology have endorsed the trial application of this approach at Hanford in an effort to increase involvement of the extended project team (three parties) in order to achieve a bias for action, identify data to support the decisions to be made and to optimize the management of uncertainty during data collection and engineering. To achieve these goals a series of SAFER meetings were held. Based on these meetings a refined scope of work has been defined.

SAFER Scoping Discussions Six scoping meetings were held between January 13 and February 15, 1994 to define required treatability test objectives and data needs. This process emphasized the data quality objectives attributes of SAFER. Consensus for the work to be conducted by Westinghouse Hanford Company for RL in order to comply with M-15-93-04 was achieved by the extended project team. This consensus is summarized in tabular form and appended as Attachment 2. Definitions for terms in this Scope of Work are also appended as Attachment 3.

Schedule Pursuant to M-15-93-04, the schedule for the 118-B-1 Treatability Test is as follows:

- **February 15, 1994**: Finalize the scope of work for the 118-B-1 Area Burial Ground Treatability Test before starting the test plan.

- **May, 1994**: Submit 118-B-1 Area Burial Ground Treatability Test Plan to EPA and Ecology.

- **August, 1994:** Commence treatability test field work for the 118-B-1 Burial Ground.

- **May, 1995:** Submit 118-B-1 Treatability Test Report to EPA and Ecology.

Assumptions This section details extended project team assumptions and agreements on regulatory, funding and logistical issues. This section defines and identifies those issues essential for all parties to understand and agree on which are fundamental to implementing the treatability study.

The assumptions are:

- 118-B-1 was selected for this treatability test because of its representiveness of other primary use burial grounds in the 100 Areas and availability of historical data.

- The approach and procedures to be developed are specifically for the 118-B-1 treatability test and appropriate review will be performed before they are extended to other 100 Area primary use burial grounds.

- Excavation will occur in five trenches.

- Overburden is not contaminated and will be removed with standard equipment and procedures.

- Overburden ends within 1 to 2 feet of the waste material and is estimated to be 5 to 10 feet thick.

- Overburden is not included in the estimate of 5,000 to 10,000 cubic yards of removed waste material.

- The estimate of 5,000 to 10,000 cubic yards of waste material includes all waste material removed from trench, and waste material segregated but not removed from the trench.

- Standard excavating equipment (e.g., backhoe equipped with a thumb) will be used.

- If field screening techniques fail to conclusively identify contamination to a level of detail to evaluate against ERDF waste acceptance criteria (as incorporated in approve test plan), then analytical laboratory analysis may be required (not to exceed 20 samples for this treatability test). No "hot cell" analytic analysis will be performed as part of this treatability test.

- Closed containers, if found, will be treated as if they contain free liquids or organic liquids, until the contents can be documented by some form of inspection (e.g.,visually).

- Liquid waste, if found, will be handled separately from the solid waste forms to prevent release of contaminants into the environment.

- Categories for segregation include containers, recyclables, soils, compactables, and bulk metals. These categories will be defined in the treatability test plan and may be modified based on field judgment.

- Categories for sorting include containers, compactables, recyclables, soils, and bulk metals. These categories will be modified in the treatability test plan and may be modified based on field judgment.

- ERDF general waste acceptance criteria for the purposes of this test include: No free liquids, no organic liquids, no radioactive waste exceeding category 3 as defined in WHC EP-0063-4.

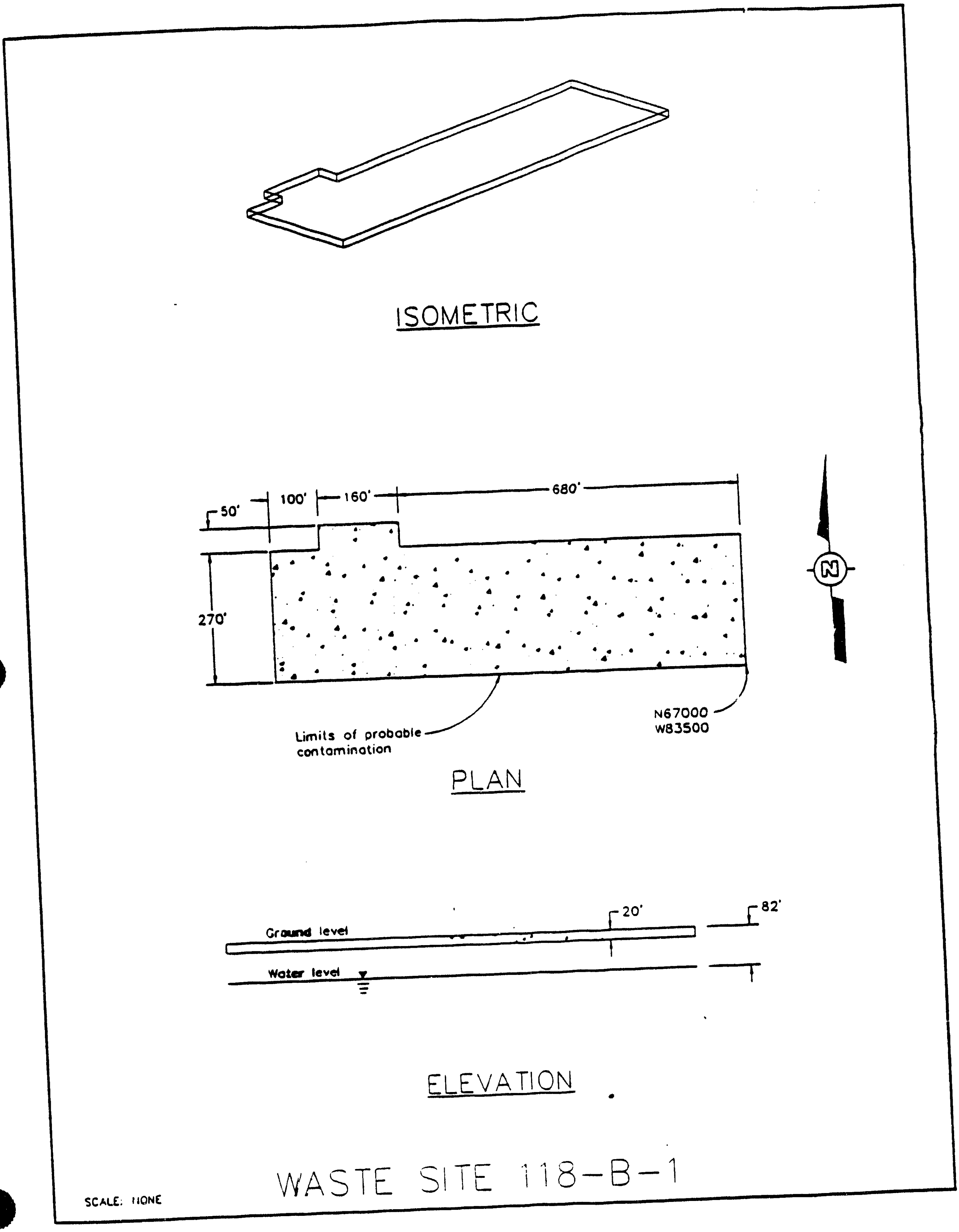
- Excavated material, excluding liquids, will be replaced in the burial ground.

- Each excavated pit will be closed before moving to a new test area.

- Interim waste storage will be managed consistent with WHC Environmental Investigation Instruction Manual EII 4.3 in an environmentally sound manner.

- Material temporarily removed from the trench as a part of this treatability test will be handled in a manner to minimize the transport of contaminants in dust, runoff, leachate, and dose. The design life of the temporary storage will be one month.

- Interim waste and material storage requirements will be of minimal and insignificant cost compared to total estimated cost of the test.
- The scope of this test was developed assuming funding is available.
- The scope of this test will not change without appropriate review of schedule and cost.
- Weather conditions will be within acceptable ranges for safe operating practice.
- The written test results will make a qualitative and general evaluation of treatment technologies and recommendations for feasible technologies required to address treatment of waste to meet ERDF waste acceptance criteria. This evaluation will be based on results of the waste form segregation and sorting tests.
- Placement of waste in the trench following the treatability test will be documented to facilitate final remediation.
- Actual treatment of waste forms is not part of the scope of this treatability test.
- Transportation decisions are not a part of the scope of this treatability test.


ISOMETRIC
50'
100'
160'
680'
270'
N
N67000
W83500
Limits of probable contamination
PLAN
20'
82'
Ground level
Water level
ELEVATION
WASTE SITE 118-B-1
SCALE: NONE

Volume Estimate
100 BC Area

SITE NUMBER: 118-B-1
SITE NAME: 105-B Burial Ground

CONTAMINATED DIMENSION ASSUMPTIONS:

Burial Ground
- 21 trenches running East/West
  - Length - 250 ft at top (R. Wahlen)
  - Width - 10 ft at base (R. Wahlen).
  - Depth - 20 ft deep (Ref 1).
  - Slopes - 1.0H:1.5V
- 3 trenches running North/South
  - Length - 160 ft at top.
  - Width - 16 ft at top.
  - Depth - 8 ft deep
  - Slopes - 1.0H/1.0V
- Perforated Burials - No data.
- Spline Silos
  - Metal Culverts with a 5-6 ft radius (Ref 1).
- Burial ground has been covered with a minimum of 4 ft of fill.

Contaminated Area -
- North, South, East, West - No lateral contamination.
- Minimum, Probable, and Maximum are the same.
- Depth -
  - Assume burial ground trench filled to 4 ft prior to fill covering.
  - Volume not calculated for Perforated Burials and Spline Silos, assumed to be included in Trench volumes.

Other Materials -
- 75% of material is non-metals (soft waste), 25% is metals. 1 bank cubic yard metals = 1.6 tons

Attached figure shows site plan and cross section with the limit of probable contamination identified.

ELEVATIONS:

Surface - 479 ft (Ref 1,7)
Groundwater - 397 ft (Ref 6)

EXCAVATION DIMENSION ASSUMPTIONS:

Assume excavation with bottom footprint of a polygon with sides measuring 940 x 270 x 50 x 160 x 50 x 680 x 270.
Excavation Slopes - 1.5H/1.0V

VOLUME CALCULATION ASSUMPTIONS:

The shape of the unit is assumed to be that of a truncated rectangular pyramid.
The shape of the excavation is assumed to be that of a truncated rectangular pyramid.
Volumes are given in bank cubic yards. Swell factors are applied for production rate and duration estimates (see page 4).

SITE NUMBER: 118-B-1

CONTAMINATED VOLUME

MINIMUM, PROBABLE, MAXIMUM

Unit	Length ft	Width ft	Thickness ft	Bottom Area sf	Side Slope H/V	Top Area sf	Volume bcy
21 Trenches					0.67		
Top dimension	250	37	20			9,167	
Bottom dimension	223	10	20	2,233			
Subtotal							86,823
3 Trenches					1.0		
Top dimension	160	16	8			2,560	
Bottom dimension	144	0	8	0			
Subtotal							1,100
Subtotal - Metal							21,981
Subtotal - Soft Waste							65,942
TOTAL							87,923

EXCAVATED VOLUME

MINIMUM, PROBABLE, MAXIMUM

Unit	Length ft	Width ft	Depth ft	Bottom Area sf	Slope H/V	Top Area sf	Volume bcy
Overburden #1					1.5		
	1,012	342	4	330,000		346,104	50,078
Excavated Material #1					1.5		
Top dimension	1,000	330	4			330,000	
Bottom dimension	940	270	24	253,800			
Subtotal							258,933
Overburden #2					1.5		
	232	122	4	24,200		28,304	3,886
Excavated Material #2					1.5		
Top dimension	220	110	4			24,200	
Bottom dimension	160	50	24	8,000			
Subtotal							13,778
TOTAL							326,675

Volume Estimate
100 BC Area

SITE NUMBER: 118-B-1

EXCAVATED QUANTITIES AND DURATION
PROBABLE VOLUME

Excavation	Quantity (1)	Production Rate (2)	Duration (3) (shifts)	Adj. Duration (4) (shifts)
Overburden	63,677 lcy	2000 lcy/shift	31.8	31.8
Basin Fill	0 lcy	1500 lcy/shift	0.0	0.0
Contaminated Material	114,300 lcy	1000 lcy/shift	114.3	114.3
Other Clean Material	218,050 lcy	1000 lcy/shift	218.1	218.1
Ramp	0 lcy	2000 lcy/shift	0.0	0.0
Misc Material Handling				
Metals Demolition	35,169 tons	100 ton/shift	351.7	351.7
Metals Loading	28,575 lcy	1500 lcy/shift	19.0	19.0
Concrete Demolition	0 lcy	200 lcy/shift	0.0	0.0
Concrete Loading	0 lcy	1500 lcy/shift	0.0	0.0
TOTAL	396,027 lcy		734.9	734.9

NOTES:

(1) - Swell factors applied to convert bank cubic yards (bcy) to loose cubic yards (lcy):

Burial Ground Waste	1.30
Other Metals	1.30
Concrete	1.60
Soil	1.18

- Metal Density applied to convert metal volume (bcy) to weight (tons), conversion factors (tons/bcy):

Burial Ground Metals	1.60
Other Metals	6.60

(2) Production rates, see section 4.4.2.

(3) 1 shift = 7 x 45 minute hours.

(4) Total Duration: not less than 1 shift.

Attachment 1

Change Number	Federal Facility Agreement and Consent Order Change Control Form	Date
M-15-93-04	Do not use blue ink. Type or print using black ink	Jan. 25, 1994

Originator: K.M. Thompson

Phone: 376-6421

Class of Change
[ ] I - Signatories [X] II - Project Manager [ ] III - Unit Manager

Change Title

ESTABLISH MILESTONES FOR A TREATABILITY TEST AT A BURIAL GROUND IN THE 100-B AREA

Description/Justification of Change

Establish the following target date and milestones:

M-15-16A-T01	Finalize the scope of work for the 100-B Area Burial Ground Treatability Test before starting the test plan.	February 15, 1994
M-15-16A	Submit to the EPA and Ecology the 100-B Area Burial Ground Test Plan.	May 1994
M-15-16B	Commence remedial field work for the 100-B Area Burial Ground.	August 1994
M-15-16C	Submit to the EPA and Ecology a 100-B Area Burial Ground Field Work Report.	May 1995

Description continued on page 2 of this change form.

Impact of Change

None.

Affected Documents

Hanford Federal Facility Agreement and Consent Order, Action Plan, Appendix D.

Approvals X Approved ___ Disapproved

This change form approved by Amendment Four to the Hanford Federal Facility Agreement and Consent Order executed by the signatories on January 25, 1994.

John Wagoner, DOE — January 25, 1994 (Date)

Gerald Emison, EPA — January 25, 1994 (Date)

Mary Riveland, Ecology — January 25, 1994 (Date)

AIIM

Association for Information and Image Management
1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIIM STANDARDS
BY APPLIED IMAGE, INC.

ACTION:

Conduct a treatability test at a burial ground in the 100-B Area to obtain additional engineering information for remedial design of burial grounds receiving waste generated from 100 Area removal actions. The test will consist of collecting waste for analysis for development of waste acceptance criteria, evaluations of safety considerations for contingency planning, waste removal and transportation technology, and verification of existing information from historical records.

BACKGROUND:

The 100 Area burial grounds, such as the 118-B-1, contain a great variety of different waste forms as per historical records. Some of the wastes were segregated into specific trenches during disposal. The waste types range from typical office trash to chemical and radiologically contaminated equipment. The 118-B-1 Burial Ground first received wastes in 1944 and continued to receive wastes until 1973. The 118-B-1 Burial Ground was sampled for radionuclide contaminants in April 1976 and reported by Dorian and Richards (1978). The 118-B-1 Burial Ground is the preferred site (to conduct a treatability test) as selected by the U.S. Environmental Protection Agency (EPA) and State of Washington Department of Ecology (Ecology).

SCOPE:

The 118-B-1 Burial Ground is part of the 100-BC-2 Operable Unit. The strategy negotiated between the Tri-Party signatories and being used for burial grounds in the 100 Area relies on existing information and the observational approach to achieve remedial action goals. The data generated from the exhumation of selected trenches in the 118-B-1 Burial Ground will help evaluate existing information on waste forms and other engineering information that is useful in planning the remediation. This information includes but is not limited to the following:

- Types of waste media that will need to be addressed.
- Amount of overburden covering trenches.
- Depth of waste material in trenches.
- Analytical Screening techniques to utilize during remediation.
- Types of contaminants for Safety planning, removal and transportation equipment, data for treatment or immobilization considerations and Waste Acceptance Criteria development.
- Segregation, decontamination and volume reduction (compaction).

The exhumation of the test pits in the 118-B-1 Burial Ground will be no less than 5000 cubic yards and up to 10,000 cubic yards. The waste generated from the test pits will be managed as "investigation-derived-waste" or returned to the excavation in a manner that will facilitate final remediation. The majority of the wastes will be handled in a manner similar to test pit wastes. The specifics of the waste management will be detailed in the treatability test plan.

An individual burial ground is heterogeneous and an excavation study may not be sufficient to develop a complete and comprehensive analog for waste acceptance criteria or analogous site strategies. Other contingencies may be found to be necessary in the planning for remediating any burial ground regardless of any prior burial ground knowledge or experience. The proposed tests will, however, serve to help identify the probability of specific waste scenario to occur during remediation.

ASSUMPTIONS:

- Use field screening techniques for contamination identification with minimal lab samples for confirmation. No high activity samples will be collected.
- Utilize information and techniques from the 100-HR-1 Excavation Treatability Study.
- The Scope of Work including number and location of trenches selected will be negotiated and agreed to by the EPA, Ecology, and the U.S. Department of Energy, Richland Operations Office (RL) before starting the Test Plan.
- Wastes will be returned to the excavation in the reverse order of the removal or will be handled as "investigation-derived-waste".

(Attachment 2)

PROBLEM	DECISION	FIELD TESTS	EVALUATION BASIS	DATA NEED	MEASUREMENT TYPE/RESULTS
Support determination of appropriate waste removal technology.	Determine how each waste removal approach works (e.g., top-down, or side).	Test each excavation approach with "standard" equipment (e.g, bucket w/thumb).	Visually and quantitivly determine if/how the approach works.	Quantity of cross-contamination. **1.1**	Document expected trench size, observed trench size, and estimates of volume of waste removed.
				Stability of the surface of the trench to support the equipment chosen. **1.2**	Visual.
				Waste forms that can't be removed using standard equipment. **1.3**	Document the problem and describe the waste forms causing the problems.
				Spillage volume contribution. **1.4**	Document the occurrences and estimate volume of spillage during waste removal.

PROBLEM	DECISION	FIELD TESTS	EVALUATION BASIS	DATA NEED	MEASUREMENT TYPE/RESULTS
				Determine lay back angle for excavation for the top-down excavation approach. **1.5**	Measurement of the slopes during waste removal.
				Determine expansion of waste volume caused by excavation. **1.6**	Measure and document waste volume before and after excavation.
				Determine how "likely" waste forms requiring special equipment are. **1.7**	Document waste forms encountered and compare to the waste forms assumed to be in the burial ground per WHC-EP-0087 <u>Estimates of Solid Waste Buried in 100 Area Burial Grounds</u>.

PROBLEM	DECISION	FIELD TESTS	EVALUATION BASIS	DATA NEED	MEASUREMENT TYPE/RESULTS
				Determine if the alternative waste removal approach alleviates the need for "special" equipment (e.g., shears). **1.8**	See removal approach data needs. Document and log occurrences and recommended methods to remove waste forms.
				Determine down time to change out special equipment. **1.9**	Document the estimated times and cost to obtain/transport/mobilize/train special people or equipment.

PROBLEM	DECISION	FIELD TESTS	EVALUATION BASIS	DATA NEED	MEASUREMENT TYPE/RESULTS
	Determining if field-screening analytical capabilities during waste removal can be used to determine if waste exceeds ERDF waste acceptance criteria.	Screen waste during removal using field techniques, to be determined in test plan.	Can waste above category 3 per table 4-1 WHC-EP-0063 be detected using field detection methods?	Alpha, Beta, Neutron, and Gamma levels relative to Category 3. **1.10**	Direct detection using field instruments. If greater than Category 3 waste is detected, it will be considered a deviation. Procedures for handling greater than Category 3 waste will be developed as part of the test plan.
			Are organic vapors detected using field detection methods?	Presence and level of organic vapor. **1.11**	Direct measurement of air above containers and periodic sampling of air above removed, contaminated soils.

PROBLEM	DECISION	FIELD TESTS	EVALUATION BASIS	DATA NEED	MEASUREMENT TYPE/RESULTS
Determining appropriate waste handling technologies.	Is segregation of waste forms during excavation feasible?	What waste forms can be segregated into standard categories (see assumptions) using standard equipment?	Ability to segregate waste forms.	List of categories and waste forms in each category. 2.1	If waste forms can be segregated, measure production rates. If waste forms cannot be segregated, the reasons why will be documented.
		Can containers (e.g., drums, boxes, etc. be segregated using standard excavation equipment and procedures, without special preparation (i.e., as is)?	Ability to segregate containers.	List of descriptive results by waste form (using field judgement). 2.2	If waste forms can be segregated, measure production rates. If waste forms cannot be segregated, the reasons why will be documented.

PROBLEM	DECISION	FIELD TESTS	EVALUATION BASIS	DATA NEED	MEASUREMENT TYPE/RESULTS
	Is sorting (i.e, out of trench) in addition to segregation of waste forms feasible and necessary to meet assumed ERDF criteria (see assumptions)?	What waste forms can be sorted (to assumed ERDF criteria) outside trench following bulk removal?		List of descriptive results by waste form (field judgement). **2.3**	Visual.
		Can containers be sorted from other waste forms and remain intact using standard procedures and equipment? Standard procedures will be further defined in treatability test plan.	Ability to sort containers.	List of descriptive results by waste form (using field judgement). **2.4**	If waste forms can be segregated, measure production rates. If waste forms cannot be segregated, the reasons why will be documented.

PROBLEM	DECISION	FIELD TESTS	EVALUATION BASIS	DATA NEED	MEASUREMENT TYPE/RESULTS
	Do contents of containers meet ERDF waste acceptance criteria?	Identify and screen contents of containers.	Do contents of containers exceed category 3 radioactive waste using field techniques?	Alpha, Beta, Gamma, and neutron levels **2.5**	Direct field measurement
			Do contents of containers contain free liquids using in field techniques?	Presence of free liquids. **2.6**	Visual or other evaluation method feasible (TBD in test plan).
			Do contents of containers contain organic liquids using in field techniques?	Level and presence of organic vapors. **2.7**	Direct field measurement or other evaluation method feasible (TBD in test plan).
			What is void space estimated to be in containers?	qualitative estimate of void space. **2.8**	Visual estimate or other evaluation method feasible (TBD in test plan).

(Attachment 3)

TREATABILITY STUDY: 118-B-1 BURIAL GROUND
CONFIRMED GLOSSARY/TERMS AND DEFINITIONS

CATEGORY 3

This is a specific list of isotopes that are roughly $1x10^5$ greater than category 1 waste.

CLEAN MATERIAL OR SOIL

This is all uncontaminated material found including soil.

CONSTRUCTION DEBRIS

Expected construction waste in the 118-B-1 Burial Ground is as follows:
rebar, concrete, building tiles, and asbestos.

CROSS CONTAMINATION

When soil or waste is considered clean and becomes contaminated during excavation process.

LIQUID WASTE

No free liquids are expected in the 118-B-1 Burial Grounds. Liquids found are expected to be containerized (e.g, paint cans, solvent cans).

METALS

The metals to be expected in the 118-B-1 Burial Ground are as follows:

- Lead; in the form of blocks, bricks, sheets and casks.
- Mercury: in the form of free elements and also will be containerized.
- Aluminum: in the form of tubes, splines and thimbles.
- Steel: carbon, stainless, graphite (in powder and formed), cadmium (in sheets and in control rods), Boron (in rods and balls).
- Carbon: in powder and sheet

OPERATIONAL FREE LIQUIDS

This are liquids caused by natural occurrences such as rain, snow or condensation in containers during conduct of the treatability test.

OVERBURDEN

Material above and adjacent to the trench which is assumed a priori to be uncontaminated.

STAKEHOLDER

For this treatability study, DOE, EPA and Ecology are the groups interested in or affected by the project conducted. These are the decision makers with signature authority for the ROD.

PRODUCTION RATE

Will be determined by the type of waste encountered and recorded throughout the excavation process.

SAFER

Streamlined Approach for Environmental Restoration, this is a DOE initiative that provides a framework for environmental restoration.

SEGREGATION

This refers to the in trench separation of clean/contaminated waste forms/types and soils.

SOFT WASTE

The soft waste expected to be found in the 118-B-1 Burial Ground are as follows:
plastic, paper, wood, and insulation, etc.

SOIL

The soils in the 118-B-1 Burial Ground contain contain
radioactive contamination and chemical contamination.

SORTING

This refers to the out of trench separation into categorized placement of clean/contaminated waste forms/types and soils.

SPILLAGE

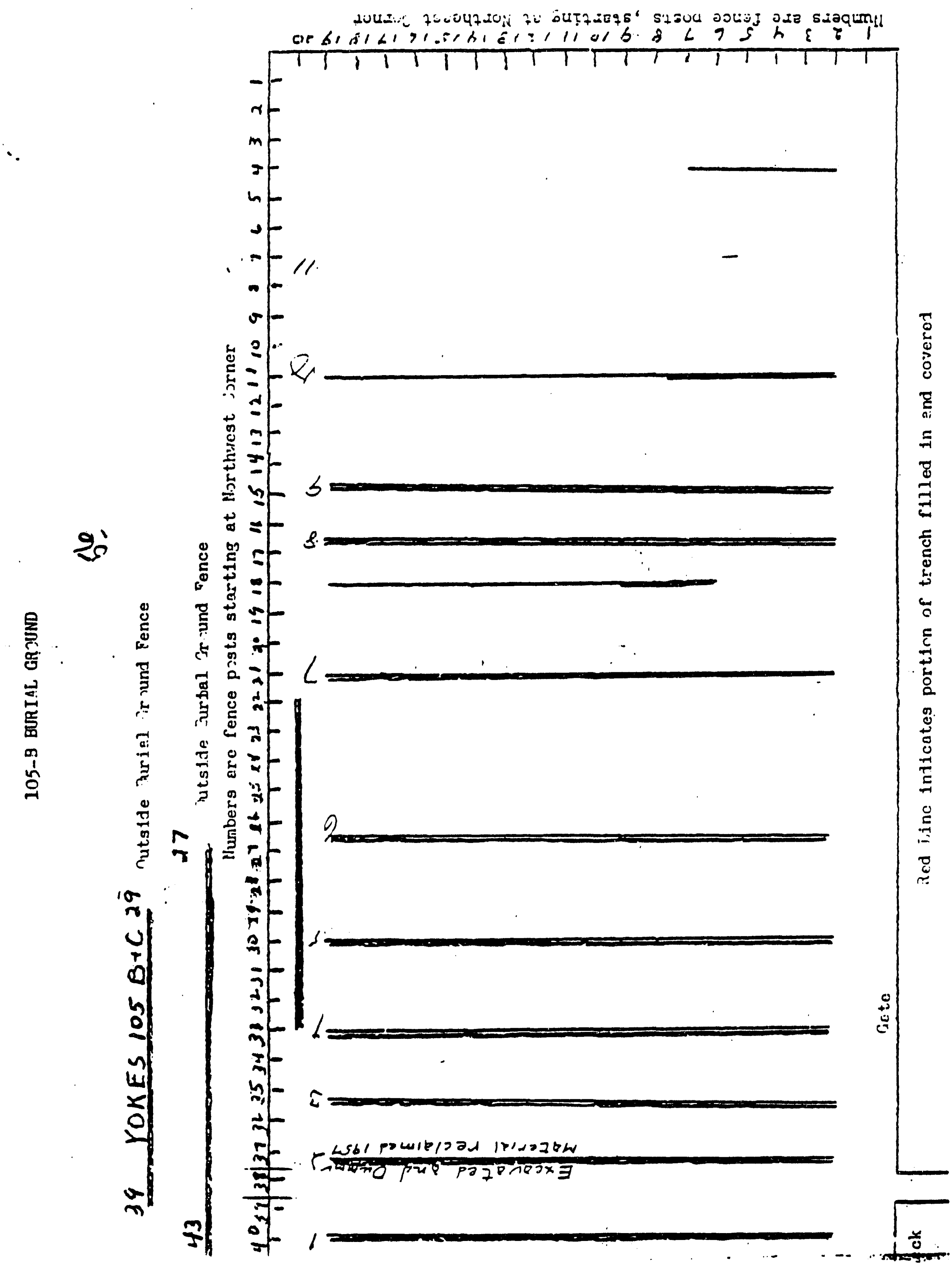
The amount of contaminated material/soil that contaminates clean material/soil when in the process of placing in designated areas.

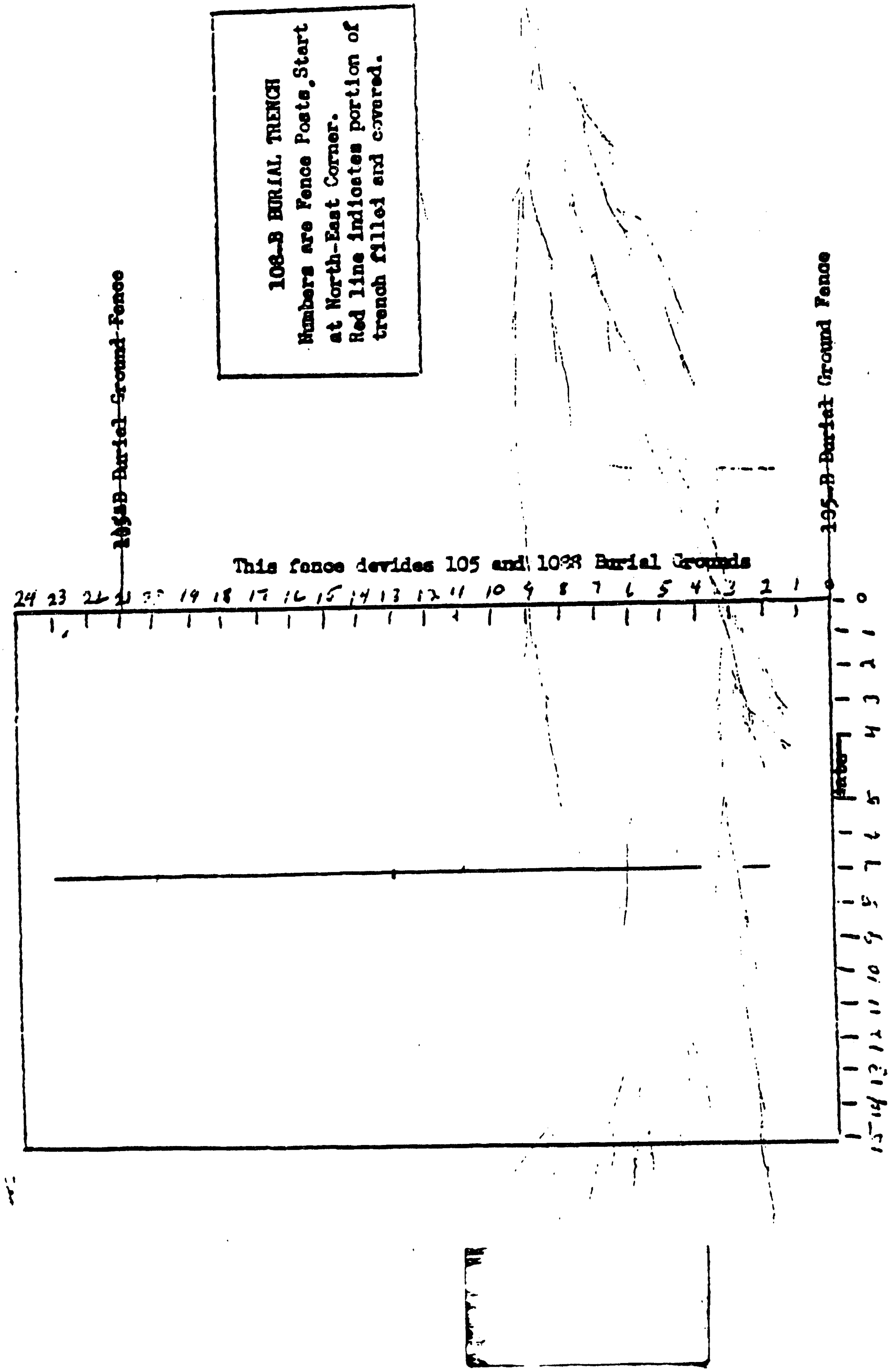
STANDARD

Ordinarily available with in schedule and resource limits.

APPENDIX B

118-B-1 BURIAL GROUND MAPS


105-B BURIAL GROUND
Outside Burial Ground Fence
Outside Burbal Ground Fence
Numbers are fence posts starting at Northwest Corner
Numbers are fence posts, starting at Northeast Corner
Red Line indicates portion of trench filled in and covered
Gate
YOKES 105 B+C 29
Excavated and Dumped
Material reclaimed 1957

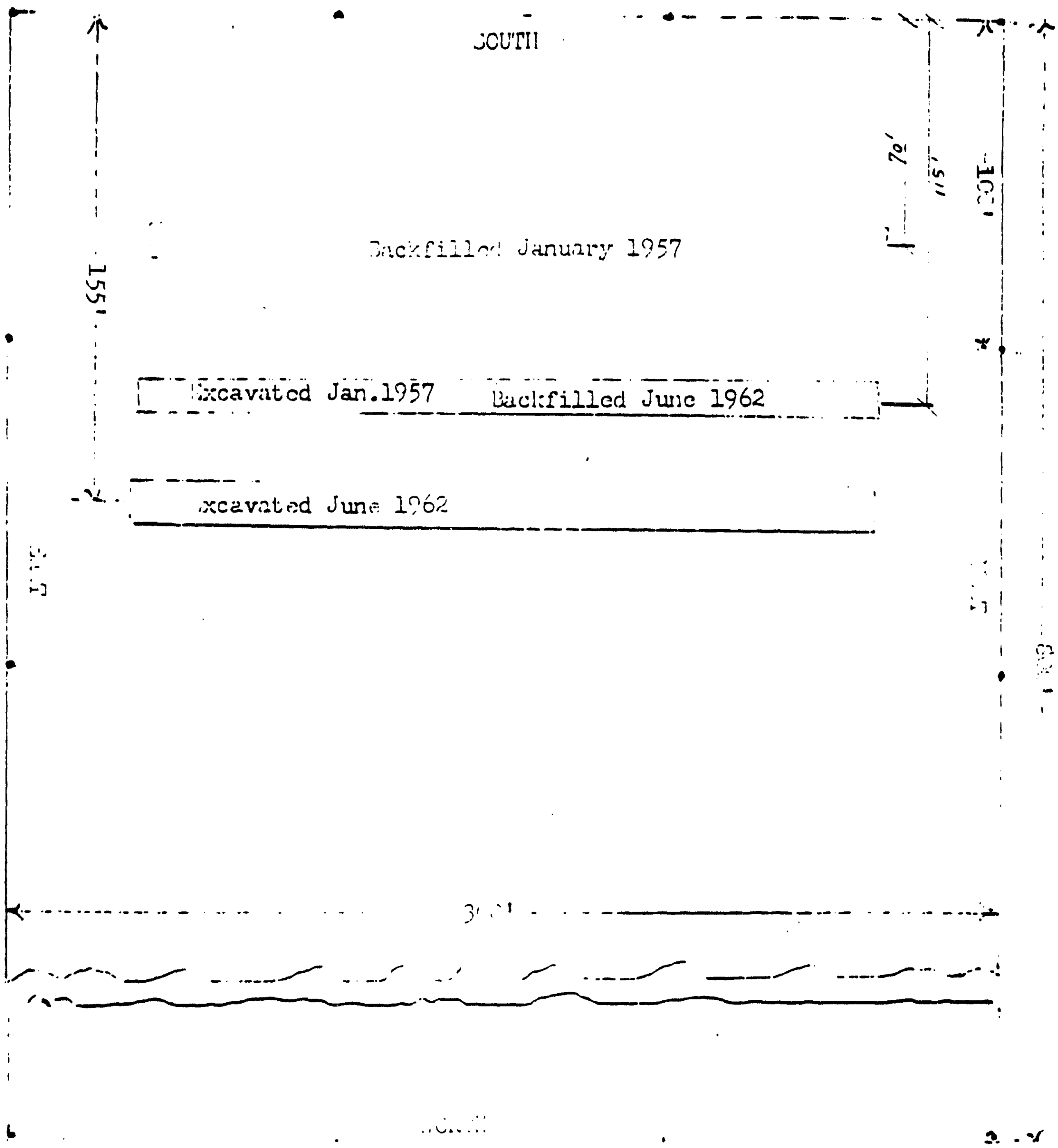

108-B BURIAL TRENCH
Numbers are Fence Posts, Start at North-East Corner.
Red line indicates portion of trench filled and covered.
108-B Burial Ground Fence
105-B Burial Ground Fence
This fence devides 105 and 108B Burial Grounds

100-B

BURIAL TRENCH

A new burial trench for burial of tubing,dummies,gun barrels and other "Hot" materials is expected to be excavated the last week in June,1962.

Cribs fabricated from used railroad ties will be installed. The cribs will be about twenty feet deep,the width, eight feet outside dimensions. Three cribs will be fabricated.



.L.Chubb June 26,1962