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Framework For DOE Low-Level and Mixed Low-Level Waste Disposal: Current Overview

June, 1994

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ABSTRACT

The Department of Energy (DOE) is required to prepare and submit Site Treatment Plan (STPs) pursuant to the Federal Facility Compliance Act (FFCAct). Although the FFCAct does not require that disposal be addressed in the STPs, DOE and the states recognize that treatment of mixed low-level waste will result in treatment residues that will require disposal in either low-level waste (LLW) or mixed low-level waste (MLLW) disposal facilities. As a result, DOE established the MLLW Disposal Working Group in June, 1993, to work with the states to define and develop a disposal-site selection process in concert with the FCCAct and STPs.

As a first step of the process, DOE prepared this report to provide the states with an overview of DOE's current and planned MLLW and LLW disposal activities and also an initial proposal of the disposal site-selection process. The report provides both (1) the history and current configuration of DOE's disposal activities across the DOE complex, including disposal capabilities, applicable requirements, and waste acceptance criteria, and (2) an outline of a proposed site-selection process for MLLW disposal. This report will be used as the basis of discussion between the DOE and the states to develop a site-selection process for DOE's MLLW disposal.

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ACRONYMS AND ABBREVIATIONS

AEA	Atomic Energy Act (of 1954)
AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
ARAR	Applicable or Relevant and Appropriate Requirement
ASL	Above Sea Level
BDAT	Best Demonstrated Available Technology
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CH	Contact-handled
CSTP	Conceptual Site Treatment Plant
DOE/EM	DOE/Environmental Restoration and Waste Management
DOE/NV	DOE/Nevada
DOE	Department of Energy
DOE/RL	DOE/Richland
DOE/ID	DOE/Idaho
DOT	Department of Transportation
EM-30	DOE Waste Management Operations
EPA	Environmental Protection Agency
ER	Environmental Restoration
ERWM	Environmental Restoration and Waste Management
FFC Act	Federal Facility Compliance Act
GCD	Greater Confinement Disposal
GTCC	Greater-Than-Class C
HSWA	Hazardous and Solid Waste Amendments of 1984
HW/MW DV	Hazardous Waste/Mixed Waste Disposal Vault
INEL	Idaho National Engineering Laboratory
IWMF	Interim Waste Management Facility
KD0	Key Decision Zero
LANL	Los Alamos National Laboratory
LDR	Land Disposal Restrictions
LLBG	Low-Level Burial Ground

ACRONYMS AND ABBREVIATIONS (Cont'd)

LLW	Low-Level (Radioactive) Waste
LLWDF	Low-Level Waste Disposal Facility
LLWPA	Low Level Radioactive Waste Policy Act
MDA	Material Disposal Area
MLLW	Mixed Low-Level (Radioactive) Waste
MLLWDF	Mixed and Low-Level Waste Disposal Facility
mrem/yr	Millirem per year
MSL	Mean Sea Level
MTR	Minimum Technology Requirement
MWDF	Mixed Waste Disposal Facility
MWDU	Mixed Waste Disposal Unit
NARM	Naturally Occurring and Accelerator Produced Radioactive Material
NGA	National Governors' Association
nCi/g	nanoCuries per gram
NEPA	National Environmental Policy Act
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PA	Performance Assessment
PEIS	Programmatic Environmental Impact Statement
ppm	Parts per million
R	Roentgen
RA	Regional Administrator
RCRA	Resource Conservation and Recovery Act
RH	Remote-handled
ROD	Record of Decision
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SARA	Superfund Amendments and Reauthorization Act

ACRONYMS AND ABBREVIATIONS (Cont'd)

SDA	Subsurface Disposal Area
SDWG	State Disposal Working Group
SLLW	Solid Low-Level Waste
SNM	Special Nuclear Material
SRS	Savannah River Site
STP	Site Treatment Plan
SWMU	Solid Waste Management Unit
SWSA	Solid Waste Storage Area
TA	Technical Area
TDDP	Tumulus Demonstration Disposal Project
TRU	Transuranic
WAC	Waste Acceptance Criteria
WDOE	Washington Department of Ecology
WERF	Waste Experimental Reduction Facility
WIPP	Waste Isolation Pilot Plant
WSRC	Westinghouse Savannah River Company

1.0 INTRODUCTION

The Department of Energy (DOE) is required, pursuant to the Federal Facility Compliance Act (FFC Act) of 1992, to prepare and submit Site Treatment Plans (STPs)[1] to the states which host DOE facilities that generate or store mixed waste. The purpose of the STPs is to lay out a plan and schedule, including milestones, for DOE to treat the mixed waste at its sites. In the April 1993 Federal Register Notice, DOE announced the schedule and process for development of the STPs. Although the FFC Act does not require that disposal be addressed in the STPs, DOE and the states recognize that treatment of mixed low-level waste will result in treatment residues that will require disposal in either low-level waste (LLW) or mixed low-level waste (MLLW) disposal facilities. DOE also recognizes that the suitability of site conditions for disposal of LLW and MLLW could be a factor in selecting technologies for the treatment of mixed wastes. In addition, waste forms resulting from certain treatment methods may affect the selection of disposal location. Finally, disposal information is needed for the states to effectively consider regional implications of site-specific waste treatment plans. Because of these interrelationships between treatment and disposal, DOE has committed to work with the states and prepare this report as a preliminary step in discussions concerning the role of disposal considerations in the FFC Act process.

DOE established the MLLW/LLW Disposal Working Group in June, 1993, and concurrently the National Governors' Association (NGA) identified a State Disposal Working Group. The mutual goal of the DOE/State Disposal Groups is to define and develop a disposal-site selection process in concert with the FFC Act and STPs.

This report provides both (1) the history and current configuration of DOE's disposal activities across the DOE complex, including disposal capabilities, applicable requirements, and waste acceptance criteria, and (2) an outline of a proposed DOE process for decision making concerning DOE's facilities for disposal of LLW and MLLW. The report presents an overview of DOE's MLLW and LLW disposal activities and provides an initial proposal from the DOE for considerations and further refinement by the State Disposal Working Group. Once a process is agreed to between DOE and the states, the DOE will, in conjunction with the NGA, develop an implementation plan for the process. The need for and content of future reports will be defined in concert with the State Disposal Working Group.

1.1 Scope

Because of the Derived-From Rule of 40 CFR 261.3(c) in the Resource Conservation and Recovery Act (RCRA), those DOE MLLW streams containing listed hazardous components will remain mixed waste after treatment and will require MLLW disposal facilities. On the

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[1] Crosswalk documents are used instead of STPs for those sites with existing agreements with states and other regulators.

other hand, those MLLW waste streams containing only characteristic hazardous components can be disposed of as LLW if the characteristics of the hazardous components can be destroyed during treatment. For this reason this report describes DOE's past and present activities related to both LLW and MLLW disposal and provides information that may be used in determining DOE's future disposal activities. The information discussed in this report concerns the siting, design, operation, and closure of LLW and MLLW facilities that are actively managed for disposal under the requirements of RCRA and/or DOE's authorities under the Atomic Energy Act (AEA) of 1954, as amended. While the actual future capacity of LLW disposal facilities will depend on many MLLW management decisions, such as waste minimization, treatment selected, and ultimate waste form, DOE will continue to need LLW disposal capacity throughout its national system. For this reason, existing and planned LLW capacity are presented in this report. Other disposal-related activities, including deep geologic repository disposal of high-level waste, the Waste Isolation Pilot Plant (WIPP) for the disposal of transuranic waste, and disposal of non-hazardous non-radioactive waste are addressed under different regulatory processes than those presented here, and therefore are not included in this report. Environmental restoration decisions, including the capping of waste in place and construction of disposal facilities for remediation wastes at contaminated areas, are regulated under the processes described by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and DOE Order 5820.2A. Such decisions result from a remedy selection process that evaluates the nature and extent of contaminated media and selects among alternatives for remediation, such as on-site and off-site options for treatment and disposal, based on balancing effectiveness (including risk), implementability, and cost. Although not the focus of this report, such environmental restoration activities are briefly discussed because some wastes resulting from restoration activities may be disposed of at the same facilities used for operations-generated wastes discussed in this report.

Chapter 2 of this report describes the regulatory framework for the disposal of DOE's LLW and MLLW. Chapter 3 describes the current configuration and operational information of DOE's disposal sites. Detailed information concerning each of the sites is included in Appendices A through F. Chapter 4 presents a discussion of the processes and factors that may affect site selection decisions and potential approaches for future disposal site selections. Finally, Chapter 5 discusses the issues and impacts that need to be factored into the disposal site selection process.

2.0 REGULATORY FRAMEWORK FOR DISPOSAL OF MIXED LOW-LEVEL WASTE AND LOW-LEVEL WASTES

Numerous laws and regulations govern DOE's disposal of low-level waste (LLW) and of mixed low-level waste (MLLW). This chapter provides an overview of the regulatory framework for management and disposal of DOE's LLW and MLLW. Specifically, the chapter discusses the Atomic Energy Act (AEA) and the two agencies, the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC), that regulate the management of the radioactive component of MLLW and LLW. The chapter also discusses the Resource Conservation and Recovery Act (RCRA) and how the Environmental Protection Agency (EPA) and authorized states regulate the management of the hazardous waste portion of DOE's MLLW. Finally, this chapter briefly discusses other laws that may affect DOE's disposal of MLLW and LLW, such as the Comprehensive Environmental Response, Compensation,and Liability Act (CERCLA or Superfund), the Low-Level Radioactive Waste Policy Act, and the Low-Level Radioactive Waste Policy Amendments Act.

2.1 Atomic Energy Act (AEA)

The Atomic Energy Act of 1954, as amended, provides dual authority to the Department of Energy and the Nuclear Regulatory Commission to govern the possession and use of special nuclear, source material, and byproduct material. The DOE is authorized to regulate radioactive material operations at its government-owned and operated facilities and at inactive sites that contain radioactive contamination from defense production activities. Non-DOE federal facilities possessing or using AEA radioactive materials are regulated by the NRC. As a result of this structure, DOE regulates the management of radioactive materials, including disposal, at all DOE sites. In contrast, NRC regulates all non-DOE management of radioactive materials including disposal, but does not actually manage any radioactive materials. DOE is exempt from NRC and equivalent agreement-state regulations, except that DOE disposal facilities that accept commercial high-level and Greater-Than-Class C (GTCC) waste are licensed by NRC.

2.1.1 DOE Regulatory Structure

DOE develops directives, policies, and orders to carry out the radioactive waste management authority provided under the AEA (e.g., DOE Order 5820.2A, Radioactive Waste Management; DOE Order 5400.5, Radiation Protection of the Public and the Environment; DOE Order 5480.11, Radiation Protection of Occupational Workers). DOE currently manages all LLW and MLLW according to these orders. DOE's policy is that the DOE generation, treatment, storage, transportation, and disposal of radioactive wastes, and other pollutants or hazardous substances they contain, is to be accomplished in a manner that minimizes the generation of such wastes across program functions and complies with all DOE requirements and applicable federal, state, and local environmental, safety, and health laws and regulations.

2.1.1.1 DOE Order 5820.2A, Radioactive Waste Management

The goal of DOE Order 5820.2A is to ensure that radioactive and mixed waste will be managed in a manner that assures protection of the health and safety of the public and DOE and contractor employees, preserves the environment, and ensures that no legacy requiring remedial action will remain after operations have terminated. Under this order LLW is managed using the most appropriate combination of waste generation, reduction, segregation, treatment, and disposal practices so that radioactive components are contained and the overall system cost effectiveness is maximized. DOE policy is to dispose of LLW on the site at which it is generated, or if on-site disposal capability is not available, at another DOE disposal facility. In addition, DOE allows disposal of certain wastes at commercial facilities, through exemptions granted on a case-by-case basis. These policies also apply to the radioactive portion of DOE's MLLW.

For all LLW and MLLW, DOE is required to dispose of the waste in a manner that ensures compliance with the performance objectives set forth in the Order. These performance objectives are:

- Protection of public health and safety in accordance with standards specified in applicable DOE Orders;

- Assurance that external exposure to the waste and concentrations of radioactive material which may be released into surface water, ground water, soil, plants and animals results in an effective dose equivalent that does not exceed 25 mrem/yr to any member of the public. Releases to the atmosphere shall meet the requirements of 40 CFR Part 61. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as reasonably achievable (ALARA);

- Assurance that the committed effective dose equivalents received by individuals who inadvertently may intrude into the facility after loss of institutional control (100 years) will not exceed 100 mrem/yr or continuous exposure of 500 mrem for a single acute exposure; and

- Protection of ground water resources, consistent with Federal, State, and local requirements.

Performance objectives act as the driving force for all LLW and MLLW disposal activities throughout the DOE complex. To ensure that the performance objectives are met, field organizations at disposal sites are preparing and will maintain a site-specific radiological performance assessment. The performance assessment supports DOE's selection of appropriate waste classification limits, engineering modifications, and disposal limits. Monitoring data and risk assessments are used to validate or modify the models and

assumptions used in the performance assessments. Where practical, monitoring measurements are used to evaluate actual and prospective performance at locations within and outside each facility and disposal site.

In order to ensure compliance with the performance objectives, each LLW and MLLW treatment, storage, and disposal facility establishes waste acceptance criteria (WAC). Waste must be shipped from one DOE facility to another for treatment, storage, or disposal in accordance with the requirements established by these criteria. Generators of LLW and MLLW are required to implement a certification program to provide assurance that the LLW and MLLW treatment, storage, or disposal facility WAC are met. It is the responsibility of both the generating and the receiving facility to ensure that the WAC are met, and that the disposal facility meets the requirements set forth by the Order. Ultimately, however, compliance with the WAC and ensuring compliance with the performance objectives is the responsibility of the operator of the disposal facility.

Other aspects of LLW and MLLW management and disposal governed by DOE Order 5820.2A include disposal site selection, design, operation,and closure/post-closure care.

Disposal Site Selection

DOE Order 5820.2A requires the development of disposal-site selection criteria for candidate sites at a specific installation. Disposal-site selection will be based on an evaluation of the prospective site in conjunction with planned waste confinement technology. Considerations for determining the most appropriate disposal sites include the waste to be disposed of, site meteorological conditions, the potential for natural hazards, hydrogeological conditions, and future land use. According to the Order, and consistent with requirements of National Environmental Policy Act (NEPA), site selection criteria must address the impact on current and projected populations, land use, resource development plans and nearby public facilities, accessibility to transportation routes and utilities, and the location of waste generation.

Disposal Facility and Disposal Site Design

DOE is required to establish design criteria prior to selecting new disposal facilities, new disposal sites, or both. These design criteria are to be based on analyses of physiographic, environmental, and hydrogeological data to assure that the policy and requirements of DOE 5820.2A can be met. The criteria also must be based on assessments of projected waste volumes, waste characteristics, and facility and disposal site performance.

Disposal Facility Operation

DOE installations that operate disposal facilities are required to develop and implement operating procedures for the disposal facilities that protect the environment, health and safety of the public, and facility personnel; ensure the security of the facility; minimize the need for long-term control; and meet the requirements of the closure/post closure plan. Operating

procedures include training for disposal-facilities operating personnel, emergency response plans, and a system of reporting unusual occurrences.

DOE Order 5820.2A requires that DOE's LLW will be disposed of by methods appropriate to achieve the performance objectives. Engineered modifications (i.e., stabilization, packaging, burial depth, barriers) for specific waste types and for specific waste compositions (i.e., fission products, induced radioactivity, uranium, thorium, radium) for each disposal site are required to be evaluated by the performance assessment process, including the performance assessment model. In the course of this process, site specific waste classification limits may be developed to determine how specific wastes should be stabilized and packaged for disposal.

DOE Order 5820.2A also specifies additional disposal requirements intended to improve stability of the disposal site or to facilitate handling and provide protection of the health and safety of personnel and the disposal site, including limitations on waste characteristics and packaging designs.

Disposal Site Closure/Post Closure

DOE facilities are required to develop site-specific comprehensive closure plans for new and existing operating LLW disposal sites. This plan addresses closure of disposal sites within a 5-year period after each is filled. Performance objectives for existing disposal sites are required to be developed on a case-by-case basis.

During and after closure, residual radioactivity levels for surface soils must comply with existing DOE decommissioning guidelines. Corrective measures must be applied to new disposal sites or individual disposal units if conditions occur or are forecasted that could jeopardize attainment of the performance objectives. Inactive disposal facilities which have received MLLW are required to be managed in conformance with RCRA, CERCLA, and the Superfund Amendments and Reauthorization Act (SARA). Closure plans for new and existing LLW disposal facilities must be reviewed and approved by the appropriate DOE field organization.

2.1.1.2 DOE Order 6430.1A, General Design Criteria

DOE Order 6430.1A specifies general design criteria for all types of DOE facilities. It requires DOE to design structures to withstand natural phenomena such as precipitation, earth pressure, temperature variance, creep and shrinkage, settlement, frost heave, and bearing abilities of soils. When selecting a disposal site, DOE must consider existing ground- and surface-water conditions; soils, geologic and topographic features; social, geographic, meteorologic, and economic factors; and aesthetic and environmental impacts. Additional requirements include, but are not limited to, ensuring accessibility, evaluating impacts on ground-water resources, addressing floodplain siting issues, and evaluating future land use.

2.1.2 Nuclear Regulatory Commission (NRC)

In general, the DOE is exempt from NRC regulation, except in limited circumstances (i.e., DOE facilities accepting commercial high-level and GTCC waste must have an NRC license). Instead, DOE is authorized by the AEA and other Federal statutes to regulate radioactive and the radioactive portion of MLLW at DOE sites. The NRC is authorized under the Atomic Energy Act of 1954, as amended, to license and regulate nuclear facilities and materials and to conduct research in support of these responsibilities. NRC issues authorizations, permits, and licenses to nuclear reactors and to persons who receive, possess, use, transfer, or dispose of AEA material; establishes standards and rulemakings; and conducts administrative and research activities. AEA materials include byproduct, source, and special nuclear material as specified in the Act and regulations. Most NRC licensees are businesses, industry, and medical and academic institutions. DOE strives, through its orders, to regulate in a manner equivalent to the NRC regulation of the private sector.

10 CFR Part 61 sets forth licensing requirements for licensees to receive, possess, and dispose of low-level radioactive waste at any near-surface land disposal facility.[2] All commercial low-level radioactive waste disposal facilities must be licensed by the NRC or, where applicable, the State in which the facility operates if that State has been delegated regulatory authority by the NRC. 10 CFR Part 61 establishes four performance objectives that provide broad authority for the NRC to establish license conditions that protect public health and safety consistent with the technical standards included in the regulations. In addition, 10 CFR Part 61 sets forth general technical standards, applicable to all low-level radioactive wastes, and technical standards applicable to specific low-level radioactive waste classes.

Even though DOE is a self-regulating body for the management of LLW and the radioactive component of MLLW under the AEA, under certain circumstances, DOE waste could fall under the jurisdiction of NRC rules and regulations. For example, if a DOE waste is transferred to an NRC licensed facility for treatment, storage, or disposal (e.g., an LLW incinerator or commercial disposal facility) at some point during the life cycle of that waste, it will have to meet all applicable DOE and NRC regulations. Furthermore, if a waste containing any RCRA (i.e., mixed waste) or Toxic Substance Control Act (TSCA) regulated material is shipped to an off-site facility for treatment, storage, or disposal, it may be required to meet other regulations (i.e., TSCA and/or RCRA, as well as NRC and DOE regulations).

2.2 Environmental Protection Agency (EPA)

The U.S. EPA is responsible for the development and enforcement of regulations that are based on environmental statutes (laws) passed by Congress. These include the Resource

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[2] Near-surface land disposal is defined as occurring in the uppermost portion of the earth (approximately 30 meters), although deeper burial may also be acceptable.

Conservation and Recovery Act of 1976 (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980.

2.2.1 Resource Conservation and Recovery Act (RCRA)

Subtitle C of the RCRA regulates the management of hazardous waste from generation through ultimate disposal (i.e., "cradle to grave"). RCRA requirements for hazardous waste disposal facilities are designed to ensure protection of human health and the environment by preventing release of hazardous waste. Although these requirements do not apply to LLW, DOE's MLLW is subject to RCRA requirements because of its hazardous component. Mixed waste must be treated in accordance with the RCRA land disposal restrictions and disposed of in accordance with RCRA requirements, which include disposal siting, operation, and closure standards.

Under RCRA, EPA sets and enforces standards applicable to management of hazardous waste. Most important to the disposal of DOE's MLLW are EPA's technical standards for hazardous waste management facilities, codified at 40 CFR Part 264.[3] These regulations, which set standards for disposal of RCRA hazardous waste, apply to the management of LLW that contains a hazardous waste (MLLW). A waste is considered hazardous under RCRA if it contains any waste listed in 40 CFR Part 261 or if it exhibits the characteristic of reactivity, corrosivity, ignitability, or toxicity. In general, RCRA hazardous waste must be treated in compliance with the RCRA Land Disposal Restrictions (LDR) standards before it can be land disposed. Some DOE installations are operating mixed waste management facilities that are regulated under interim status and therefore must comply with 40 CFR Part 265. Remediation of Solid Waste Management Units (SWMUs) and closure of Hazardous Waste Management Units are also regulated under RCRA.

Disposal Facility Requirements

The hazardous waste disposal standards and requirements found in 40 CFR 264, which apply to facilities disposing of MLLW, include location standards, operating standards, disposal requirements, ground-water protection and monitoring requirements, and closure and post-closure standards.

Location Standards

40 CFR 264.18 discusses location standards for hazardous waste treatment, storage and/or disposal facilities. 40 CFR 270.14 contains the permit requirements related to those location standards. Section 264.18(a) states that facilities must not be located within 61 meters (200 feet) of an active fault. Section 264.18(b) sets additional design, construction, and operating

[3] For sites regulated under interim status, the applicable regulation is 40 CFR Part 265.

requirements for facilities located in a 100-year flood plain. Provisions in the Hazardous and Solid Waste Amendments (HSWA) of 1984 require EPA to strengthen these location criteria. EPA is currently working on revising the regulations to reflect this statutory requirement.

Corrective Action Management Units (CAMUs)

On February 16, 1993 (58 CFR 8658), EPA promulgated provisions addressing new units, called corrective action management units (CAMUs), that may be used for remedial purposes under RCRA Subtitle C corrective action authorities. This unit is an area within a facility that is designated under 40 CFR Part 264 Subpart S for the purpose of implementing corrective action requirements. These units can generally be used only at a facility regulated under Subtitle C or at CERCLA sites where RCRA is determined to be an applicable or relevant and appropriate requirement (ARAR). Under Section 7003, the Regional Administrator (RA) has the discretion to implement the CAMU rule if there is imminent or substantial danger to the environment during the course of remedial actions. Consequently, the RA could designate a CAMU even if the remediation was not at a Subtitle C regulated facility. If DOE installations undergoing remediation are subject to RCRA corrective action, Federal CERCLA authorities, or state Superfund requirements, the CAMU rule may be applicable. These units are limited to managing environmental remediation wastes, including the hazardous component of MLLW.

2.2.2 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The CERCLA program implemented by EPA has established a process for addressing abandoned hazardous substances throughout the United States. This process is being used at some DOE facilities requiring cleanup of contaminated materials that resulted from previous DOE operations, former Manhattan Project sites, and sites contaminated by AEC operations. Under CERCLA §120(a), all guidelines, rules, regulations, and criteria for site assessments, site investigations, National Priorities List (NPL) listings, and remedial actions are applicable to federal (DOE) facilities to the same extent they are applicable to other sites. CERCLA does not establish standards for siting, operating, or closing a site on the NPL. However, as discussed in the National Contingency Plan (40 CFR Part 300), waste cleanup under CERCLA must be managed in accordance with all ARARs, unless waivers are appropriate, and in a manner that protects human health and the environment. On-site disposal of waste as part of a CERCLA remedial action must be conducted in a protective manner and in accordance with pertinent ARARs.

Remedial action disposal alternatives for DOE sites being remediated under CERCLA are evaluated according to several factors, including human health and ecological risks, feasibility, and cost. A no-action alternative is assessed as the baseline scenario; various remedial action scenarios are also evaluated to determine an effective and feasible alternative that provides risk protection. The prime objective of CERCLA-based remedial actions is to reduce or eliminate any current risks to the local population and/or the environment and to

maintain protection for the long term. Remedial actions taken at sites with radiological contamination consider reducing risks to levels as low as reasonably achievable. CERCLA remedial actions are driven by processes that are proceeding concurrently and in general paralleling activities at operating federal facilities. Selection of an on-site disposal option under CERCLA considers site-specific conditions, including engineering factors and regulatory requirements (including appropriate waivers) to assess whether the site is adequately suited for long-term waste management activities. The criteria that are developed in this report to locate new LLW and MLLW disposal facilities (e.g., at uncontaminated sites) are not directly applicable to the environmental restoration activities mentioned above.

2.3 Low-Level Radioactive Waste Policy Act

To allow the states to take responsibility for the commercially generated LLW generated within their borders, Congress enacted the Low-Level Radioactive Waste Policy Act (LLWPA) in 1980 (Public Law 96-573, December 23, 1980), and revised it in 1985 (Public Law 99-240, January 15, 1986). The Act authorizes states, individually or in compact with other states, to site, develop, and operate LLW disposal facilities. The term "compact" is applied to states entering into a regional agreement to provide disposal capacity for all LLW generated in the region.

The Act holds the federal government responsible for the disposal of LLW "owned or generated" by the DOE, and that any LLW disposal facility operated exclusively for the disposal of federal government waste is not subject to any action taken under a compact. Therefore, states and their regional compact disposal facilities are not responsible for the disposal of radioactive waste "owned or generated" by the DOE. The Act, however, does not prohibit state regional compact facilities from accepting DOE waste. If DOE were to dispose of its LLW at a state or regional compact facility, then under the Act, DOE would be as subject to the regulations, fees, taxes, and surcharges imposed by the compact as any non-Federal waste generator.

The LLWPA was amended in 1986 to extend the development schedule for commercial LLW sites and to authorize DOE to manage special classes of commercial waste. This amendment also authorized the NRC to license DOE facilities for managing commercial GTCC waste.

2.4 State Regulatory Framework

2.4.1 Atomic Energy Act (AEA)

Under the AEA of 1954, as amended, NRC delegates regulatory authority to qualified states to license and regulate byproduct material, source material, mill tailings, and small quantities of special nuclear material. In 1981, the Commission determined that qualified states may also enter into limited agreements to regulate LLW in permanent disposal facilities. NRC, however, will always retain some jurisdiction over federal agencies (but generally not DOE), nuclear facilities, exports and imports, consumer products, special nuclear material exceeding

critical mass, offshore waters, and certain aspects of mill tailings. NRC also regulates all AEA-regulated materials in Non-Agreement States.

NRC approves the agreement if the state's radiation control program is compatible with the federal program, meets applicable parts of the AEA, and is adequate to protect the public health and safety. Under the agreement, a state must ensure that its program remains compatible with the NRC program. In addition, the AEA provides that NRC can terminate an agreement if it finds that such termination is needed to protect public health and safety. To date, 28 states have entered into an agreement with NRC (Table 2-1). Of these Agreement States, all but one, Iowa, have authority to regulate commercial LLW disposal sites.

2.4.2 RCRA

The RCRA hazardous waste regulations are implemented either directly by EPA or by states authorized to administer the program in lieu of the federal program. Congress designed RCRA so that the entire hazardous waste program would eventually be administered by the states. States seeking authorization must develop a program that is equivalent to or more stringent than EPA's program. Until a state receives authorization, EPA administers the RCRA program. EPA also implements certain federal requirements that have been added to RCRA in states that have authorized programs but that are not yet authorized for a specific new requirement. Such a requirement is the regulation of mixed waste; in general, EPA regulates mixed waste under the RCRA regulations until a state becomes authorized for mixed waste regulation. Authorized states must revise their programs to include mixed waste. As of September 31, 1993, 45 states, the District of Columbia, and Guam are authorized for the base program, and 36 states and Guam are authorized for mixed waste (Table 2-1). In addition, some states, as part of their RCRA program, have additional requirements such as siting criteria and Certificates of Designation.

Table 2-1. Authorized and Agreement States

State	RCRA Authorized	Mixed Waste Authorized	NRC Agreement State
Alabama	✓	✓	✓
Alaska			
Arizona	✓	✓	✓
Arkansas	✓	✓	✓
California	✓	✓	✓
Colorado	✓	✓	✓
Connecticut	✓	✓	
Delaware	✓		

State	RCRA Authorized	Mixed Waste Authorized	NRC Agreement State
District of Columbia			
Florida	✓	✓	✓
Georgia	✓	✓	✓
Guam	✓	✓	
Hawaii			
Idaho	✓	✓	
Illinois	✓	✓	✓
Indiana	✓	✓	
Iowa			✓
Kansas	✓	✓	✓
Kentucky	✓	✓	✓
Louisiana	✓	✓	✓
Maine	✓		✓
Maryland	✓		✓
Massachusetts	✓		
Michigan	✓	✓	
Minnesota	✓	✓	
Mississippi	✓	✓	✓
Missouri	✓	✓	
Montana	✓		
Nebraska	✓	✓	✓
Nevada	✓	✓	✓
New Hampshire	✓		✓
New Jersey	✓		
New Mexico	✓	✓	
New York	✓	✓	✓
North Carolina	✓	✓	✓
North Dakota	✓	✓	✓
Ohio	✓	✓	
Oklahoma	✓	✓	
Oregon	✓	✓	✓
Pennsylvania	✓		
Rhode Island	✓		✓
South Carolina	✓	✓	✓
South Dakota	✓	✓	
Tennessee	✓	✓	✓
Texas	✓	✓	✓

State	RCRA Authorized	Mixed Waste Authorized	NRC Agreement State
Utah	✓	✓	✓
Vermont	✓	✓	
Virginia	✓		
Washington	✓	✓	✓
West Virginia	✓	✓	
Wisconsin	✓	✓	
Wyoming			

Note: Authorization is as of September 31, 1993

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3.0 DISPOSAL OF DOE LOW-LEVEL AND MIXED LOW-LEVEL WASTE

The purpose of this chapter is to provide an overview of the historical perspective and the current status of the disposal of LLW and MLLW within the DOE complex.

LLW has been generated and disposed of by government laboratories and facilities since the beginning of the Manhattan Engineer District program to develop the atomic bomb during World War II. Until the early 1960s, LLW generated by activities or licensees of the Atomic Energy Commission (AEC) was disposed of at facilities owned and operated by the AEC. Waste generated by commercial-sector licensees was shipped to AEC-owned facilities for disposal. Typically, LLW generated at AEC facilities was disposed of at the site where it was generated. The majority of LLW generated during this time was disposed of using near-surface burial. Ocean disposal was also used for a small portion of the LLW between 1946 and 1970. Ocean disposal was conducted at locations off both the Atlantic and Pacific coasts. Ocean disposal of LLW by the United States stopped in 1971.

In the late 1950s and early 1960s the AEC started a program to encourage the development of commercial nuclear industries. Part of this program was to develop commercial disposal facilities for LLW. The first commercial disposal facility was opened in 1962 near Beatty, Nevada. Subsequently, five additional disposal sites were opened: Maxey Flats, near Morehead, Kentucky; West Valley, New York; Barnwell, South Carolina; Sheffield, Illinois; and Hanford, Washington. In May 1963 the AEC decided that all AEC licensees and all AEC facilities without on-site disposal should make use of commercial facilities for the disposal of LLW. By 1978 three of the six commercial sites were closed: West Valley in 1975, Maxey Flats in 1977, and Sheffield in 1978. In 1979 the Beatty and the Hanford sites were temporarily closed by the governors of the host states. With only one commercial site remaining, it became clear that the DOE could not rely on commercial disposal.

In November 1979, DOE issued guidance for the disposal of LLW and directed all DOE field offices and nuclear reactor programs to terminate disposal of LLW at commercial sites. DOE facilities without on-site disposal capacity were directed to ship their LLW to DOE facilities at either the Nevada Test Site, the Idaho National Engineering Laboratory, the Savannah River Site, the Hanford Site, or facilities operated by the Albuquerque and Oak Ridge field offices.

Currently, 49 DOE installations (Table 3-1) store or generate MLLW (DOE, 1993). The MLLW stored at each site needs to be treated and ultimately disposed of. Nearly all the LLW generated by activities of the DOE is now disposed of at facilities owned and operated by the DOE. Figure 3-1 shows the locations of the six DOE facilities that are presently used to dispose of LLW. Table 3-2 shows the three DOE disposal sites that receive off-site LLW from both DOE and non-DOE off-site waste generators.

Table 3-1. DOE Installations That Store or Generate MLLW

CALIFORNIA
- Energy Technology Engineering Center
- General Atomics
- General Electric Vallecitos[a]
- Lawrence Livermore National Laboratory
- Lawrence Berkeley Laboratory
- Laboratory for Energy-Related Health Research
- Mare Island Naval Shipyard
- Sandia National Laboratories-California

COLORADO
- Grand Junction Project Office
- Rocky Flats Plant

CONNECTICUT
- Knolls Atomic Power Laboratory, Windsor[a]

FLORIDA
- Pinellas Plant

HAWAII
- Pearl Harbor Naval Shipyard

IDAHO
- Argonne National Laboratory-West
- Idaho National Engineering Laboratory

IOWA
- Ames Laboratory

ILLINOIS
- Argonne National Laboratory-East
- Site A/Plot M, Palos Forest Preserve[a]

KENTUCKY
- Paducah Gaseous Diffusion Plant

MAINE
- Portsmouth Naval Shipyard

MISSOURI
- Kansas City Plant
- University of Missouri
- Weldon Springs Site Remedial Action Project

NEVADA
- Nevada Test Site

NEW JERSEY
- Middlesex Sampling Plant
- Princeton Plasma Physics Laboratory[a]

NEW MEXICO
- Inhalation Toxicology Research Institute
- Los Alamos National Laboratory
- Sandia National Laboratories-New Mexico

NEW YORK
- Brookhaven National Laboratory
- Colonie Interim Storage Site
- Knolls Atomic Power Laboratory, Kesselring
- Knolls Atomic Power Laboratory, Niskayuna
- West Valley Demonstration Project

OHIO
- Battelle Columbus Laboratory[a]
- Fernald Environmental Management Project
- Mound Plant
- Portsmouth Gaseous Diffusion Plant
- RMI Titanium, Inc.

PENNSYLVANIA
- Bettis Atomic Power Laboratory

SOUTH CAROLINA
- Charleston Naval Shipyard
- Savannah River Site

TENNESSEE
- K-25 Site, Oak Ridge Reservation
- Oak Ridge National Laboratory, Oak Ridge Reservation
- Y-12 Plant, Oak Ridge Reservation

TEXAS
- Pantex Plant

VIRGINIA
- Norfolk Naval Shipyard[a]

WASHINGTON
- Hanford Site
- Puget Sound Naval Shipyard

[a] Installation not currently producing or storing mixed waste but might do so in the next 5 years.

Figure 3-1. DOE LLW Disposal Facilities

Table 3-2. DOE Disposal Sites That Currently Receive Off-Site Low-Level Waste.[a]

DISPOSAL SITE	OFF-SITE WASTE GENERATORS
Nevada Test Site [(*)]	Fernald Environmental Management Project (OH), General Atomics (CA), Inhalation Toxicology Research Institute (NM), Lawrence Livermore National Laboratory (CA), Pantex Plant (TX), Rocky Flats Plant (CO), Sandia National Laboratories, California (CA).
Hanford Site [(**)]	Ames Laboratory (IA), Argonne National Laboratory-East (IL), Atomic International (CA), Babcock & Willcox (VA), Bonneville Power Administration (WA & OR), Brookhaven National Laboratory (NY), Battelle Columbus Laboratory (OH), Fermi Laboratory (IL), General Atomics (CA), Laboratory for Energy-Related Health Research (CA), Lawrence Berkeley Laboratory (CA), Lawrence Livermore National Laboratory (CA), Massachusetts Institute of Technology (MA), National Institute of Standards and Technology (NIST) (MD), Mare Island Naval Shipyard (CA), Pearl Harbor Naval Shipyard (HI), Puget Sound Naval Shipyard (WA), Paducah Gaseous Diffusion Plant (KY), Portsmouth Gaseous Diffusion Plant (OH), Princeton Plasma Physics Laboratory (NJ), Rocky Flats Plant (CO), SSC High Burnup Effects Program, Stanford Linear Accelerator Center (CA), TRW (CA), UC-Los Angeles (CA), University of Utah (UT).
Savannah River Site	Bettis Atomic Power Laboratory (PA), Charleston Naval Shipyard (SC), Kesselring Atomic Power Laboratory (NY), Knolls Atomic Power Laboratory (NY), Mound Plant (OH),[(***)] Newport News Naval Shipyard (VA), Norfolk Naval Shipyard (VA), Pantex (TX), Pinellas Plant (FL), Portsmouth Naval Shipyard (ME), Winston Site (SC).

[a] In general, ER wastes are not managed for disposal at DOE LLW disposal sites.

[(*)] This list represents the sites which have completed applications to ship waste to the NTS. Additional facilities have applications in progress, and some facilities which have been approved by DOE/HQ to ship to Nevada have not submitted an application.

[(**)] This list indicates presently authorized generators. Generators not shipping waste are not included. Some facilities listed have not sent waste to Hanford.

[(***)] Shipment stopped in 1993.

Although DOE Order 5820.2A requires that LLW be disposed of at a DOE disposal facility, DOE has approved exceptions on a case-by-case basis. Commercial disposal has been used in the past for LLW and is an issue for future discussion for both LLW and MLLW. Envirocare of Utah, Inc., operates a facility which is permitted to receive certain types of LLW and MLLW. Envirocare is currently accepting LLW from RMI Titanium, and MLLW debris from Colonie, NY and Fernald, OH. Envirocare is licensed to accept Class A LLW, debris, by-product material (e.g., uranium and thorium mill tailings), and F-listed solvents. A contract is currently being pursued to provide for the disposal of MLLW generated on the Oak Ridge Reservation (ORR) at Envirocare.

Table 3-3 summarizes the status of the six facilities for LLW disposal. ORR uses above-grade tumulus disposal. The other five sites use below-grade disposal. All six sites have additional LLW disposal facilities planned.

Chapter 2 of this report describes the performance assessment process required by DOE Order 5820.2A to demonstrate the safety of a disposal site. Table 3-3 also shows the status of performance assessment process for the six LLW disposal sites. SRS has completed the performance assessment calculations for the Saltstone Facility and is currently under review for approval. Hanford has completed the performance assessment for its Grout Facility.

Table 3-4 shows the status of MLLW disposal. Currently, no facility can dispose of MLLW within the DOE complex. All six sites have planned MLLW disposal capacities, although only four have been approved by DOE for potential funding. Approval is defined as meeting Key Decision Zero (KD0)[4] according to DOE 4700.1. None of the sites have received a RCRA Part B permit.

The disposal status at each of the six sites that are actively disposing of LLW is summarized below. The information outlined for each site includes a site description, operational status, waste acceptance criteria, disposal limitations, and disposal capacity. Detailed information and maps for each site can be found in Appendices A through F.

3.1 Richland Operations, Hanford Site, Washington

3.1.1 Site Description

The Hanford Site covers approximately 1,500 square kilometers (560 square miles) of semiarid land that is owned by the U.S. Government and managed by the DOE/RL. The

[4] Key Decision Zero is approval of mission need and is a prerequisite for release of funding for conceptual design.

Table 3-3 Low-Level Waste Disposal Facility Status

DOE SITE	CURRENTLY OPERATIONAL	CURRENT DISPOSAL METHOD	PLANNED FACILITY	PERFORMANCE ASSESSMENT (PA) STATUS	
				PRELIMINARY PA COMPLETE	FINAL PA COMPLETE
Hanford					
LLBG *	Yes	Shallow land burial	Yes; additional capacity available	X	(April 94)
Grout	Yes	Vaults	Yes; vitrification facility	X	X
INEL	Yes	Pits, trenches, soil vaults	Yes; additional pits planned	X	(Feb 94)
NTS					
Area 3	Yes	Craters	Yes; three reserve craters	X	(Jan 95)
Area 5	Yes	Shallow land burial	Yes; two reserve trenches	X	(Sept 94)
LANL					
MDA G	Yes	Pits, disposal shafts	Yes; expansion of existing disposal area	(Dec 93)	
ORR					
SWSA 6	Yes	Above-grade tumulus	Yes; six above-grade tumulus pads planned	X	(Dec 94)
SRS					
LLRWDF	Yes	Shallow land burial		---	
Saltstone	Yes	Vaults		X	X
E-Area Vault	No	Vaults	Yes; two vaults constructed and one planned to be operational in 1997	X	

* Limited MLLW also disposed of at LLBG.

Table 3-4. Mixed Low-Level Waste Disposal Facility Status

DOE SITE	CURRENTLY OPERATIONAL	PLANNED, APPROVED *	PLANNED, NOT YET APPROVED
Hanford	No	Yes	----
INEL	No	No	Yes
NTS	No	Yes	----
LANL	No	Yes	----
ORR	No	No	Yes
SRS	No	Yes	----

*** Approved by DOE for potential funding.**

Hanford Site is located northwest of the city of Richland, Washington. The Hanford Site is on the Columbia Plateau and is bounded on the north by the Saddle Mountains, on the east by the Columbia River, and on the south and west by the Yakima River and the Rattlesnake Hills, respectively. The dominant features of the Hanford Site include the Columbia River, sand dunes located near the Columbia River, and the basaltic ridges, including the Rattlesnake Hills, which rise to an altitude greater than 1,100 m (3,600 ft). The climate is semiarid with an average annual rainfall of about 16 cm (6.3 in), which supports the Site vegetation of sagebrush and cheatgrass. The waste management facilities are in the 200 Areas, which are located on a plateau approximately 11 km (7 mi) from the Columbia River.

3.1.2 Operational Status

The active Low-Level Burial Grounds (LLBGs) are classified as shallow landfill disposal facilities and cover a total area of about 660 hectares (1,500 acres). The landfill is divided into eight burial grounds, comprising a number of trenches or caissons. Two burial grounds are located in the 200 East Area, and six are located in the 200 West Area.

Two basic types of trenches have been used for disposal in the LLBG: V-trenches and industrial trenches. The V-trenches normally were dug to a depth of 4.9 m (16 ft) with the bottom ranging from 0 to 4.9 m (0 to 16 ft) wide. Industrial, or wide bottom, trenches may be up to 15 m (50 ft) deep with the bottom ranging from 4.9 m (16 ft) to over 31 m (100 ft) wide.

Based on generator forecasts, the average amount of low-level waste to be disposed of annually in the LLBG is estimated to be 4,248 m^3 (150,000 ft^3). Mixed waste is estimated to make up 1% or less of the waste. Recent generator forecasts suggest the total quantity of mixed waste accepted by Hanford could vary from 56.6 to 141.6 m^3 (2,000 to 5,000 ft^3) per year into the foreseeable future. The amount of waste received by the LLBG is highly

variable and may differ greatly from year to year because of changes in the nature or level of activities on and off the Hanford Site. Waste forecasts are updated annually. As cleanup activities progress, these forecasts could change. DOE/RL does not typically authorize disposal of MLLW. However, within an agreement with the Washington Department of Ecology (WDOE) (documented in a letter from DOE-RL to WDOE dated January 26, 1988), RL can dispose of remote-handled MLLW waste packages which have high radiological dose concerns. Since 1988 two such waste packages have been buried. The contents were K-3 HEPA filters which had radiological doses of 5 R.

Ultimately, MLLW will be disposed of either in burial ground 218-W-5 in RCRA-compliant lined trenches with leachate collection systems, unless appropriate waivers are applied. Construction of Hanford's first RCRA compliant MLLW disposal facility is under way.

Engineering work is in progress on the Environmental Restoration Disposal Facility, a solid waste disposal facility for environmental restoration CERCLA waste. Total volume estimates up to 20 million cubic meters (26 million cubic yards) have been made for a combination of waste forms. Contaminated soil makes up the largest portion of the volume. Other waste forms include construction debris, glass, paper, metal pipe/shapes, plastics, etc. Current activities are focused on engineering studies for the disposal facility and site characterization of a six-square-mile area west and south of the 200 West area.

A Grout Treatment Facility has been constructed at Hanford for processing the LLW fraction of the liquid radioactive and hazardous tank waste into a cement-based solid for disposal in near-surface concrete vaults. A Federal Facility Agreement and Consent Order Change Control action is underway on this treatment technology. The change request embodies the decision to implement a glass low level waste form and to design, construct and operate a LLW vitrification facility. This action is being performed in concert with the three parties to the Tri Party Agreement and values received from the public, stakeholders, and other affected parties. The DOE will maintain in a standby condition the capability to restart the grout facility if its operation is necessary before new double shell tanks are available to provide tank space to resolve safety issues.

3.1.3 Waste Acceptance Criteria

Before receipt of waste at the LLBG, the solid-waste organization characterizes the waste and designates the waste according to DOE Order 5820.2A, the Washington Administrative Codes 173-303-070, and the *Hanford Site Solid Waste Acceptance Criteria* (WHC-EP-0063). The generator is responsible for packaging the waste according to DOT regulations for hazardous materials. The waste received by the LLBG is typically packaged in wooden boxes, steel drums, concrete burial vaults, or other approved burial methods. Mixed waste is received for storage only in approved steel or concrete containers. Generators are assessed annually to ensure their waste program satisfies the *Hanford Site Solid Waste Acceptance Criteria.*

Radioactive waste is to be segregated into the highest category determined from the limits indicated in WHC-EP-0063. Classification is required to provide the physical, chemical, and radionuclide data to support the planning, storage, treatment, and disposal of LLW/MLLW per the regulatory requirements as identified in WHC-EP-0063.

3.1.4 Disposal Limitations

In addition to specific restrictions stated in the *Hanford Site Solid Waste Acceptance Criteria* (WHC-EP-0063), the following materials are prohibited in radioactive solid waste proposed for storage or disposal at the Hanford Site facilities:

- Liquids (except properly packaged)
- Etiologic agents or infectious wastes
- Radioactive animal carcasses (except properly packaged)
- Reactive metals (prohibited from disposal only)
- Chemically incompatible materials in any waste container
- Explosives
- Pyrophorics
- Gas cylinders that are not permanently vented
- Chelating compounds (prohibited from disposal only)
- Unidentified, uncharacterized, or poorly characterized waste
- Greater-Than-Class C radioactive waste, except upon specific written approval by the DOE
- Long half-life radionuclides (as identified by WHC-EP-0063), except case-by-case
- The hazardous component of MLLW exceeding limits set forth for LDR
- Waste packages that do not meet criticality limits

3.1.5 Disposal Capacity

An engineering study is planned to optimize the total capacity for LLW disposal facilities within the 200 Areas. Engineering estimates for disposal indicate that 3 million cubic feet of space is available for LLW in the 218-W-5, and upon the completion of construction the LLW mixed waste trench in 1995 there will be a minimum of 7,646 m^3 (270,000 ft^3) (this volume will be increased with planned waste loading optimization) of RCRA compliant disposal space. Preliminary calculations show that it is possible to dispose of more than 23 million cubic meters (30 million yd^3) of combined daily cover and waste in the 218-W-5 South area.

3.2 Idaho Operations, Idaho National Engineering Laboratory

3.2.1 Site Description

The Idaho National Engineering Laboratory (INEL) covers nearly 2,300 km^2 ($\sim$890 mi^2) of dry, cool desert in southeastern Idaho. Most of this land is undeveloped. Local population

centers are Idaho Falls 35 km (21 mi) to the east, Pocatello 71 km (44 mi) to the south, and Arco 11 km (7 mi) to the west. The INEL is located along the northern edge of the Eastern Snake River Plain, lying at the southern extremity of the Lost River, Lemni, and Beaverhead Mountain ranges. The region is generally flat with a broad volcanic ridge crossing the eastern portion of INEL. The climate is semiarid, with sagebrush-steppe characteristics. Average annual precipitation at the INEL is 22 cm (8.5 in.). Except for evaporation, all water on the INEL is recharged to the ground. The Snake River Plain Aquifer appears to be a continuous body of ground water that underlies nearly all of the Eastern Snake River Plain. The depth to the aquifer at the INEL varies from 61 meters (200 feet) to 270 meters (900 feet). Ground water in the aquifer flows generally southwest with an average flow rate near 3 meters (10 feet) per day.

The Radioactive Waste Management Complex (RWMC) is located in the southwest portion of the site. It was established in 1952 as a disposal site for solid, LLW and/or MLLW generated by INEL operations. Its current mission is to provide waste management for the present and future needs of the INEL and to retrieve, examine, and certify stored transuranic (TRU) waste for ultimate shipment to the Waste Isolation Pilot Plant in Carlsbad, New Mexico. The RWMC encompasses 58 ha (144 acres) and consists of two main disposal and storage areas: the TRU Storage Area and the Subsurface Disposal Area (SDA). Within these areas are smaller, specialized disposal and storage areas. Solid radioactive waste generated by national defense and research programs is stored or buried at the RWMC. The facility currently receives solid LLW from INEL generators for disposal at the SDA.

3.2.2 Operational Status

LLW that meets the requirements of the Waste Acceptance Criteria is currently being disposed of in the SDA, a 36-ha (88-acre) area at the RWMC. Contact-handled LLW (<500 mrem/hr at 1 m) is usually disposed of by high density stacking in segregated pits. Remote handled LLW (>500 mrem/hr at 1 m) is usually disposed of from bottom discharge shielded casks into "soil vaults." A soil vault is a hole augured into the ground in predefined areas between existing closed pits and trenches. Approximately 208,340 m^3 (281,259 yd^3) of LLW was disposed of in the SDA (1952 to 1992). Until 1970, TRU waste and LLW was disposed of in the SDA. Since 1970, only LLW has been placed there, and Waste Acceptance Criteria have been expanded to ensure that all current LLW disposal operations meet present requirements. At the present time about 66 m^3 (89 yd^3) of INEL-generated LLW, meeting the requirements of the Waste Acceptance Criteria, are disposed of each month. There are no plans to expand the existing RWMC SDA. Currently, new disposal concepts are being evaluated to establish environmental compliance plans and functional and operational requirements for new disposal facilities.

The INEL currently has no disposal facility available for the disposition of MLLW. In 1992 the Mixed and Low-Level Waste Disposal Facility project was initiated to provide long-term disposal capability, whether onsite or offsite, for both mixed waste and LLW (Smith et al., 1993). No schedule has been developed for possible operation.

3.2.3 Waste Acceptance Criteria

The requirements pertaining to the treatment and disposal of LLW are specified in the INEL Low-Level Radioactive Waste Acceptance Criteria, DOE/ID-10112 (EG&G, 1993). These criteria apply to the Waste Experimental Reduction Facility (WERF) that treats LLW for disposal at the RWMC and LLW received by the RWMC. DOE/ID-10112 prescribes detailed requirements for waste characterization and periodic audits of the generating facility by the RWMC. As part of this audit program, waste-receiving facilities perform representative sampling of received waste packages, including waste package radiography, gamma spectroscopy analysis, head-gas sampling, radiological measurements, gross weight assessment, physical inspection, and intrusive inspection. However, the major element confirming compliance with these criteria is the generator certification program.

3.2.4 Disposal Limitations

Applicable disposal limitations are described in the INEL Low-Level Radioactive Waste Acceptance Criteria. The following materials are specifically prohibited from disposal:

- Unpackaged or improperly packaged waste materials
- Nonradioactive materials
- Pressurized containers
- Gaseous radioactive materials
- Radioactive mixed waste as defined in 40 CFR 261
- Readily accessible classified materials
- Chelating or complexing agents which have the potential for mobilizing radionuclides
- Free liquids
- Greater-Than-Class-C radioactive waste
- Pyrophoric radionuclides greater than one percent
- Phenolic compounds
- Polychlorinated biphenyls greater than 50 ppm
- Transuranic wastes
- Spent nuclear fuel
- High-level waste
- Pathogenic wastes
- Explosives
- Toxic gases, vapors, or fumes
- Wastes with pH less than 2.0 or greater than 12.5

The waste characterization program defined in the Waste Acceptance Criteria prescribes detailed requirements to identify these prohibited items.

3.2.5 Disposal Capacity

The current disposal capacity remaining available for radioactive LLW in the RWMC SDA is 39,000 m^3 (1,360,000 ft^3) as of January 1993. This capacity is available in the current active pits and does not consider any specific actions to extend the life of the existing disposal facility.

3.3 Nevada Operations Office, Nevada Test Site

3.3.1 Site Description

The Nevada Test Site (NTS) is a DOE nuclear testing facility occupying 3,500 km^2 (1,400 mi^2) of federally owned land in southeastern Nevada's Nye County. NTS is located about 105 km (65 mi) northwest of Las Vegas. The site is bordered to the west, north, and east by the Nellis Air Force Range and the Tonopah Test Range. NTS is in the Basin and Range Geologic Province, which is characterized by north-south trending mountains and valleys. Altitudes range from 910 m (2,990 ft) at Yucca Flats on the east to about 2,400 m (7,900 ft) at Pahute Mesa on the west side. Upland areas are steep and dissected. Valleys are gently sloping alluvium-covered bajadas with playas in most of the basins. The climate is arid with extreme diurnal temperatures. Vegetation is predominantly desert shrubs.

Ground water (uppermost alluvial aquifer) is roughly 200 m deep in Frenchman Flat. The underlying carbonate aquifer is thought to flow to the southwest and discharge to the surface about 48 rm (30 mi) southwest of the NTS boundary. The estimated velocity of the carbonate aquifer in the eastern valleys of the NTS is approximately 13 m/yr. The Frenchman Flat ground water (uppermost alluvial aquifer) is virtually horizontal with little or no lateral movement.

The NTS serves as a disposal site for LLW generated by DOE defense-related facilities and as a storage site for a limited amount of mixed transuranic wastes from Lawrence Livermore National Laboratory (LLNL) pending opening of the Waste Isolation Pilot Plant in southeastern New Mexico.

Area 5 Radioactive Waste Management Site

The Area-5 Radioactive Waste Management Site (RWMS) was formally established in 1978 for the disposal of low-level and classified low-level radioactive waste generated by various NTS operations and by other DOE facilities. The developed portion of the Area 5 RWMS occupies 37 ha (92 acres) in the southeast corner of the 296-ha (732-acre) designated area. This developed area of the RWMS currently consists of 17 landfill cells (pits and trenches), thirteen greater confinement disposal boreholes, and a Transuranic Waste Storage Pad.

The existing operational LLW and MLLW disposal units within the Area 5 RWMS include:

- Pit 3 for disposal of MLLW
- The proposed 10-cell Mixed Waste Disposal Unit for disposal of MLLW generated both at the NTS and off-site.
- Pit 4 for current LLW operations
- Pit 6 for future LLW operations
- Trench T02C for classified LLW
- Trench T03U for LLW
- Trench T04C for classified LLW

Area 3 RWMS

The Area 3 RWMS is located on Yucca Flat and covers an area of approximately 20 ha (50 acres). Contaminated debris from the NTS Atmospheric Testing Debris Disposal Program (ATDDP) and packaged bulk LLW from offsite DOE facilities is disposed of in subsidence craters that have resulted from underground nuclear tests. These tests were conducted well above the water table (upper alluvial aquifer), which is located approximately 500 m (1640 ft) below Yucca Flat. The waste materials are disposed of by using conventional landfill techniques where each layer of waste is covered with one meter (3 ft) of fill before additional waste materials are disposed of. The craters used or committed in Area 3 RWMS are:

- U3ahat (currently used for LLW)
- U3axbl (used in the past for MLLW)
- U3az, U3bg, U3bh (uncommitted LLW units)

Three additional craters are reserve LLW units: U3az, U3bg, and U3bh.

3.3.2 Operational Status

Area 5 Low-Level Mixed Waste Disposal Unit Pit 3

Pit 3 is a disposal unit which has received mixed waste while under RCRA Interim status. However, as part of the agreement in principle with the State of Nevada, Pit 3 is not receiving mixed waste while awaiting resolution of waste acceptance criteria. Upon resolution of these issues, the facility could receive mixed waste for disposal.

This landfill unit has accepted pondcrete from the Rocky Flats Plant in Colorado. Pondcrete consists of MLLW sludge from the solar evaporation of pond liquid mixed with cement.

Area 5 Mixed Waste Disposal Unit

A landfill designated the Mixed Waste Disposal Unit (currently designed to consist of 10 cells) is proposed for location on about 18 ha (45 acres) of the Area 5 RWMS, immediately

north of the developed RWMS landfill area. The unit has been designed and is included in the NTS RCRA Permit application. The environmental assessment for this unit is also being updated.

Area 5 Pit 4

Pit 4 is used for the disposal of currently approved LLW streams. Pit 4 was opened on June 21, 1988, and is currently over two-thirds full. The pit is 310 m (1,000 ft) long, 6 m (20 ft) deep, and 61 m (200 ft) wide. Waste is stacked in a tiered staircase configuration to within 1.2 m (4 ft) of the natural grade and covered with about 2.4 m (8 ft) of soil.

Area 5 Pit 6

Pit 6 was opened in 1990 and is reserved for disposal of LLW when Pit 4 has reached capacity. It is approximately 190 m (630 ft) long, 30 m (100 ft) wide, and 7.2 m (24 ft) deep.

T02C, Area 5 RWMS - Classified Waste

Trench T02C was opened in May of 1988 and is reserved for classified LLW disposal. It is approximately 76 m (250 ft) long, 12 m (40 ft) wide, and 6 m (20 ft) deep.

Trench 3 (T03U)

Trench T03U is currently non-operational, and is reserved for disposal of LLW containing asbestos. It is approximately 190 m (630 ft) long, 14 m (46 ft) wide, and 6.6 m (22 ft) deep.

Trench 4 (T04C), Area 5 RWMS - Classified Waste

Trench T04C was opened in March of 1969 and is reserved for the disposal of classified waste. It is approximately 340 m (1100 ft) long, 12 m (41 ft) wide, and 6 m (20 ft) deep.

U3ahat

U3ahat is an active disposal cell at the Area 3 RWMS, currently receiving LLW from approved off-site generators. The cell was created from two adjacent subsidence craters, U3ah and U3at, with a combined original volume of approximately 425,000 m^3 (15,000,000 ft^3) and a remaining capacity of 380,000 m^3 (13,500,000 ft^3).

U3axbl

U3axbl is an inactive, covered disposal cell. Disposal was discontinued in January 1988, and the site was covered. Due to the presence of lead in the waste in the past, U3axbl may

contain mixed waste. Formal closure activities will commence when the RCRA closure cap plan is approved.

3.3.3 Waste Acceptance Criteria

DOE/NV has defined the requirements for all waste generators and requires generators to have a waste characterization program, supported by a DOE Order 5700.6C-based certification program. For waste characterized by sampling and analysis, generators must submit a sampling and analysis plan according to guidance provided in the document "Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements (NVO-325, Rev. 1)." Sampling and analysis plans must be approved by DOE/NV before sampling begins. Each plan will define the number of waste packages represented by the sampling and analysis effort. Prior to sampling, the generator must also procure or provide qualified analytical laboratory services that meet DOE/NV requirements as defined in NVO-325, Rev. 1. The preparation of an approved sampling and analysis plan, obtaining the services of a qualified laboratory, submission of the data package to DOE/NV, and the DOE/NV validation of that data package completes the waste characterization requirements for the generator.

3.3.4 Disposal Limitations

NVO-325, Rev. 1, provides detailed requirements for disposal of LLW and MLLW. The criteria include:

- Restrictions on:
  - Free liquids
  - Hazardous waste components
  - Particulates
  - Gases
  - Stabilization
  - Etiological agents
  - Chelation agents
  - Polychlorinated biphenyls
  - Explosives and pyrophorics
- Package design
- Nuclear heating
- Radiation levels
- Activity limits
- Multiple hazards
- Size
- Weight
- Loading
- Marking and labeling
- Barcoding

- Treatment
- Reactive wastes
- Potentially incompatible waste

3.3.5 Disposal Capacity

Pit 3 process design capacity is 90,250 m^3 (3,190,000 ft^3). Because of the stringent certification requirements for the acceptance of mixed waste by the NTS, no ignitable, reactive, or incompatible wastes are expected.

The Mixed Waste Disposal Unit (MWDU) will be located within the Area 5 RWMS. Plans call for an initial permit for 10 landfill cells for the permanent disposal of MLLW. Each cell is intended to contain approximately 12,000 m^3 (425,000 ft^3) of mixed waste. This capacity figure was obtained by determining the maximum number of 1.2 m (4 ft) x 2.1 m (7 ft) x 1.2 m (4 ft) waste packages that will fit into each cell and using this to calculate a total waste volume. No ignitable, reactive, or incompatible wastes are anticipated for disposal at the MWDU because of the stringent requirements in NVO-325, Rev. 1.

For LLW, it is estimated that a total capacity of 67,000 m^3 (2,360,000 ft^3) remains in Area 5 and 382,000 m^3 (13,500,000 ft^3) in Area 3 RWMS. Most of the remaining LLW disposal capacity is in Pit P04U and Pit P06U.

3.4 Albuquerque Operations, Los Alamos National Laboratory

3.4.1 Site Description.

Los Alamos National Laboratory (LANL) is a DOE research facility occupying 107 km^2 in north-central New Mexico. LANL is located in a semiarid, temperate climate with mixed forests and grasslands. The facility is characterized by mesas separated by deep canyons with altitudes ranging between 1,900 to 2,400 m. The region is seismically, volcanically, and geomorphically active. Ground water in the main aquifer is 180 to 370 m below the mesa tops, with water present in some canyon bottoms as perched or shallow-alluvium aquifers and as intermittent or perennial streams. LANL is bounded on the southeast by the Rio Grande.

3.4.2 MDA G Low Level Waste Disposal Site.

Technical Area (TA) 54, MDA G has been operating since 1957 and occupies 64 acres on the southeast end of Mesita del Buey, a finger mesa that is bounded by Canada del Buey on the north and Pajarito Canyon on the south. An additional 24 acres, immediately adjacent, are dedicated for future expansion of the LLW disposal area. The current facility consists of 39 landfill cells (pits and trenches) and 237 land disposal shafts.

At TA-54 the main aquifer in the Los Alamos region lies more than 217 m (700 ft) below the land surface. There is little potential for downward flow from the surface due to the low moisture conditions of the tuff. The floor of Pajarito Canyon, south of TA-54, is underlain by up to 3.4 m (11 ft) of alluvial silt, sand, and gravel above underlying bedrock of welded and non-welded Bandelier Tuff. Investigation of the perched ground water in the alluvium of Pajarito Canyon has not indicated that there is a hydraulic connection with the main aquifer.

3.4.2.1 Operational Status

There are four active disposal units within MDA G: Pit 37 for disposal of LLW, Pit 39 for disposal of LLW when Pit 37 is filled; Pit 31 for disposal of asbestos LLW; and 29 LLW disposal shafts. Closed units include 36 landfill cells (pits and trenches) and 208 land disposal shafts.

3.4.2.2 Waste Acceptance Criteria

As these disposal facilities currently handle LANL-generated wastes only, the Waste Acceptance Criteria are designed to address internal generators. The generators are responsible for properly identifying, characterizing, segregating, packaging, and documenting waste prior to shipment to TA-54, MDA G; ensuring that waste sent to TA-54, MDA G complies with the WAC; and implementing a LLW certification program.

3.4.2.3 Disposal Limitations

All waste disposed at TA-54, MDA G must be solid with no free liquids. In the case of powders or particulate wastes, if more than 1 wt-% of the particles are smaller than 10 microns or more than 15 wt-% consists of particles less than 200 microns in size, then the particulate portion of the waste must be immobilized to reduce inhalation and dispersion risks during handling. Pressurized and evacuated containers cannot be disposed unless they are vented to atmospheric pressure. RCRA regulated components are currently not acceptable for disposal at MDA G. Restrictions on radionuclide content only relate to the exclusion of TRU and GTCC waste, criticality safety, and safe handling during disposal.

3.4.2.4 Disposal Capacity

Current remaining disposal capacity at MDA G is approximately 13,000 m^3, which will satisfy LANL needs through the end of FY 1995. The future expansion area will provide for the disposal of an additional 127,000 m^3 of waste.

3.4.3 TA-67 Mixed Waste Disposal Facility (Proposed)

The projected location of the Mixed Waste Disposal Facility is at TA-67. Because site characterization is in progress, most of the available information is from draft documents.

At TA-67 over 403 m (1,300 ft) of unsaturated tuff and volcanic rock separate the surface from the aquifer.

3.4.3.1 Operational Status

This facility is currently in the Title I design stage. It is scheduled to begin receiving waste around 1997 or 1998. The RCRA permit application is scheduled for submission in April 1994.

3.4.3.2 Waste Acceptance Criteria

This facility is expected to handle only LANL-generated environmental restoration wastes at this time. Accordingly, the draft waste acceptance criteria are designed to address internal generators. The generators will be responsible for properly identifying, characterizing, segregating, and documenting waste prior to shipment to TA-67, MWDF and ensuring that waste sent to TA-67, MWDF complies with these WAC.

3.4.3.3 Disposal Limitations

All waste disposed at TA-67, MWDF must comply with applicable Land Disposal Restrictions (LDR) as specified under Title 40 CFR 268, Land Disposal Restrictions, unless treated as specified under 40 CFR 268, Subpart D, Treatment Standards.

All waste disposed at TA-67, MWDF must be solid with no free liquids. In the case of powders or particulate wastes, if more than 1 wt-% of the particles are smaller than 10 microns or more than 15 wt-% consists of particles less than 200 microns in size, then the particulate portion of the waste must be immobilized to reduce the inhalation and dispersion risks during handling. Pressurized and evacuated containers cannot be disposed unless they are vented to atmospheric pressure.

Wastes containing pathogens, infectious wastes, or other etiologic agents as defined in Title 49 CFR 173.386 will not be accepted. Wastes containing polychlorinated biphenyls (PCB) at greater than 50 ppm will not be accepted. Asbestos contaminated wastes will not be accepted.

Restrictions on radionuclide content only relate to the exclusion of TRU and GTCC waste, criticality safety, and safe handling during disposal.

3.4.3.4 Disposal Capacity

Design capacity for TA-67, MWDF is approximately 400,000 m^3 (14,100,000 ft^3), which is expected to satisfy LANL needs for a 20-year period.

3.5 Oak Ridge Operations, Oak Ridge Reservation, Tennessee

3.5.1 Site Description

The Oak Ridge Reservation (ORR) consists of some 35,252 acres of federally owned lands west and south of the population center of Oak Ridge, Tennessee. Owned and controlled by the DOE, and managed under contract by Martin Marietta Energy Systems, Inc., the ORR contains three major facilities--the Oak Ridge National Laboratory (ORNL), the K-25 Site, and the Oak Ridge Y-12 Plant. The Oak Ridge climate is typical of the humid southern Appalachian region. The average annual precipitation measured in the Oak Ridge vicinity is 138 cm (54 in.), ranging from 95 cm (37 in.) to 187 cm (76 in.). Site topography is characterized by a series of alternating, elongated, and parallel valley troughs and ridges trending northeast to southwest. Surface elevations range from about 225 m (740 ft) at the Clinch River to about 413 m (1,400 ft) at the crest of Melton Hill. In the Oak Ridge area the Knox dolomite and the Rome Formation are the principal aquifers. The Knox, located beneath Chestnut Ridge, is the major aquifer in the White Oak Creek Basin. The thick, weathered mantle seems to have a high infiltration capacity and serves as a reservoir feeding large solution cavities in bedrock. Depth to the water table varies both spatially and temporally. In Bethel Valley, depth to water table ranges from 0.30 to 11 m (1 to 35 ft), while in Melton Valley the range is from 0.30 to 20 m (1 to 67 ft). The major portion of the industrial and drinking water supplies in the Oak Ridge area is taken from surface-water sources.

3.5.2 Low Level Waste Disposal Site SWSA 6

ORNL is currently operating Solid Waste Storage Area (SWSA) 6 as a disposal site for LLW. This 28 ha (68 acre) site is located in the southwest region of the ORR and has been used by ORNL since 1969 for the disposal of on-site generated LLW. Since 1986, SWSA 6 has utilized a variety of Greater Confinement Disposal (GCD) techniques for the disposal of ORNL LLW, including the use of below-grade concrete silos and wells and two above-grade tumulus demonstration projects.

Below-Grade Disposal Concrete Silos. Although concrete silos have been used for LLW disposal in the past, they are being phased out of operation based on agreements between DOE/ORO and the State of Tennessee. Concrete silos are used for contact-handled LLW. A concrete silo is constructed of two 16-gauge, corrugated steel pipes--one 2.4 m (8 ft) in diameter and the other 2.7 m (9 ft) in diameter. The smaller pipe is concentrically placed inside the larger pipe, and both are placed vertically in a trench. The annular space between the two pipes is filled with concrete. The pipes range from 4.3 to 6 m (14 to 20 ft) in length, depending on the depth of the water table at a given location. A wire reinforced, 31 cm thick (12 in.) concrete pad is poured in the bottom of the silo. The silos are aligned in clusters within the trench. The depth of the trench is always located and dug with its lowest point a minimum of 0.60 m (2 ft) above the maximum water-table evaluation. The silo is capped with a 30.48-cm-thick (12-in.) steel-reinforced concrete cap.

Above-grade tumulus disposal. Above-grade tumulus disposal is the preferred method for disposal of LLW in SWSA 6. Tumuli I and II were used for the disposal of LLW in SWSA 6 from April 1988 through December 1991. Use of the IWMF for disposal of Class L-II at the Interim Waste Management Facility (IWMF) LLW began in late 1991 and will continue until new disposal facilities are operational. (Class L-II waste consists primarily of fission product radionuclides with half lives of 30 years or less suitable for disposal in engineered facilities designed to isolate LLW from the environment and the public)

Tumulus disposal involves the placement of containerized LLW into concrete rectangular vaults that are subsequently loaded and stacked on a curbed concrete pad and capped with natural materials. The Tumulus I pad was constructed in SWSA 6 early in 1987 and started receiving waste in April 1988. The Tumulus I pad was filled to capacity in June 1990, and a plastic cover was installed over the entire assembly. A total of 290 vaults [approximately 784 m^3 (28,000 ft^3)] were placed on the Tumulus I pad. The pad is approximately 19.8 x 32 m (65 x 105 ft).

The Tumulus II pad is located on an approximately 0.4 ha (1 acre) site just north of the Tumulus I pad. It began operation in October 1990 and was filled to capacity in late 1991. Prior to the operation of the Class IWMF, a total of 220 vaults were placed on the Tumulus II pad. The pad is approximately 18.2 x 27.4 m (60 x 90 ft) and is 30.48 cm (12 in.) thick.

IWMF. The first phase of IWMF was completed in FY 1992. The disposal capacity of the IWMF is anticipated to be extended with additional pads to be constructed depending on the waste generation rate and development of new Class L-II disposal facilities.

The IWMF occupies an area of approximately 3.8 ha (9.5 acres) in the southwest portion of SWSA 6. Construction is expected to be completed over a period of five to six years. The first phase will include the construction of two tumulus pads, a loading area, surface drainage channels, under and surface-pad drainage systems, a monitoring/transfer station, and the required utilities. When the disposal capacity of the first pad is depleted, construction of the third pad will be initiated. This process will continue until six pads have been constructed--utilizing the maximum capacity of the site. Each tumulus pad will be approximately 18 x 27 m (60 x 90 ft) and 0.31 m (1 ft) thick. The pads will be constructed using high-density concrete and reinforced with epoxy-coated steel.

3.5.3 Operational Status

Future operations at SWSA 6 will use only above-grade tumulus disposal since below-grade disposal ceased December 31, 1993. The initial closure of SWSA 6 has already begun, with all disposal operations planned to end in 1998. ORNL has been developing SWSA 7 since 1979 as an additional disposal site for LLW.

3.5.4 Waste Acceptance Criteria

SWSA 6 only accepts wastes generated by facilities on the ORR, thus the waste acceptance criteria (WAC) are designed only for internal generators.

The generators are responsible for:

- Waste minimization.
- Proper package classification, identification, and containerization.
- Ensuring WAC are met (*Waste Acceptance Criteria for Radioactive Solid Waste Disposal at SWSA-6*, WMRA-WMPC-203, Oak Ridge National Laboratory, 4/30/93).
- Implementing a generator waste certification program.

A draft Performance Assessment (PA) for SWSA 6 disposal operations has been completed, and, when the PA is approved, the Waste Acceptance Criteria will be modified to reflect the performance objectives defined in DOE Order 5820.2A.

3.5.5 Disposal Limitations

All waste disposed of in SWSA 6 must be certified not to contain:

- Free liquids
- PCB contaminated materials
- Compressed gases
- Hazardous wastes (listed or characteristic as defined in 40 CFR 261 Subpart D and 40 CFR 261 Subpart C
- Chelating agents
- Transuranic elements in concentrations greater than 100 nCi/g

3.5.6 Disposal Capacity

SWSA 6 will meet the contact-handled solid low-level waste (SLLW) disposal needs of ORNL through 1998.

3.5.7 Waste Classification/Categorization

SLLW shall be classified into one of the following categories:

- Contact-handled (CH) SLLW - Packaged waste with an unshielded container surface radiation dose equivalent rate of less than or equal to 200 mrem/hr.
- Remote-handled (RH) SLLW - Packaged waste with an unshielded container surface radiation dose equivalent rate of greater than 200 mrem/hr.

- Fissile waste - Solid waste that contains the isotopes U-233, U-235, Pu-238, Pu-239, Pu-241, and/or the elements neptunium, americium, curium, berkelium and californium.
- Biological waste - Any waste of a biological nature.
- Asbestos waste - Any waste containing commercial asbestos or asbestos material.
- Naturally occurring and accelerator produced radioactive material (NARM) - Solid waste that contains radionuclides which, due to their origin, are not regulated under the Atomic Energy Act of 1954, as amended, but are regulated under CERCLA.
- TRU waste - Waste contaminated with alpha-emitting transuranic radionuclides having half-lives greater than 20 years in concentrations >100 nCi/g at the time of the assay.

3.6 Savannah River Operations, Westinghouse Savannah River Company

3.6.1 Site Description

Savannah River Site (SRS) is located in south central South Carolina and occupies an almost circular area of approximately 300 square miles (192,000 acres) near the Georgia border. It ranges from 25 to 130 m above MSL. The major geophysical feature is the Savannah River, which forms the southwestern boundary of the site and is also the South Carolina/Georgia border. The SRS includes portions of Aiken, Barnwell, and Allendale Counties in South Carolina. The site is 25 miles southeast of Augusta, Georgia, 22 miles south of Aiken, South Carolina and 100 miles from the Atlantic Coast.

SRS currently generates low-level radioactive waste (LLW) in both solid and liquid forms, with the majority being solid. SRS defines LLW in accordance with DOE Order 5820.2A and refers to radioactive waste that does not meet the definition of high-level or transuranic waste. SRS further breaks down low-level waste into two categories: as either low-activity (LAW - waste radiating $<$ 200 mrem/hour) or intermediate waste (ILW - waste radiating $\geq$ 200 mrem/hour). The radiation dose rate shall be measured at a distance of 3 inches from an unshielded container. The site's solid LLW includes such items as protective clothing, tools, and equipment that have become contaminated with small amounts radioactive material. WSRC currently operates a solid waste burial ground, Low-Level Radioactive Waste Disposal Facility (LLRWDF) for the disposal of this LLW waste. However, in 1987, DOE issued guidance which directed that new disposal facilities constructed in humid climates (including the SRS area) must be "decoupled from the ground water table." In order to comply with this directive, a project to build disposal vaults (called the E-Area Vaults) for the disposal of LLW was developed.

Some operations at SRS produce hazardous and mixed (waste having both hazardous and radioactive components) waste materials which are regulated under the Resource Conservation and Recovery Act (RCRA) and the Atomic Energy Act. Currently, these hazardous and mixed waste materials are being stored in accordance with RCRA requirements until treatment and disposal capacity is available. Onsite disposal for these wastes has been planned with the

development of the Hazardous Waste/Mixed Waste Disposal Vault (HW/MW DV) project. This project is intended to provide management and disposal capabilities for hazardous and mixed (radioactive waste containing hazardous waste components) waste generated at the Savannah River Site (SRS) that cannot be handled at other existing or planned facilities.

Mixed waste, in the form of a decontaminated salt solution, from the In-Tank Precipitation and Effluent treatment Facilities is treated in a grouting facility and permanently disposed in above-ground vaults at the Z-Area Saltstone Facility. The disposal vaults are permitted under a South Carolina Department of Health and Environmental Control (SCDHEC) Industrial Waste Permit. SCDHEC permits the grouting facility as a Wastewater Treatment Facility by virtue of a "totally enclosed exemption". This is an exemption from the Resource Conservation and Recovery Act (RCRA) regulation and stipulates that only F- and H-Area tank farm waste may be treated and disposed at the facility and therefore, could not accept offsite waste without extensive permit modification. Due to this limitation, the Z-Area Saltstone Facility will not be discussed further in this report.

3.6.2 Operational Status

LLRWDF & E-Area Vaults:

Solid, low-level radioactive waste generated at the SRS and some wastes from offsite are disposed at the LLRWDF, formerly called the Low-Level Burial Ground, a 195 acre facility. These wastes have accumulated from operations in the production of nuclear materials for the U.S. Defense Programs since 1953. The LLRWDF consists of two sections. The original, or old, Burial Ground, consists of 76 acres, is designated as Area 643-E, and ceased operations in 1972. Burial operations were phased in during 1969 to 1972 in the present Burial Ground which is designated as Area 643-7E and occupies 119 acres.

Some sections of the LLRWDF are currently accepting solid LLW. The waste placed in the LLRWDF will remain there and monitoring of the surrounding groundwater will continue, to detect migrating radionuclides. Post-closure care of closed sections of the LLRWDF (including sections awaiting closure) will be conducted in accordance with a RCRA Part B Permit.

The E-Area vaults were designed for a 20-year operational life for disposal of LLW. The current schedule estimates the vaults will begin accepting waste in mid-1994. Three different types of vaults will be used for proper waste segregation. The Low-Activity Waste (LAW) Vaults will accept LAW. The Intermediate-Level Vaults is designed to accept both tritium ILW (defined as ILW containing $\geq$ 10 Ci/package of TRU isotopes) and non-tritium ILW (defined as ILW containing $<$ 10 Ci/package of TRU isotopes). Currently, one LAW and one ILW vault have been constructed; one more of each is planned to be operational in mid-1997. Eighteen LAW vaults and eight ILW vaults will be constructed according to the project schedule, contingent upon funding and DOE approval.

HW/MW DV:

The HW/MW DV will consist of ten, above-grade, reinforced concrete disposal vaults which are to be permitted as landfills under the South Carolina Hazardous Waste Management Regulations (SCHWMR) R.61-79.264 Subpart N Standards. The disposal vaults will be designated as Building Numbers 645-1E to 645-10E.

Initially, two of these disposal vaults will be constructed. Four more vaults are planned under the HW/MW Disposal Facility - Vault Expansion project. The disposal facility will be constructed as a final disposal area for treated and stabilized hazardous and mixed waste generated at the SRS. Operations are anticipated to continue for approximately 15 years after startup, based on the current waste generation, forecasted generation rate, and SRS mission. The above-grade vaults have been designed to isolate the disposed waste from the ground water regime, the general environment, and inadvertent human contact.

The current project schedule shows the first two vaults operational in 1/99, contingent upon receipt of the RCRA Part B Permit, DOE approval and adequate funding. Title II Design has been completed on the vaults. A RCRA Part B Permit application has been submitted to the South Carolina Department of Health & Environmental Control.

3.6.3 Waste Acceptance Criteria

LLRWDF & E-Area Vaults: Detailed procedures for accepting nonhazardous, low-level radioactive solid waste (LLW) in the LLRWDF or E-Area Vaults are provided in the SRS Waste Acceptance Criteria (WAC) Manual, WSRC-1S as required by DOE Order 5820.2A. Waste generators are responsible for:

- ensuring prohibited materials are not shipped as LLW to SRS
- adhering to the principles of waste minimization
- establishing auditable programs to minimize the amount of LLW generation
- implementing and documenting a LLW certification program
- providing annual and ten year forecasts of LLW streams to be shipped to the facility
- complying with the requirements for waste containers
- characterizing all waste streams using approved methods
- financing corrective actions required as a result of nonconformance
- providing waste data via the Waste Information Tracking System

HW/MW DV:

The HW/MW Disposal Vaults will be used as a permanent disposal site for hazardous and mixed waste generated at several locations at SRS. The first two vaults constructed have been dedicated for the disposal of Consolidated Incineration Facility stabilized ash and blowdown. Waste Acceptance Criteria which conforms to DOE Order 5820.2A will be provided in the SRS WAC Manual, WSRC-1S when developed for the HW/MW DV. The Waste Acceptance

Criteria listed in the RCRA Part B permit application for the facility is summarized in Table 1, Appendix F.

Any waste generator that plans to send waste to the HW/MW Disposal Vaults will be required to develop a waste certification program to ensure all elements of the WAC will be met. As part of the WAC, Waste Management Operations will ensure prior to accepting waste for disposal that the waste meets applicable Land Disposal treatment standards. A Waste Tracking Record that must accompany a waste shipment requires certification that the waste meets applicable Land Disposal treatment standards.

3.6.4 Disposal Limitations

The following materials are prohibited from disposal at each facility:

LLRWDF & E-Area Vaults:

- hazardous wastes as designated by South Carolina Hazardous Waste Management Regulations (SCWMR) R.61-79.261 (e g. lead, mercury, cadmium) and EPA regulations (40 CFR 261)
- rags or wipes that have come in contact with any F-listed solvent as defined by RCRA.
- free liquids in greater than incidental quantities (1% of the waste volume when the waste is in a disposal container)
- gaseous waste (e.g. unpunctured aerosol cans and gas cylinders)
- explosive materials
- pyrophoric materials
- chelating agents in amounts greater than 1% of the weight of the waste (e.g. ethlyene diamine tetraacetic acid [EDTA] must be stabilized (8% max limit))
- unneutralized acids or bases not in the pH range of 5 to 9
- unreacted alkali metals (e.g., lithium, sodium, potassium)
- biological, pathogenic, or infectious materials
- TRU waste > 100 nCi/g
- waste containing 50 ppm or greater polychlorinated biphenyls (PCB)s
- petroleum contaminated soil with greater than 100 ppm total petroleum hydrocarbons
- petroleum contaminated soil with greater than 10 ppm benzene, toluene, ethyl benzene, xylene
- wastes containing radionuclide in concentrations greater than allowed by the process requirements as specified in Attachments B through F of the WSRC -1S Manual
- waste containing or capable of generating quantities of toxic gases, vapors, or fumes harmful to personnel transporting, handling, or disposing of the waste
- chemically incompatible materials in any waste container or package (refer to Appendix B of the WSRC 1S Manual)
- waste generating a radiation rate greater than 50 R/hr at 1 ft from outer surface of disposal container without prior Solid Waste Management approval

- nitrated organic resins
- waste classified as Greater-Than-Class-C by 10 CFR 61
- waste that has not been certified as described in procedure WAC 2.01 of the WSRC-1S Manual
- LLW packages shall not contain greater than 15% void volume
- the waste shall contain no more than one weight percent of less-than-10-micrometer-diameter particles or 15 weight percent of less than 200-micrometer-diameter particles
- waste packages generating greater than one watt per cubic foot

Procedures WAC 3.03 and 3.10 in the WSRC-1S Manual describe limitations in terms of physical form, radionuclide content, nuclear safety, and heat load limitations for the LLRWDF and EAV, respectively.

HW/MW DV:

The following wastes are prohibited from disposal at the HW/MW DV:

- Reactive, ignitable, or incompatible wastes will not be disposed at the facility.
- Free liquids will not be disposed at this site. This will be ensured by requiring the waste be tested using the Paint Filter Test, Method 9095 prior to disposal.
- Any wastes which do not meet applicable Land Disposal treatment standards required by SCHWMR R.61-79.268 and 40 CFR 268 will not be accepted for disposal at the HW/MW DV.
- Any wastes which do not meet the Waste Acceptance Criteria will not be accepted for disposal.
- A site-specific performance assessment will be completed to demonstrate that the HW/MW DV will meet the performance requirements stated in DOE Order 5820.2A. Any wastes not meeting the inventory limits established by the performance assessment will not be accepted for disposal.

Sections C, "Waste Characteristics" and D, "Process Information" of the HW/MW Disposal Vaults Part B permit application describe limitations in terms of disposal container requirements, configuration, and labeling. Criteria for physical form, radionuclide content, nuclear safety, and heat load limitations for the HW/MW DV will be described in the WSRC-1S Manual.

3.6.5 Disposal Capacity

E-Area Vault Capacity:

LAW Vault: Each concrete vault is 643 feet long by 145 feet wide by 27 feet tall with has approximately 1,700,000 cubic feet of disposal capacity.

ILW Vault: Each non-tritium ILW vault is 189 feet long by 48 feet wide by 29 feet tall with approximately 200,000 cubic feet of disposal capacity. The tritium vaults are structurally identical to the nontritium ILW vaults except for the length, which is only 57 feet. The tritium vaults have a disposal capacity of 57,000 cubic feet.

HW/MW DV:

The approximate outside dimensions of each vault are 205 feet long by 46-1/2 feet wide by 24-2/3 feet high. Each vault contains four individual waste cells with temporary, removable steel covers. Each waste cell is sized to contain the equivalent of 300 4 feet wide by 6 feet long x 4 feet rectangular concrete disposal containers or 2250 55/71-gallon drums. Due to backlog of wastes, the first two vaults will be dedicated to the disposal of on-site, stabilized Consolidated Incineration Facility ash and blowdown wastes.

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4.0 PROPOSED DISPOSAL PLANNING PROCESS

In accordance with the requirements of the Federal Facility Compliance Act (FFC Act) for the development of STPs, the DOE, working in conjunction with the affected states, proposes to develop a process to identify and evaluate MLLW disposal options. This process will assure that adequate capacity exists for the disposal of residues from the treatment of DOE's MLLW. The proposed process must address not only technical issues related to the feasibility of siting and operating disposal facilities but also socio-political and institutional issues associated with disposal. This section of the report proposes a process for DOE/State interaction and identifies issues DOE believes should be considered in identifying and evaluating disposal options.

DOE is proposing a phased approach in the site selection and disposal options analysis for its LLW and MLLW disposal. The stepwise process (Figure 4-1) proposed for discussion with the states would be iterative and carried out in concert with the states. The first step is the definition of the current configuration of LLW/MLLW disposal operations in the DOE system. This step includes identifying locations of current and planned LLW and MLLW disposal facilities, identifying wastes requiring disposal, and developing the process for identifying the range of acceptable on-site and off-site disposal options and issues requiring resolution during the planning process. This report provides the fundamental information needed for the first step.

Concurrent with activities related to the FFC Act, the DOE is studying a wide range of waste management configurations in a Programmatic Environmental Impact Statement (PEIS). In the PEIS, options are being developed to configure the DOE waste treatment and disposal system. Options range from decentralized treatment and disposal sites to regional and centralized sites. During the FFCA disposal planning process, results from the PEIS analysis will be used as input in the development of screening criteria and site evaluation methodology. Similarly, results from FFCA disposal planning will be used as input for the PEIS to ensure that the two processes are consistent. Updates or revisions of materials prepared in the PEIS will be shared with the states as part of the FFCA process.

4.1 Goals and Objectives of the Disposal Plan Process

The goal of the DOE disposal plan process is to advance an acceptable solution to the many-faceted problem of disposal of DOE MLLW. Several aspects of the problem must be considered: (1) protection of public and worker health and safety, (2) protection of the environment and ensure that no legacy requiring remedial action remains after operations have been terminated, (3) cost-effectiveness, (4) feasibility of implementation, and (5) equity among stakeholders. In addition, each disposal facility must meet the performance objectives of DOE Order 5820.2A and all applicable environmental regulations and requirements. Collectively, the selected sites must provide a technically sound and permanent disposal system for DOE wastes. Achieving the proper balance between often conflicting priorities among these goals constitutes the challenge of the decision process faced by DOE and the states. Key issues for each of these goals are discussed below.

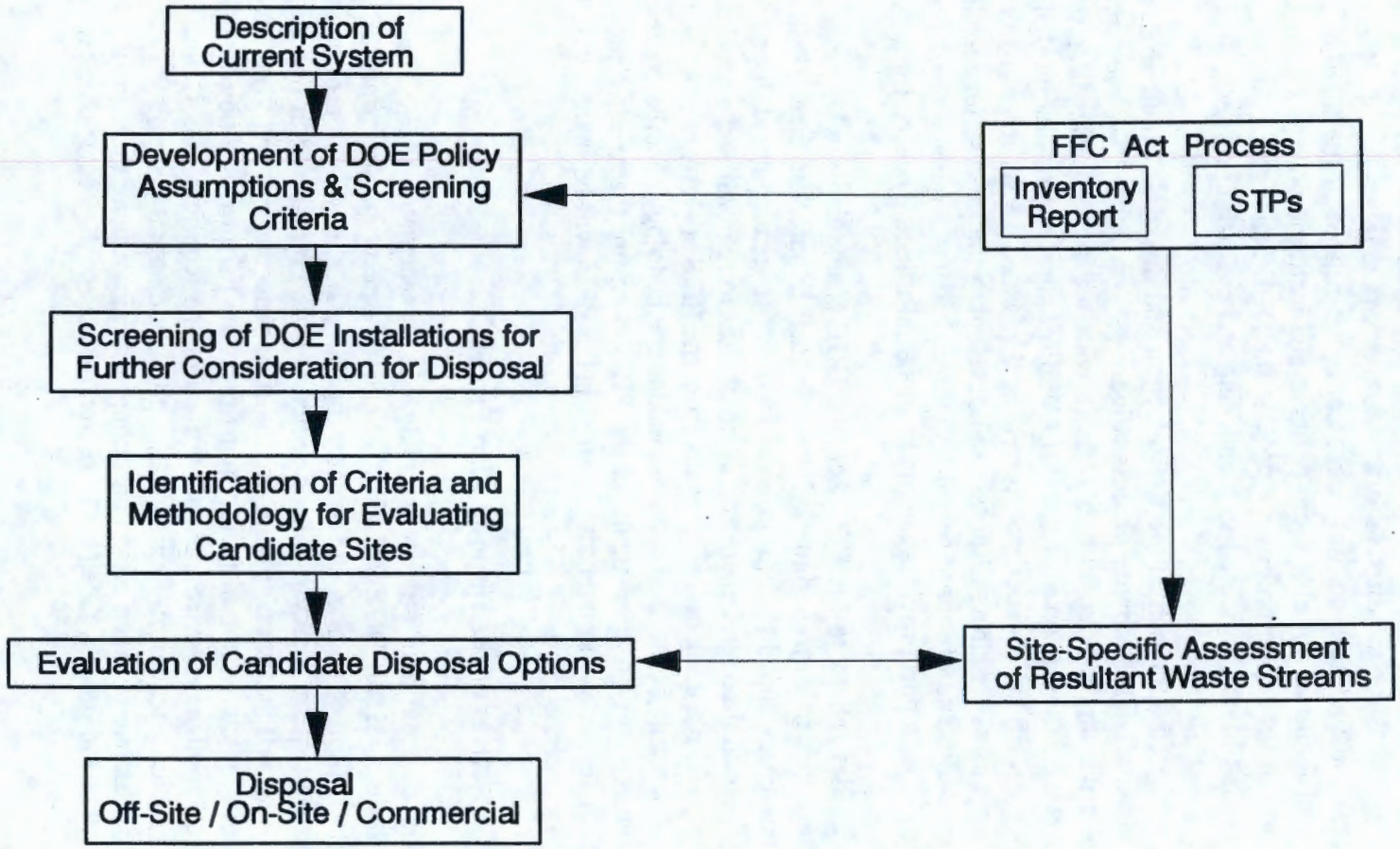

Figure 4-1. Proposed Disposal Planning Process

Protection of Public and Worker Health and Safety

DOE's primary goal is to dispose of its mixed and low-level waste in a manner that protects the health and safety of workers and the public.

The general public must be adequately protected from releases of radioactivity and hazardous materials from a disposal site during normal operations, off-normal events, and after closure of the facility. DOE Order 5820.2A requires that external exposure to the waste and concentrations of radioactive material that may be released from a disposal site into surface water, ground water, soil, plants, and animals must not exceed 25 mrem/yr effective dose equivalent to any member of the public. Releases to the environment must meet the requirements of 40 CFR 61. Because the disposal of DOE's LLW and MLLW could involve shipping of waste between installations, risk of releases associated with the transportation of LLW and MLLW must also be considered.

Site workers must be adequately protected during normal operations and unanticipated events. Inadvertent intruders must be protected after the disposal facility is closed. DOE Order 5820.2A states that the committed effective dose equivalents received by individuals who inadvertently intrude into the facility must not exceed 100 mrem/yr for continuous exposure or 500 mrem for a single acute exposure.

Protection of Environment and No Legacy Requiring Remedial Action

In addition to protecting health and safety of workers and the public, DOE recognizes the need to protect the environment and ecological systems, and indeed such laws as the National Environmental Policy Act make environmental protection the mandate of every federal agency. Siting decisions could fully protect human health by containing the waste completely and still represent a threat to some aspect of the environment. For example, a disposal facility might be located near a national park or in a sensitive habitat, or it might have detrimental effects on a threatened or endangered species simply by virtue of the effects of construction. Similarly, air quality, ground water, or more aesthetic characteristics such as previously pristine scenic resources could be impaired by construction and operation.

Cost Effectiveness

Cost effectiveness is an important consideration in DOE's site selection process because DOE is a taxpayer-supported organization and DOE's activities are constrained by congressionally approved budgets. A number of factors affect the total cost of developing a LLW or MLLW disposal facility: disposal technology, facility size, site conditions, methods of construction and operation, and monitoring after closure. Transportation costs must also be considered, depending on proximity of the disposal facility to the waste generation site and the available transportation infrastructure. In general, there is some minimum disposal volume for a specific disposal technology that provides economic viability, because construction entails some minimum

capital and operational cost. Development of an adequate minimum number of disposal sites will also be a goal of DOE's site selection activities.

Equity Among Stakeholders

Public concerns are very important in the site selection process. Experience has shown that opposition by the public to the siting of disposal facilities can often be reduced through the active participation of the public and local officials in all stages of the selection process. A primary concern among the public is that disposal facilities are sited fairly. DOE recognizes the need to site and operate disposal facilities equitably. To achieve this objective, the active participation of the states during the development and implementation of the entire site-selection process will be necessary.

Feasibility of Implementation

Subject to its primary goals, DOE prefers options that are politically viable and feasible to implement. For instance, DOE prefers to select disposal sites from installations that DOE currently owns. DOE also prefers options that have relatively low uncertainty in meeting regulatory requirements and acceptance by the local community.

4.2 Planning Process Description

As shown in Figure 4.1, the first step in the process is to define the current disposal configuration for the DOE complex. This report provides that information. The next step is to develop policy assumptions and decisions so that screening criteria and methods can be developed and applied to potential disposal locations. Input from states via the DOE Disposal Workgroup will be incorporated in this step. Screening criteria can then be applied to identify preferred site locations.

When the Conceptual and Draft Site Treatment Plans are developed by MLLW generating sites, the types of wastes that require disposal can be identified and the feasibility of on-site disposal can be evaluated. At the same time those wastes that will require off-site disposal can also be identified. DOE sites as well as commercial sites will be considered for wastes that require off-site disposal. Evaluation of the disposal options will include considerations of the overall environmental protection provided by the waste form, waste package, engineered barriers and the natural conditions of the site.

Key steps in the disposal planning process are discussed below.

4.2.1 Current Configuration

As shown in Figure 4-1, the first step in the proposed process is to define the current configuration of the DOE waste disposal complex. This report provides that information.

4.2.2 Development of Policy Assumptions

The second step is to develop policy assumptions and decisions so that screening criteria and methods can be developed and applied to potentially viable disposal locations.

DOE will make several policy decisions before the disposal process; these decisions will affect site selection. Policy decisions will be used to ease implementation and reduce the cost associated with the selection of disposal sites. Some of these decisions directly affect the siting process and may reduce the number of sites considered for development. The policy may be regulatory-based or technically based. For example, DOE may decide that waste-disposal sites should have the potential for permanent DOE ownership in order to facilitate access control and post-closure monitoring, or it may decide whether to site disposal facilities over sole-source aquifers or recharge-protection areas.

Although a number of policy decisions may be required, DOE will make some of these decisions early with the involvement of states. Both the safety of the disposal site and the fairness of the siting process must be addressed. A policy that favors one area or population may be difficult to justify even if the solution makes sense from the standpoint of cost or safety. Early and continuous involvement with the states can be critical to the success of a siting program.

4.2.3 Development of Screening Criteria

After potential installations have been reviewed for consistency with policy decisions, the third step is to apply screening criteria to eliminate areas that are unfavorable or unacceptable. Favorable factors then can be applied to the remaining areas to enable the most promising sites to be identified for more detailed analysis.

Screening criteria can be based on regulatory or technical considerations. Regulatory considerations will be based on existing siting regulations affecting LLW and MLLW disposal. For example, 40 CFR 264.18 requires that all parts of a disposal facility must be more than 61 m (200 ft) from any fault that has been active during the Holocene Epoch. This could be used as a criterion to exclude potential sites from further consideration. Technical criteria will be developed based on factors that may significantly affect the performance of the disposal system or factors that may cause undue hardship for the implementation of site development.

It is important to develop technical siting criteria that will enhance the ability of a disposal site to contain the waste and keep them from reaching the biosphere. This is known as the performance objective. For radioactive waste, there are two aspects that affect a site's ability to meet performance objectives: minimize the probability of an event that may lead to a release of waste, or minimize the consequence should a release occur. The evaluation of these two aspects of waste isolation are addressed in the performance assessment process in DOE Order 5820.2A. Performance assessment is essentially a predictive analysis of the migration of radionuclides for 10,000 years. The hazardous waste regulations do not require any predicitive analysis of the long-term behavior of hazardous constituents as the performance assessment

required by DOE Order 5820.2A. The RCRA approach is to prevent the migration of hazardous waste constituents from disposal facilities by requiring compliance with: 1) 40 CFR 268 Land Disposal Restrictions (LDRs); 2) strict landfill design criteria (40 CFR 264 Subpart N); 3) detection criteria in the uppermost aquifer (40 CFR 264 Subpart F); and 4) corrective action measures (40 CFR 264 Subpart F). EPA has set a precedence by permitting RCRA facilities that have demonstrated compliance with these requirements. The result of these different containment philosophies is that radioactive waste disposal is generally more restrictive and oftentimes becomes the driving factor in the development of siting criteria for mixed-waste disposal. The areas recommended for criteria development and a discussion of the issues associated with each is presented in the following sections. It is proposed that these criteria be developed in concert with the State Disposal Working Group.

Geology

The geology of the disposal site and the surrounding area must be carefully examined during site characterization, both to determine whether exclusionary or favorable factors are present and to gather data to be used in the performance assessment if the site is to be considered further. Some of the characteristics to be considered are land-form and tectonic stability and rock types.

The disposal facility must be physically stable after closure both to avoid the need for future corrective actions and to avoid the possibility that performance assessment calculations based on current conditions will be invalid. Properties of the geologic materials at the site are important because their geochemical and hydrological properties affect the site's ability to promote or mitigate the leaching and transport of contaminants through ground and surface water. The ease of site characterization depends largely on the homogeneity and isotropy of the geologic materials at the site.

Hydrology

Probably one of the most significant potential pathways for the release of contaminants from a disposal site is through the ground-water system. The rate of contaminant migration from a site and the ultimate effects of the contaminant depend on the hydraulic and chemical characteristics of the ground-water system and their relation to the geology and geography of the site. The goal of disposal-site development should be to minimize the rate and total volume of contaminant released to the environment. Three factors are especially important in the subsurface transport of contaminants: depth to ground water, ground-water flow, and ground-water use. Escape of the waste is inhibited by such factors as low recharge, great depth to water table, and geochemical retardation. Transport of the waste is inhibited by such factors as low ground-water velocity, which is attained through a combination of low hydraulic conductivity, high effective porosity, and low hydraulic gradient in the aquifer. Current and potential uses of ground water at the site should also be considered. Finally, the potential impact of a disposal facility on surface water bodies and the effects of flooding on the performance of the facility should also be considered during siting.

Other Characteristics

Some factors that can affect siting have little to do with the ability of the site to contain waste. For example, the presence of ecological, cultural, historical, and archeological resources must be considered during site selection. Wetlands are protected under the Clean Water Act and by Executive Order 11988. Disposal sites should avoid areas that contain cultural and archeological sites or that provide habitat for endangered species if site development or operation would threaten the integrity of the habitat. Areas having natural resources that may enhance the probability of human intrusion into the disposal facility should also be avoided unless institutional controls can prevent such intrusion.

4.2.4 Identification and Evaluation of Disposal Options

DOE has relied on a systems approach to waste management. In applying this approach to developing disposal facilities, DOE considers the overall environmental protection provided by the combination of several separate physical components. The main physical components include the waste form, waste package, engineered barriers, and the natural hydrologic, geologic, and climatologic characteristics of the site. These system components can interact in a complex manner that determines whether the disposal system as a whole will function satisfactorily. Attention to one part of the system, without understanding its relationships to the other components, can impair the performance of the disposal system. For this reason, a system approach is important to the selection of a disposal site and its associated technology.

The systems approach acknowledges that each component affects the performance of the waste disposal facility and allows facility managers to evaluate and use technical approaches that together provide appropriate protection. For example, engineered features can usually be designed to compensate for shortcomings of site characteristics, but engineering features may become unreliable after two to three hundred years. This means that sites with unfavorable conditions and good engineering structures could be suitable for disposal of waste containing short-lived radionuclides but unsuitable for disposal of long-lived waste. As an alternative, DOE could control the overall quantity and spatial distribution of specific radionuclides in a disposal facility either by controlling the inventory or by requiring waste treatment that makes the critical radionuclides unavailable for release to the environment. Through the use of such engineering designs, the disposal facility can be optimized to enhance the features of the waste form and natural site so that potential release mechanisms are controlled.

Site Treatment Plans will provide preliminary information on the waste streams and waste characteristics. This information will provide an indication of what and how much waste can be disposed of on-site based on the knowledge of acceptable radiological limits in waste acceptance criteria for existing and/or planned LLW disposal facilities. Comparing these WAC to waste-stream characterization information will also provide a first approximation of

wastes that are not acceptable for disposal on-site and will probably require off-site disposal. The performance assessment (PA) would serve as the basis for defining the acceptability of wastes for on-site disposal. PA frequently requires detailed knowledge about the characteristics of the candidate sites and the engineering elements of the disposal system. Typically, a PA is an iterative process that will identify weaknesses or new data needs that may require further analysis. Recognizing the iterative nature of the PA process, the first tier evaluation should not require significant new data collection but should utilize existing available information to evaluate the suitability of a site. More complex analyses of sites passing the initial evaluation would be conducted in the next step of the process using more detailed, specific information gathered for the site.

Ultimately, isolation relies on the inherent ability of the disposal site itself to contain the waste. This ability in turn depends on the site meteorology, hydrology, geology, and mineralogy. These site features must be considered as part of an overall system of isolation features, and disposal sites for LLW and MLLW should be selected to optimize the ability of the system to protect human health and safety, protect the environment, minimize cost, promote ease of implementation, and provide equity among stakeholders.

5.0 ISSUES

The identification and evaluation of on-site and off-site waste disposal options requires consideration, resolution, and agreement on several issues. Resolution of these issues will affect the volume and type of waste requiring disposal as well as the technologies to be used. For example, delisting of mixed wastes will reduce the volume of waste requiring disposal in a mixed-waste disposal facility but will increase the volume of LLW requiring disposal. The assumptions and analyses supporting decisions about in-situ closure of remedial action sites containing residual radioactivity are also relevant to the planning for waste disposal. Remedial action closures and planning for new sites should be based on consistent risk levels and should use consistent methods for assessing facility performance. Finally, siting of disposal facilities and the planned siting of treatment facilities to be defined under the Site Treatment Plan (STP) process are related, but the nature of that relationship is inconsistent. In some cases, sites hosting treatment facilities are not suitable for disposal of treated residuals. Other sites are more appropriate for disposal of treated residuals, thus ensuring that the waste management cycle is completed. These issues, which are discussed in more detail below, require further definition and resolution through discussions with the State Disposal Working Group.

5.1 Disposal of Environmental Restoration Wastes

For waste requiring removal and disposal, the Environmental Restoration (ER) Program is planning to use the disposal facilities in the DOE system developed by Waste Management Operations (EM-30) for waste generated from the environmental restoration activities. The ER Program will also create additional disposal facilities through the CERCLA process, such as the creation of on-site disposal cells for waste materials.

Projecting the volume of mixed waste that will require treatment to meet LDR standards is difficult. Few data will be available for environmental-restoration sites until after adequate characterization is completed, which will take many years. In many cases, important data may not be available until remedy selection is completed and, in some cases, until the engineering design phase is under way. EPA's requirements for treatment and disposal of contaminated soils is currently being revised, and volumes of environmental restoration wastes cannot be predicted with any degree of certainty. The volume of waste requiring disposal varies as characterization proceeds because new areas of contamination are identified; however, the evaluation can also reduce the estimated amounts because the preferred alternative is no action or more limited action than the assumptions used for preliminary estimates. Projected ER waste volumes are being included in each site's STP.

Waste from environmental remediation tends to be much larger in volume but lower in levels of contamination than the waste from operations. Therefore, the design requirements for disposal facilities to address environmental restoration wastes (and the waste acceptance criteria for treatment facilities) may be less restrictive for those wastes from operations

facilities. The large uncertainty of potential ER mixed waste volume needing disposal capacity can be a major issue during the planning of DOE MLLW and LLW disposal.

5.2 Delisting Petition for Treated and Secondary Mixed Waste

Wastes are hazardous under RCRA if they are either "listed" or "characteristic." **Listed wastes** are identified in Subpart D of 40 Code of Federal Regulations (CFR) Part 261 and are designated as P, U, K, or F wastes. Wastes with F codes are from non-specific sources; wastes with K codes are from specific sources; and wastes with P and U codes are commercial chemical products. **Characteristic wastes** are those that display any of the characteristics of ignitability, corrosivity, reactivity, or toxicity.

The Derived-From Rule of 40 CFR 261.3(c) in RCRA states that any solid waste generated by the treatment, storage, or disposal of a listed hazardous waste may remain a hazardous waste unless it is delisted. In the case of a characteristic waste, if the waste no longer exhibits the characteristic after treatment, it will no longer be considered as hazardous waste.

Because of the Derived-From Rule, those DOE MLLW streams that contain listed hazardous components will remain mixed waste after treatment and will require MLLW disposal facilities. On the other hand, those MLLW streams containing only characteristic hazardous components can be disposed of as LLW if the characteristics of the hazardous components can be destroyed or immobilized during treatment. Since the STPs are still under development, the volume of DOE MLLW remaining after treatment that is still considered MLLW cannot be estimated yet. However, information from the Interim Mixed Waste Inventory Report (DOE, 1993) prepared under the FFC Act indicates that a significant amount of the current MLLW inventory contains listed hazardous components. It is therefore anticipated that a significant portion of the DOE's MLLW will ultimately need MLLW disposal facilities.

A delisting procedure in RCRA is available to allow a listed hazardous waste to be designated nonhazardous (and managed as such). Petitions for delisting a waste are submitted to the EPA for approval on a case-by-case basis. The intent of the delisting process is to avoid overregulation of hazardous materials that do not pose a threat to human health and the environment. Delisting of waste treatment residuals is difficult because it normally requires very explicit knowledge of processes by which waste streams are generated and subsequently treated (wastes derived from specific sources) or it requires that the composition of a waste stream undergoing treatment is well known (wastes from nonspecific sources).

If a petitioned MLLW stream can be delisted, it can be disposed of in accordance with DOE Order 5820.2A in a LLW facility. In general, the radioactive waste disposal facility provides an equal level of protection to the environment, public, and workers. In practice, however, delisting is costly, complicated, and time-consuming. DOE needs to decide whether it will pursue the delisting process for its MLLW. If so, DOE needs to identify the

pertinent MLLW streams that may qualify for delisting and seek state support to accelerate EPA's delisting petitions.

5.3 Relations Between Treatment and Disposal Locations

The Department recognizes that there is an important relationship between where wastes are treated and where they are subsequently disposed. When considering the range of possible configurations of mixed-waste facilities there are a number of ways in which treatment and disposal facilities could be linked. Options appear to fall generally into the following five categories, assuming that waste originates at Site A:

1. Treat and dispose at Site A.
2. Treat at Site A, transport to Site B for disposal.
3. Transport from Site A, treat at Site B, and return to Site A for disposal.
4. Transport from Site A, and treat and dispose at Site B.
5. Transport from Site A, treat at Site B, and dispose at Site C.

These options are graphically represented in Figure 5-1.

Not every site will be a realistic candidate for disposal. Factors that could influence the choice of options regarding a disposal configuration include (1) technical suitability of a site (e.g., it is large enough); (2) regulatory constraints; (3) cost; (4) public support or opposition; and (5) equity issues. These issues are discussed in Chapter 4. Moreover, the configuration could be a combination of options depending on regional preference. For example, it may be appropriate and acceptable to regionalize treatment and disposal activities in one area of the country while in another it may be appropriate to decentralize.

The issue of linkage between treatment and disposal will be addressed in the Programmatic Environmental Impact Statement (PEIS) for Environmental Restoration and Waste Management as it analyzes the risks associated with alternative waste management configurations ranging from decentralized ("on-site") to regionalized and centralized activities. Each of the five options presented above will be discussed, and issues accompanying each alternative will be evaluated. For instance, a decentralized configuration would generally minimize transportation of waste, but would require a greater commitment of land and resources. On the other hand, regionalized or centralized waste-management facilities would tend to minimize land use and potential impacts to workers while increasing transportation risks and costs. DOE believes that the PEIS analyses of the possible options to link treatment and disposal will provide valuable insight as the public, States, and DOE discuss the continued use of existing and possible locations of future mixed-waste facilities.

5.4 Land Use and Institutional Controls

The management and disposal of MLLW and LLW raise several issues related to land use that should be examined prior to and during site selection. At this time, two groups are

actively investigating land-use issues in connection with waste management: the DOE/EM Future Uses Working Group and the Environmental and Occupational/Public Health Standards Steering Group.

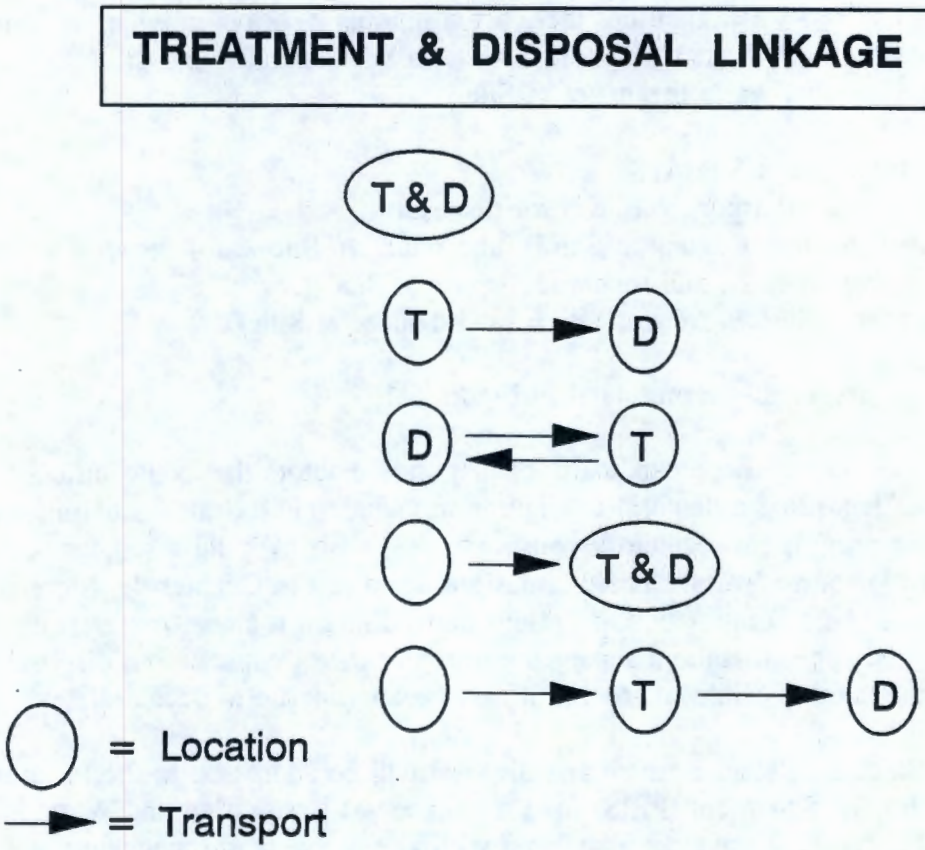

Figure 5-1. Treatment and Disposal Linkage

The Future Uses Working Group has been established by DOE to coordinate and build on a number of existing efforts in the general area of land-use planning. The Working Group plans to prepare guidance in the near future on ways that DOE sites can work with local communities and stakeholders to consider options for future DOE activities. The guidance is expected to be similar in spirit to the outline of the recent successful work done by the Hanford Future Site Uses Working Group. The guidance will be based on two premises: future-use planning is a local activity, not a national activity, and the activities must generate future-use goals that feed into DOE's strategic planning. The advice and opinions offered by local stakeholders will help to set goals that the DOE uses in planning. It is not clear how this process of stakeholder involvement will affect existing deadlines and agreements.

The Environmental and Occupational/Public Health Standards Steering Group is chartered by the directors of 13 national laboratories As one of its activities, the Steering Group held an informal preliminary workshop on land-use planning in May 1993. Participants at the workshop included DOE and national-laboratory site planners, land-use planners from universities, state and local planners, representatives of various public-interest groups, tribal representatives, and a number of DOE managers interested in the problem. The Steering Group is also interacting with the Future Uses Working Group. The Steering Group plans to hold a larger forum on land-use planning in March 1994. The forum will address both environmental restoration and waste management.

Future-use considerations are important during planning for environmental restoration. Clean-up measures taken on land to be released for unlimited use might be much more stringent than those taken for land that will remain part of an access-controlled DOE site, for example. Land-use planning to support remediation decisions should consider such factors as the capability of the land to be used for various activities, growth projections for the area, and future DOE missions at the site.

A number of land-use issues are important in siting waste-disposal facilities. Three examples illustrate the kinds of considerations that the DOE should take into account during siting decisions. The first consideration in the siting of MLLW and LLW facilities is the existing, prior, and planned future use of the land surrounding the potential disposal facility. If, for example, the local community is planning residential development in an area, nearby land may not be suitable for development as a disposal facility. If land has never previously been used for agriculture, residences, or industrial development, the area may in fact be unsuitable for those uses for more basic reasons, such as lack of access, difficulty in building, or remoteness. These considerations might suggest objective criteria for deciding whether a location is suitable for a disposal facility. The second issue is ownership. Simple ownership of land usually does not entail the right to use the land in any way the owner desires. Treaty obligations, federal and state laws, state and local zoning ordinances, and similar restrictions on land use must all be considered during siting. In siting a MLLW disposal facility, restrictions or lack of restrictions on surrounding land should also be considered. Finally, in designing and siting a MLLW facility, the DOE will probably consider the nature of any planned institutional controls. Active institutional controls include such activities as continued land ownership, access control, monitoring, maintenance, and if necessary, remedial action. Passive institutional controls include legal land-use restrictions such as zoning, deed covenants, and easements and various kinds of notification, such as deed recordation and marker systems. Active controls are designed primarily to prevent damage or intrusion into a site; passive controls are designed primarily to transmit information about the site.

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6.0 CONCLUSIONS

This report provides an overview of current DOE LLW and MLLW disposal activities and a proposed process for MLLW disposal site selection. The report represents the first step for initiating discussions with the states, through the National Governors' Association (NGA), to address final disposition of the residues resulting from the treatment of both the current and future DOE MLLW inventory. The report has been provided to the NGA and DOE to assist in the development of a equitable solution for the disposal of DOE's MLLW. Upon completion of the NGA and DOE review of the report, the DOE Disposal Working Group will meet with the State Disposal Working Group to discuss NGA comments on the report and reach agreement on a process for addressing MLLW disposal. Once a process has been agreed to between DOE and the states, the DOE, in conjunction with the NGA, will develop an implementation plan for the process.

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APPENDIX A:

HANFORD SITE, WASHINGTON

Site Contact:

Don Plowman (509) 376-7848

A.1 Site Description

The Hanford Site covers approximately 1,450 square kilometers (560 square miles) of semiarid land that is owned by the U.S. Government and managed by the DOE-RL. The Hanford Site is located northwest of the city of Richland, Washington, (Figure A-1). The city of Richland adjoins the southeastern most portion of the Hanford Site boundary and is the nearest population center. In early 1943, the U.S. Army Corps of Engineers selected the Hanford Site as the location for reactor, chemical separation, and related facilities and activities for the production and purification of plutonium. The Hanford Site is on the Columbia Plateau bounded on the north by the Saddle Mountains, on the east by the Columbia River, and on the south and west by the Yakima River and the Rattlesnake Hills, respectively. The dominant features of the Hanford Site include the Columbia River, sand dunes located near the Columbia River and the Basaltic Ridges, including the Rattlesnake Hills which rise to an elevation of greater than 1,100 meters (3,600 feet). Three buffer zones predominately around the 100 and 200 areas currently exist within the Site. The Arid Lands Ecology Reserve a 310 square kilometers (120 square miles) area to the south and west of Route 240. The Saddle Mountains National Wildlife Refuge approximately 130 square kilometers (50 square miles) north of the Columbia River, and the Wahluke Wildlife Recreation Area a 220 square kilometers (85 square miles) plot to the northeast of the Columbia River. The climate is semiarid with an average annual rainfall of about 16 centimeters (6.3 inches) which supports the Site vegetation typically sagebrush and cheatgrass.

The regional road and rail service support the Hanford Site treatment, storage and disposal facilities include Washington State Highways 24 and 240, Route 10, and that portion of Route 4S south of the Wye barricade. Roadways on the Hanford Site north of the Wye barricade and within the 300 and 400 Areas are restricted to authorized personnel. The nearest public roadway to the patrolled Site areas is Washington State Highway 240. Railroad service is connected to the national network at the south of Site. They are maintained to the requirements of the Federal Railroad Association track safety standards for Class III track, as detailed in 49 CFR Part 213 (DOT 1987). Class III track is sufficient for loads and train speeds occurring on the Hanford Site.

Hanford plutonium production and purification activities were centralized in numerically designated areas. The reactor facilities are located along the Columbia River in what is known as the 100 Area. The reactor fuel processing and waste management facilities are in the 200 Areas, which are located on a plateau approximately 11.3 kilometers (7 miles) from the Columbia River. The 300 Area, located north of Richland, contains the reactor fuel manufacturing facilities and the research and development laboratories. The 400 Area, 8 kilometers (5 miles) northwest of the 300 Area, contains the Fast Flux Test Facility used in the testing of liquid metal reactor systems. The 600 Area covers all locations not specifically given an area designation. Adjacent to, and also north of Richland, the 1100 Area contains facilities associated with administration, maintenance, transportation, and materials procurement and distribution. The 3000 Area, between the 1100 Area and the 300 Area,

The Hanford Site

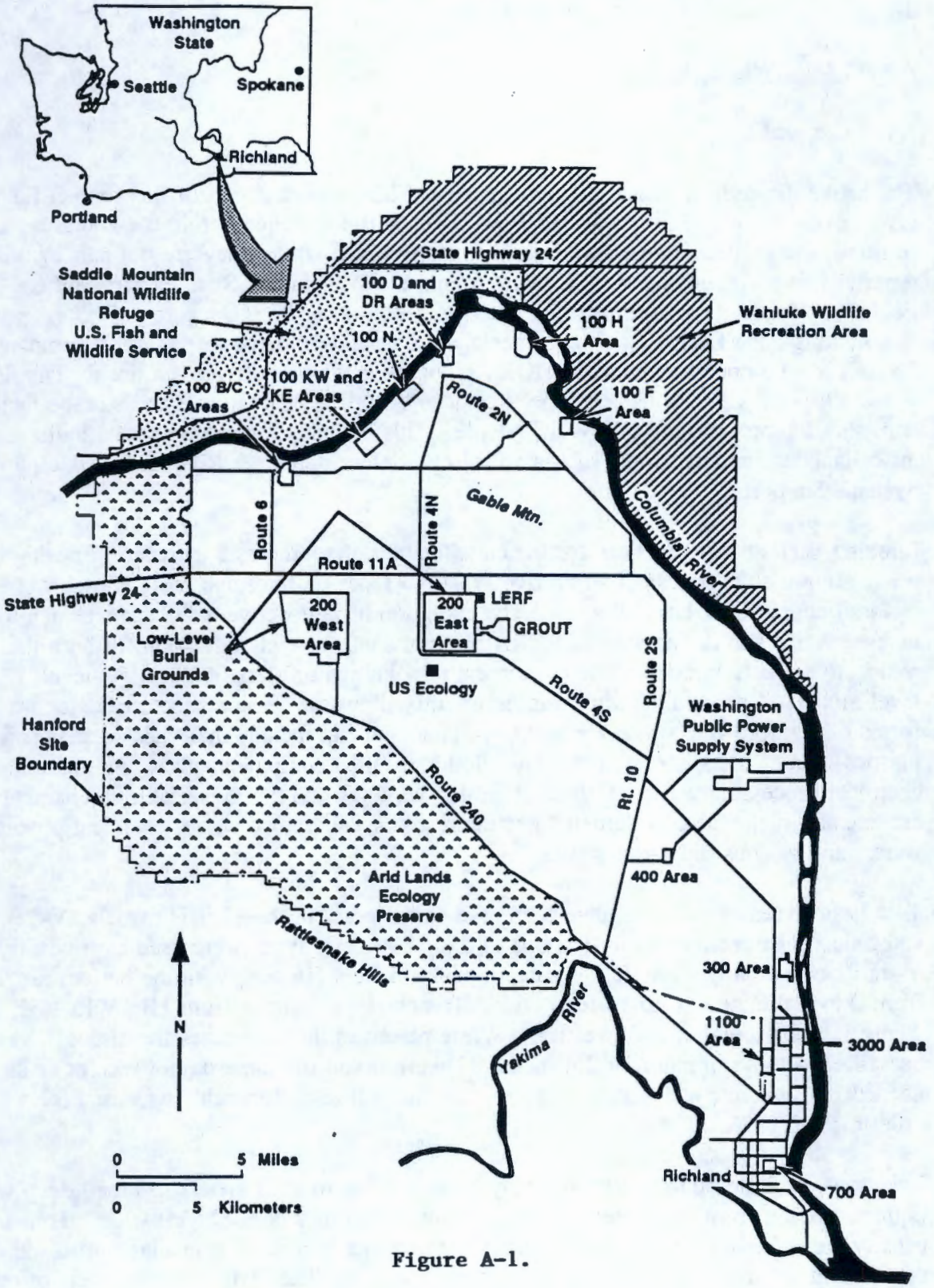

Figure A-1.

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contains engineering and administrative offices. Administrative buildings also are located in the 700 Area, which is in downtown Richland.

A.1.1 Solid Waste Disposal

(1) General

The active disposal facilities (Hanford inactive LLBGs are not part of this report) for Solid Low Level Waste and future Mixed Low Level Waste are sited within the 200 areas. In addition, the PUREX tunnels were used to store mixed waste; they are not part of this report. For purposes of the RCRA (1976) and the Washington State Department Of Ecology, Washington Administrative Code, Chapter 173-303, "Dangerous Waste Regulations", the DOE-RL is the owner/operator and Westinghouse Hanford Company (WHC) is a co-operator, with the DOE-RL, of these waste management units. The Solid Waste Disposal Operations personnel (includes operation of treatment and storage facilities) consists of approximately 375 WHC people. This includes approximately 90 indirect miscellaneous support people such-as: Projects, Safety, Crane & Rigging, QA/QC, and Fire Systems Support.

Looking back at past practices for the classification of solid waste included disposing of waste simply classified as "Radioactive Waste". Later on the same basic wastes were reclassified as "Low Level Waste". The evolution of radioactive waste management of defense waste and the passing of RCRA brought about new classification for both the radioactive and hazardous waste constituent now known or classified as "low-level", "low-level mixed", "transuranic", or "transuranic mixed" waste. The characteristics or waste forms of Hanford Site waste are highly variable and can include materials such as soil, plastics, paper, metals, rags, protective clothing, failed equipment, glass, and laboratory and chemical processing waste. Offsite generated waste also is highly variable in character and can include such waste as defueled nuclear reactors, laboratory waste, chemical processing waste, and various industrial wastes.

Two basic types of trenches have been used for disposal in the LLBG, namely, V-trenches and industrial trenches. Modifications to these two basic types were used as necessary. The V-trenches normally were dug to a depth of 4.9 meters (16 feet) with the bottom ranging from 0 to 4.9 meters (0 to 16 feet) wide. Trench slopes ranged from 1H:1V to 1.5H:1V, where H=horizontal and V=vertical. Waste placed in these trenches for disposal was backfilled with a minimum of 2.4 meters (8 feet) of soil the same day of receipt or as needed. A concrete and metal variation, a 'V' trench (a V-7 trench), was used for a short time in 1972-1973.

Industrial, or wide-bottom, trenches may have been up to 15.2 meters (50 feet) deep with the bottom ranging from 4.9 meters (16 feet) to over 30.5 meters (100 feet) wide. Trench slopes usually were 1.5H:1V to avoid sloughing of the trench walls. If vehicular traffic was required in the trench, the bottom of the trench was stabilized with several layers of crushed

gravel. This layer also provided a base for stacking waste. A wide-bottom trench was routinely backfilled. Backfill consisted of soil to a minimum depth of 2.4 meters (8 feet) for disposed waste and 1.2 meters (4 feet) for retrievably stored waste.

Before 1970, no attempt was made to segregate the waste as to type or level of radioactivity. Since 1970, solid waste designated or suspected to be transuranic waste has been segregated from other radioactive waste and placed in retrievable storage units. Since 1985, steel drums containing radioactive organic liquid waste (mixed waste) also was placed in retrievable storage. Since November 23, 1987, mixed waste burial has been halted except for the disposal of mixed waste containers with a dose rate greater than 200 millirem per hour at the container surface and special-case wastes (e.g., K-3 filters, Shippingport reactor vessel). Waste with a dose rate of greater than 200 millirem per hour requires the use of remote-handling techniques to keep the radiation exposure to workers as low as reasonably achievable. All transuranic waste, regardless of storage method, eventually will be retrieved.

For retrievable waste storage, special backfilling techniques were used. The retrievable waste was placed in a V-trench with a wide bottom (Figure A-2). Before placement of the waste, an asphalt pad or fire retardant plywood was laid on the bottom of the trench. Plywood also was placed between layers of waste and on top of the waste. After 1974, the waste and plywood were covered with a heavy plastic layer before the trench was backfilled. A small amount (estimated to be less than 2.3 kilograms [5 pounds]) of remote-handled retrievable transuranic waste with a dose rate of greater than 200 millirem per hour at the container surface was stored in covered caissons (Figure A-3). The caissons were used only for small quantities of remote-handled waste from laboratories. All caissons in the 200 West LLBG are located in burial ground 218-W-4B.

Each burial ground may consist of trenches containing combinations of waste. For example, a trench containing low-level mixed waste may lie between a trench containing low-level waste and a trench containing retrievable transuranic waste. Some trenches contain areas with low-level waste (i.e., disposed of) and other areas with retrievably stored waste interspersed. In these cases, only the retrievably stored waste will be retrieved. An individual container may contain more than one type of waste (e.g., low-level waste and transuranic waste packages in one drum).

Trenches that received mixed waste and were backfilled before the effective date of regulation of mixed waste are not subject to regulation as permitted treatment, storage, and/or disposal units under WAC 173-303 (Ecology 1989). However, because of the irregular distribution of these trenches within areas containing trenches that received waste after the effective date of regulation, both types of trenches will be closed under WAC 173-303 regulations to facilitate the design and construction of closure barriers.

The existing portions of the LLBG are exempt from the liner system requirements or alternate technologies requirements as provided for in WAC 173-303-806(4)(h)(ii)(A) (Ecology 1989). The existing portion includes all filled and unfilled trenches constructed

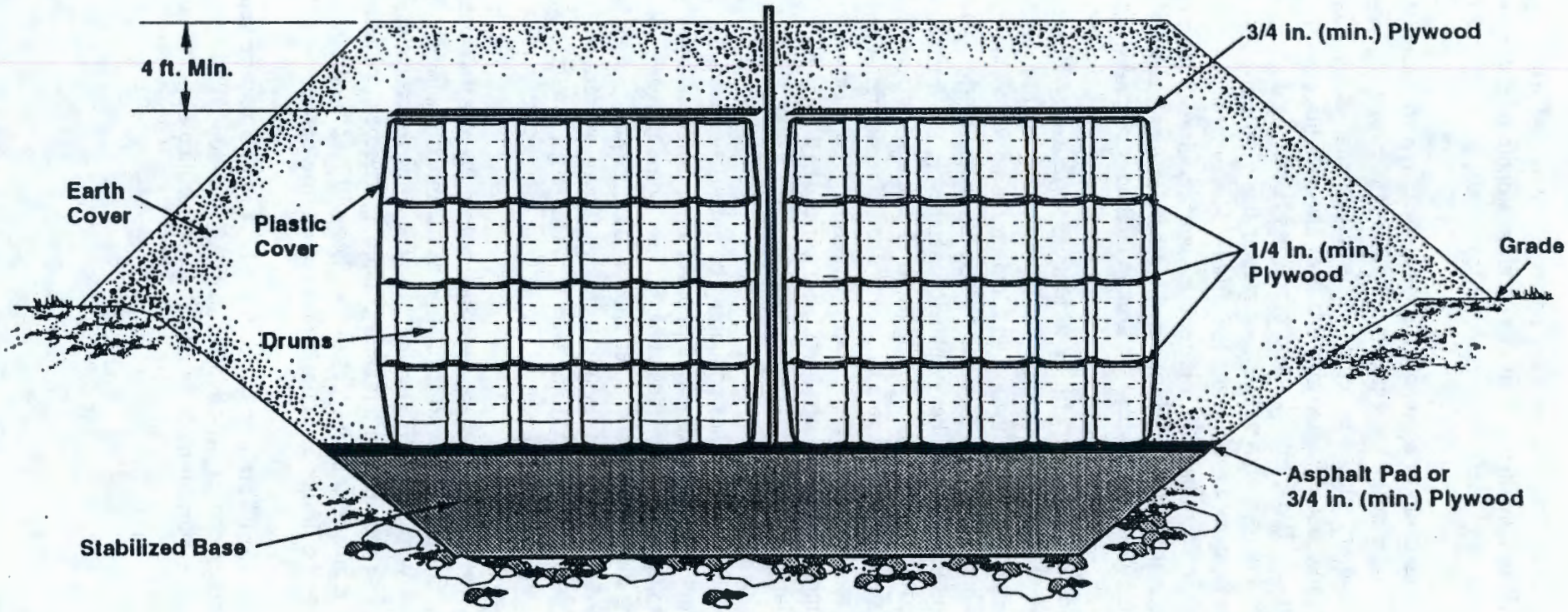

Figure A-2. Retrievable Waste Storage, Late 1970's Version

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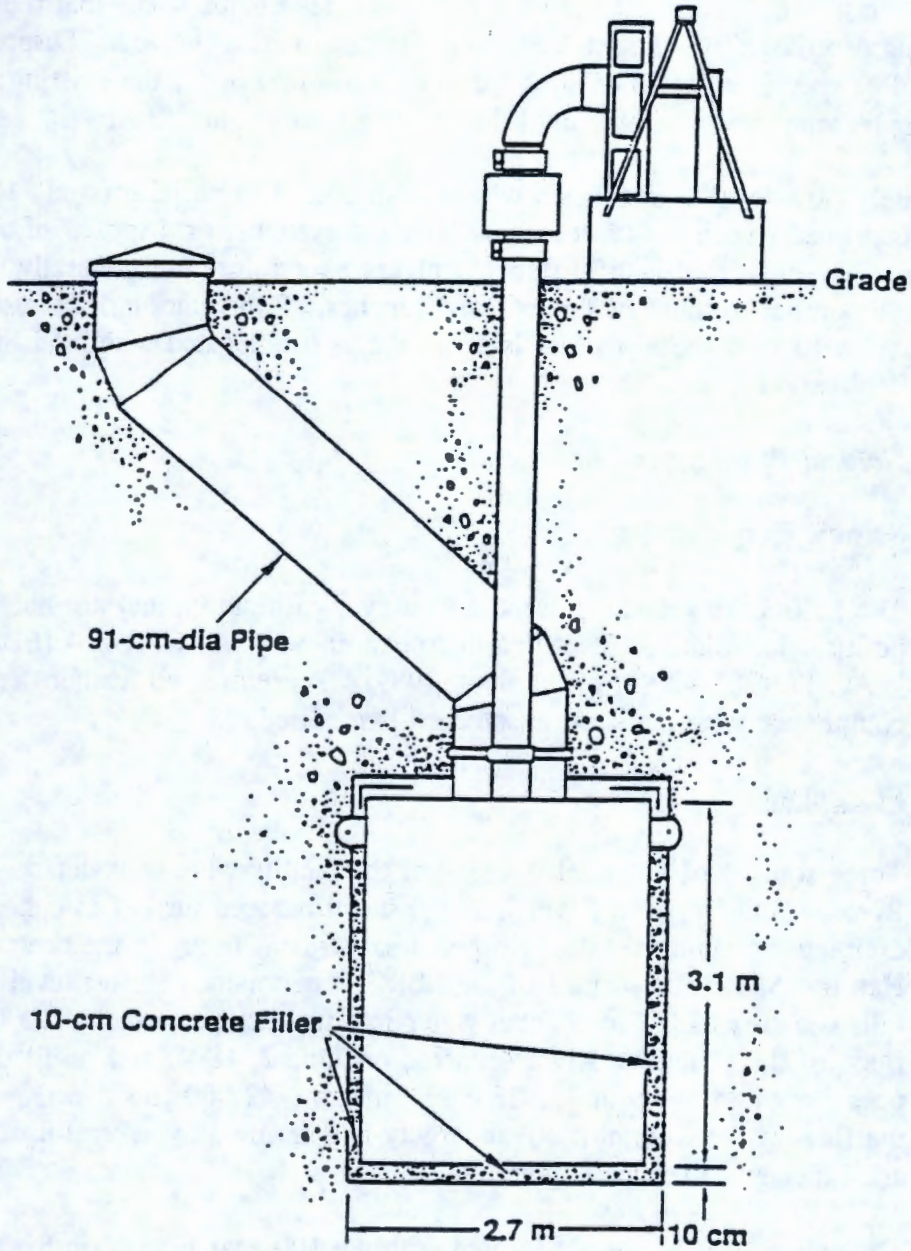

Figure A-3. Caisson for Remote Handled Waste

before November 23, 1987 (Chapter 4.0, Section 4.6.2.1). Two types of mixed waste currently are being disposed of at the LLBG. This mixed waste includes remote-handled waste (with exposures of greater than 200 millirem per hour at the container surface) and special waste. Special waste, as used here, includes unique waste that requires special handling or unusual waste such as decommissioned reactor vessels. Disposal of remote-handled or special waste in existing trenches is allowed under the existing exemption. Use of existing trenches will continue until the existing trenches are filled.

Ultimately, low-level mixed waste will be disposed of in burial ground 218-W-5 in RCRA-compliant lined trenches with leachate collection systems, or disposed of using approved waivers. The low-level landfill trenches planned for future use generally will be of a length and width similar to those of the existing trenches. Construction of Hanford's first RCRA compliant MLLW disposal facility is under way. It is located within LLBG 218-W-5 in trench number 31.

(2) Natural Phenomena

Seismic Consideration

The LLBG are located in Benton County, Washington, and are not within one of the political jurisdictions identified in Appendix VI of 40 CFR 264 (EPA 1988) and in WAC 173-303-420(3)(c) (Ecology 1989). Therefore, no further demonstration of compliance with the seismic standard is required.

Floodplain

Three sources of potential flooding of the facility were considered: (1) the Columbia River, (2) the Yakima River, and (3) storm induced run-off in ephemeral streams draining the Hanford Site. No perennial streams occur in the central part of the Hanford Site. The surface of the LLBG is maintained almost level and there are no hills near the LLBG to channel water into the disposal areas. The largest historical flood of the Columbia River occurred on June 7, 1894, and resulted in an estimated peak flow rate of about 21,013 cubic meters (742,000 cubic feet) per second. Today, the flow of the Columbia River largely is controlled by several upstream dams, that are expected to reduce major flood flows.

The active LLBGs are not located within a 100-year floodplain for the Columbia River. The U.S. Army Corps of Engineers has calculated the probable maximum flood based on the upper limit of precipitation falling on a drainage area and other hydrologic factors such as antecedent moisture conditions, snow melt, and tributary conditions that could lead to maximum run-off. The probable maximum flood for the Columbia River below Priest Rapids Dam has been calculated to be 1.4 million cubic feet per second. The floodplain associated with the probable maximum flood is shown in (Figure A-4). The inundated area from the probable maximum flood shown in

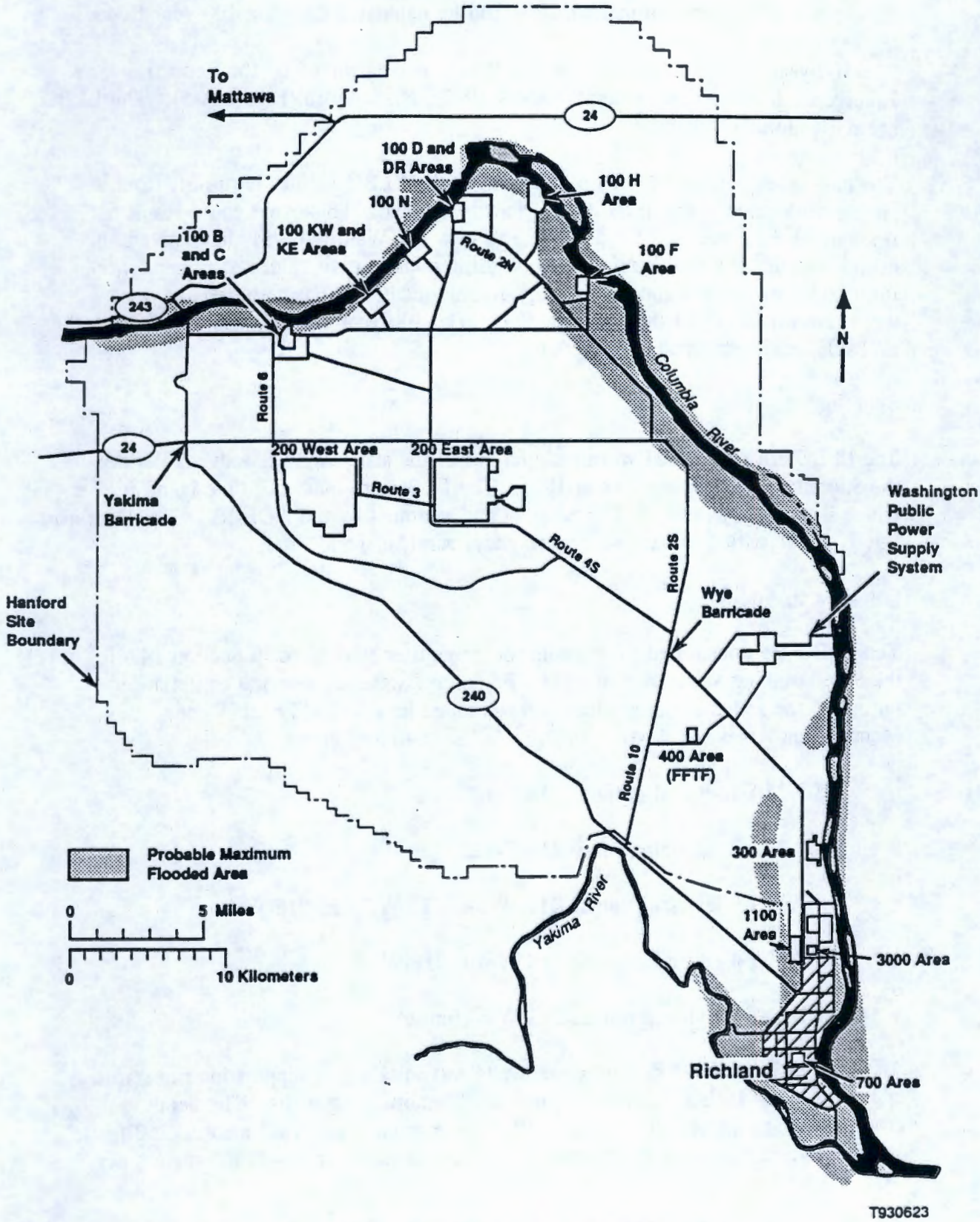

Figure A-4. Columbia River 100 Year Flood Plain

Figure A-4 is greater than that which would be inundated during a 100-year flood.

The 100-year floodplain for the Yakima River, as determined by the Federal Emergency Management Agency (FEMA 1980), is shown in (Figure A-5). The LLBG are not within the floodplain.

The only other potential source of flooding of the LLBG facility is run-off from a large precipitation event in the Cold Creek watershed. This event could result in flooding of the ephemeral Cold Creek. Skaggs and Walters (1981) have given an estimate of the probable maximum flood using conservative values of precipitation, infiltration, surface roughness, and topographic features. The resulting flood area would not affect any of the active LLBGs. The 100-year flood would be less than the probable maximum flood (Figure A-6).

Shoreline

The LLBG are not located within 'shorelines of the state' or 'wetlands' as defined in the Shoreline Management Act of 1971. The LLBG are located on the Hanford Site, which is owned by the U.S. Government and operated by the DOE-RL. The Hanford Site is not classified as natural, conservancy, rural, or residential.

Sole Source Aquifer

The LLBG are not located over a sole source aquifer as defined in Section 1424(e) of the Safe Drinking Water Act of 1974. For groundwater monitoring compliance purposes, the active burial grounds were grouped into 5 Low Level Waste Management Areas (LLWMA) (Figures A-7 & A-8) as follows:

- LLWMA-1--Burial ground 218-E-10
- LLWMA-2--Burial ground 218-E-12B
- LLWMA-3--Burial grounds 218-W-3A, 218-W-3AE, 218-W-5
- LLWMA-4--Burial grounds 218-W-4B, 218-W-4C
- LLWMA-5--Burial grounds 218-W-6 (future).

An initial network of 35 ground-water wells was installed to support interim status operation of the LLBG. Currently there are 80 monitoring wells. The depth to ground water in the vicinity of the LLWMA's approximately 76.2 meters (250 feet), and the ground water velocity ranges from .0004 meters per day to 8.2 meters per day.

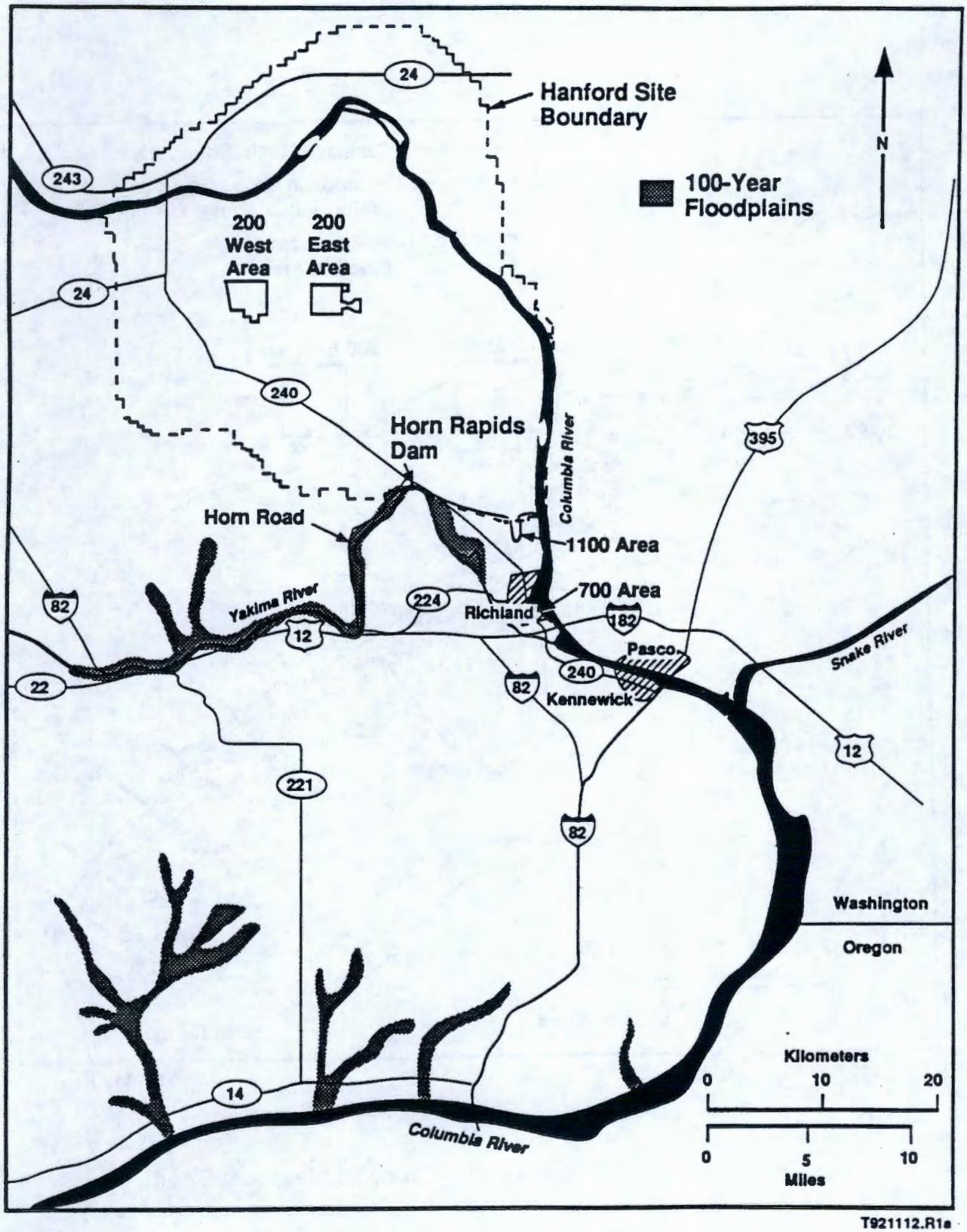

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Figure A-5. Yakima River 100 Year Flood Plain

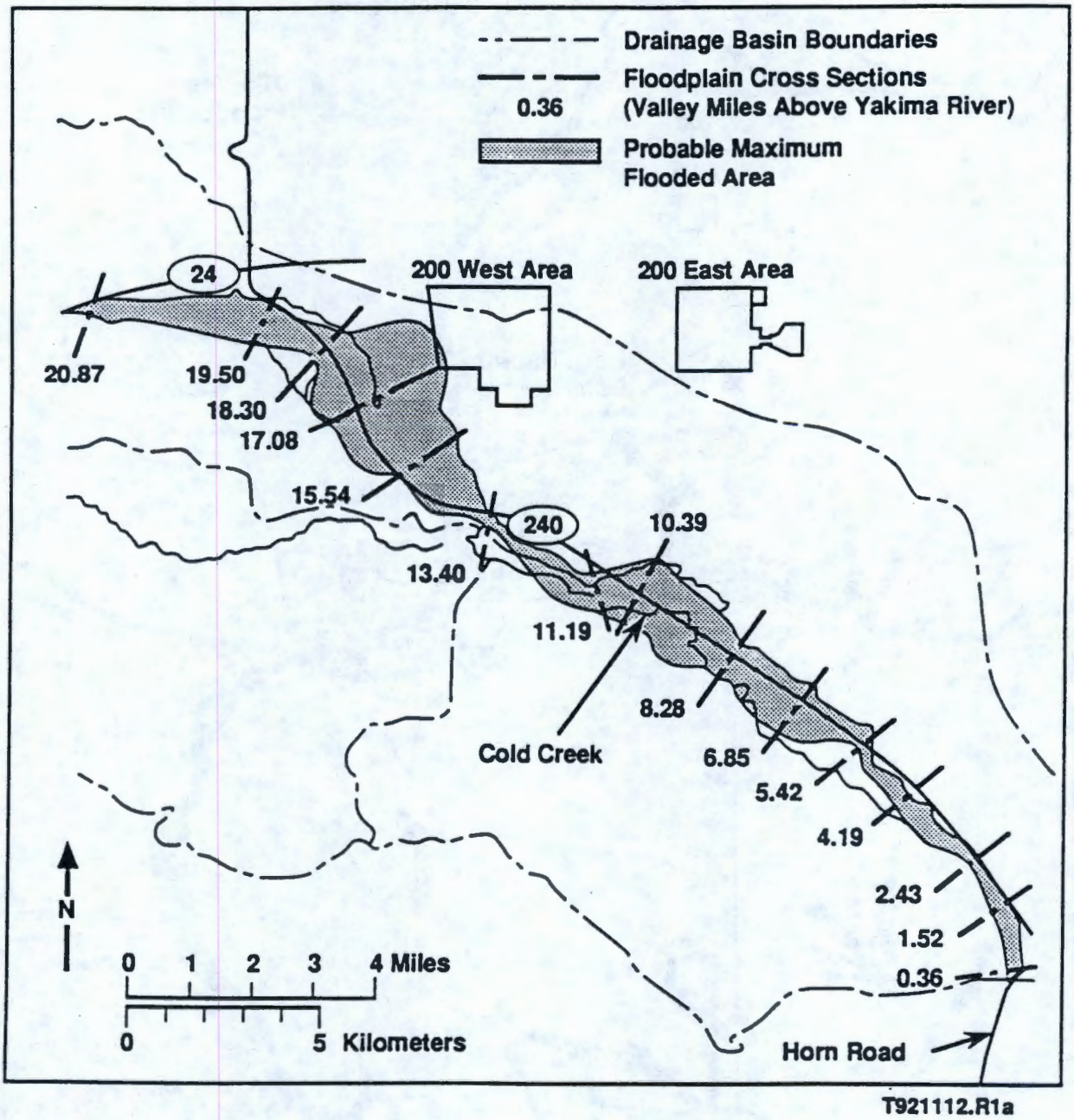

Figure A-6. Cold Creek Watershed Probable Maximum Flood

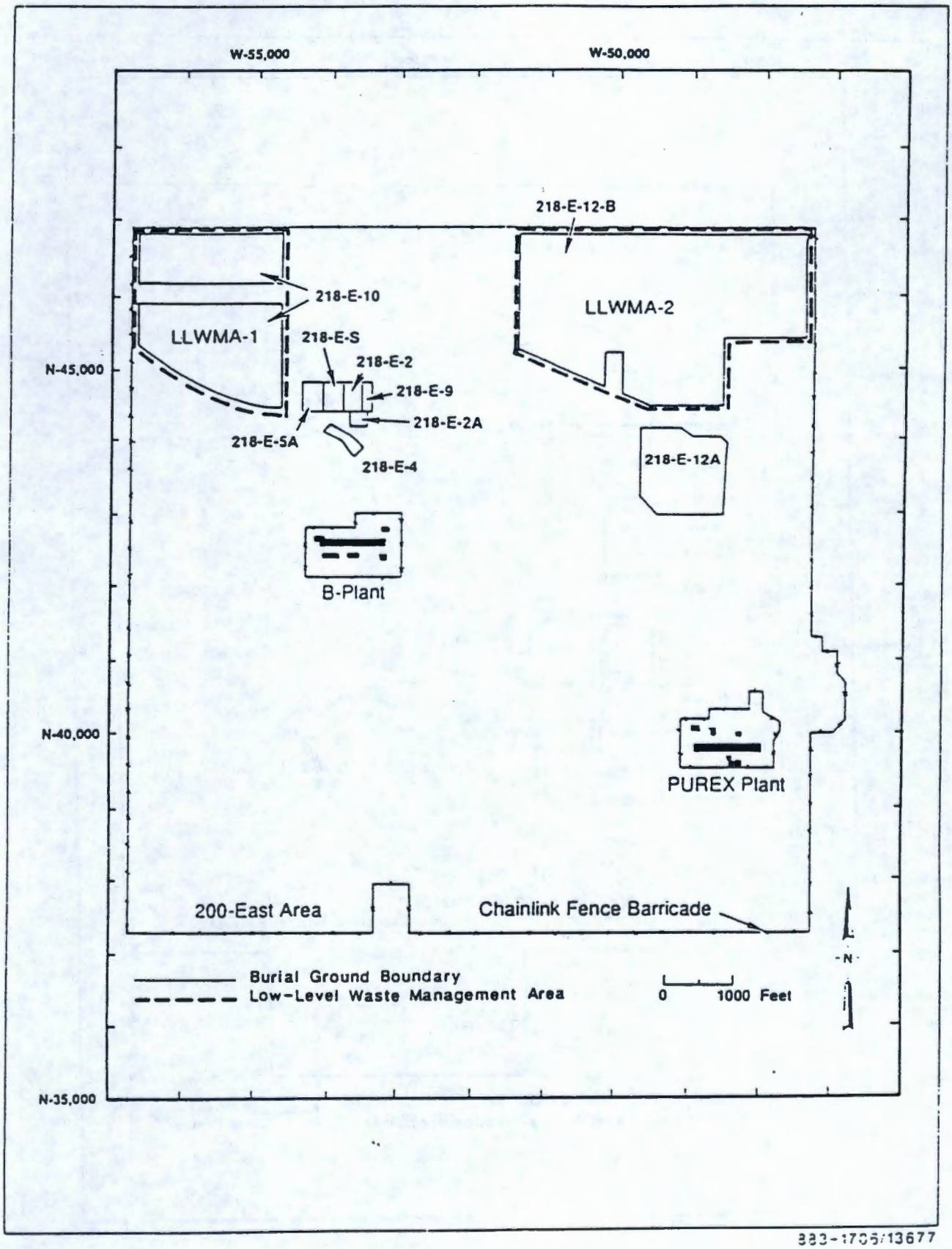

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Figure A-7. Low-Level Waste Management Area's 200 East Area

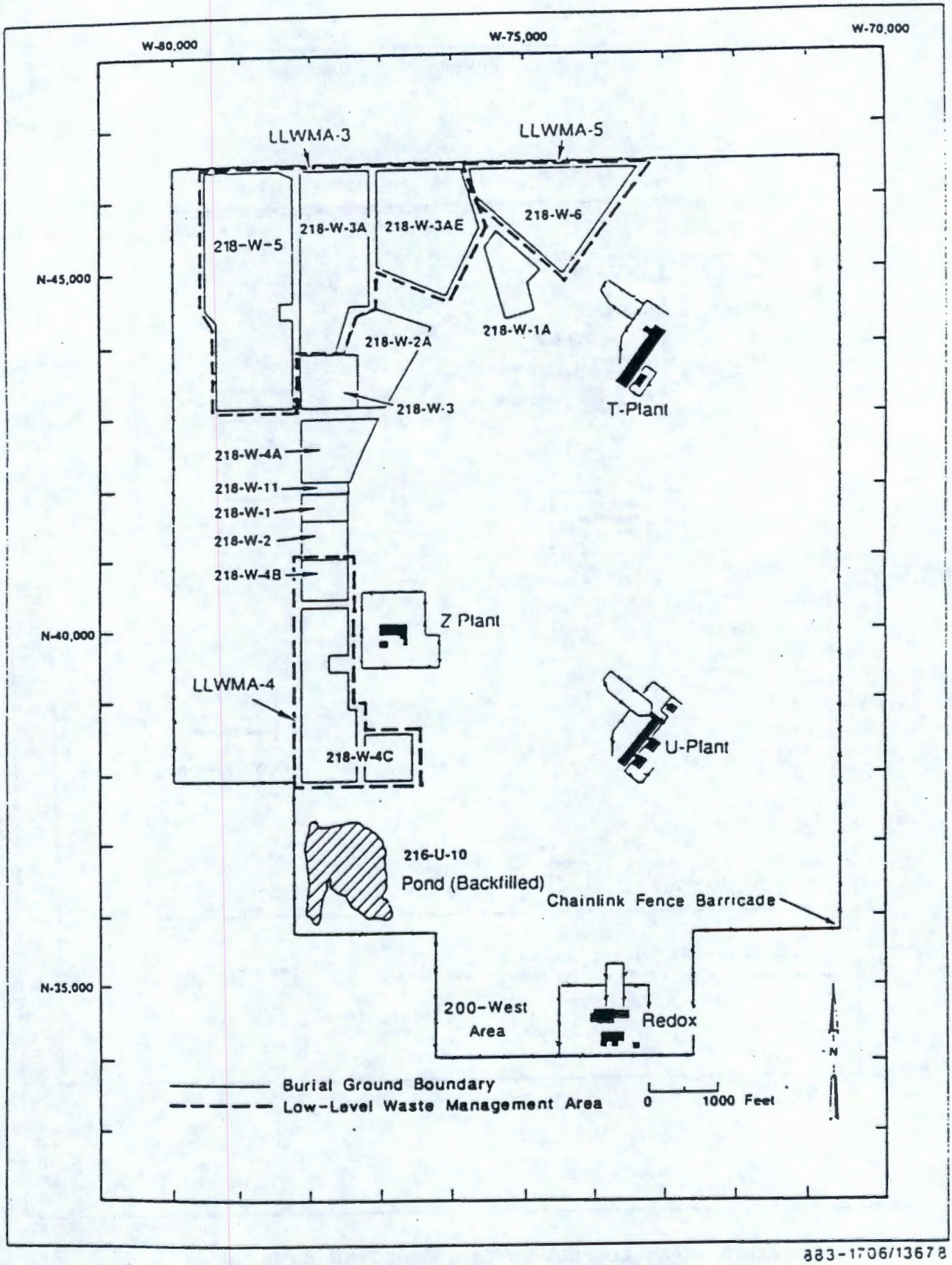


Figure A-8. Low Level Waste Management Area's 200 West Area

A.2 Operational Status

A.2.1 Current and Future Practices.

(1) General

The Hanford Site active LLBGs are classified as shallow landfill disposal facilities and cover a total area of approximately 606 hectares (1,498 acres). The landfill is divided into eight burial grounds. Each burial ground is comprised of a number of trenches or caissons. Two burial grounds are located in the 200 East Area (Figures A-9 & A-10), and six burial grounds are located in the 200 West Area (Figures A-11 through A-17). The active burial grounds are designated as follows:

200 West Area	200 East Area
218-W-3A	218-E-10
218-W-3AE	218-E-12B.
218-W-4B	
218-W-4C	
218-W-5	
218-W-6	

It is to be noted that other LLBGs shown on Figures 7 & 8 not within the LLWMAs are inactive closed facilities. Based on onsite and offsite generator forecasts, the average amount of low-level waste to be disposed of annually in the LLBG is estimated to be approximately 4,248 cu. meters (150,000 cubic feet). Mixed waste is estimated to make up 1 percent or less of the waste received by the LLBG. Based on recent generator forecasts, the total quantity of mixed waste accepted by Hanford is expected to vary from 56.6 to 141.6 cubic meters (2,000 to 5,000 cubic feet) per year into the foreseeable future. This waste will all require storage at the CWC with exception of the K-3 filters from "B" Plant which are remote handled (RH) MLLW. RL does not authorize disposal of MLLW unless it is RH and meets the requirements of a letter dated January 26, 1988 to the Washington Department of Ecology. The amount of waste received by the LLBG is highly variable and may differ significantly from year to year because of changes in the nature or level of activities on and off the Hanford Site. Waste forecasts are updated annually. As cleanup activities progress, these forecasts will change significantly.

(2) Burial Grounds Descriptions.

The burial grounds are numbered according to the standard Hanford Site facility numbering system. The system uses a three-digit code for the type of facility (i.e., 218 indicates that the facility is a 200 Area burial ground), an 'E' or 'W' indicates the location in either the 200 East Area or 200 West Area, and the final code indicates the individual burial ground. The discussion that follows is on the current active disposal facilities and includes the year

each unit began receiving waste, the waste placed in each unit, and figures showing the configuration of individual trenches within each burial ground.

Burial Ground 218-E-10.

Burial ground 218-E-10 (Figure A-9) began receiving waste in 1960 and consists of 18 trenches covering 23 Hectares (56.7 acres). Waste at this site was received from the Plutonium/Uranium Extraction Plant, B Plant, and N Reactor and includes low-level and low-level mixed waste such as failed equipment, and industrial waste. Figure A-9 shows the existing trenches in burial ground 218-E-10 and the proposed trench layout as designed for closure and post-closure requirements.

Burial Ground 218-E-12B.

Burial ground 218-E-12B (Figure A-10) began receiving wastes in 1967 and consists of 94 trenches covering 70.1 Hectares (173.1 acres). Areas are set aside for future expansion of this burial ground. Waste contained in this burial ground includes mixed waste, low-level, and transuranic waste. Figure A-10 shows the existing trenches in burial ground 218-E-12B and the proposed trench layout as designed for closure and post-closure requirements.

Burial Ground 218-W-4C.

Burial ground 218-W-4C (Figure A-11) began receiving waste in 1978 and consists of 69 trenches covering 21 Hectares (51.7 acres). Waste in this facility includes transuranic, mixed, and low-level waste. Examples of waste placed in trenches include contaminated soil, decommissioned pumps, pressure vessels and hardware, and stored RH-TRU. Some of the trenches are designed to be retrievable storage. Figure A-11 shows the existing trenches in burial ground 218-W-4C and the proposed trench layout as designed for closure and post-closure requirements..

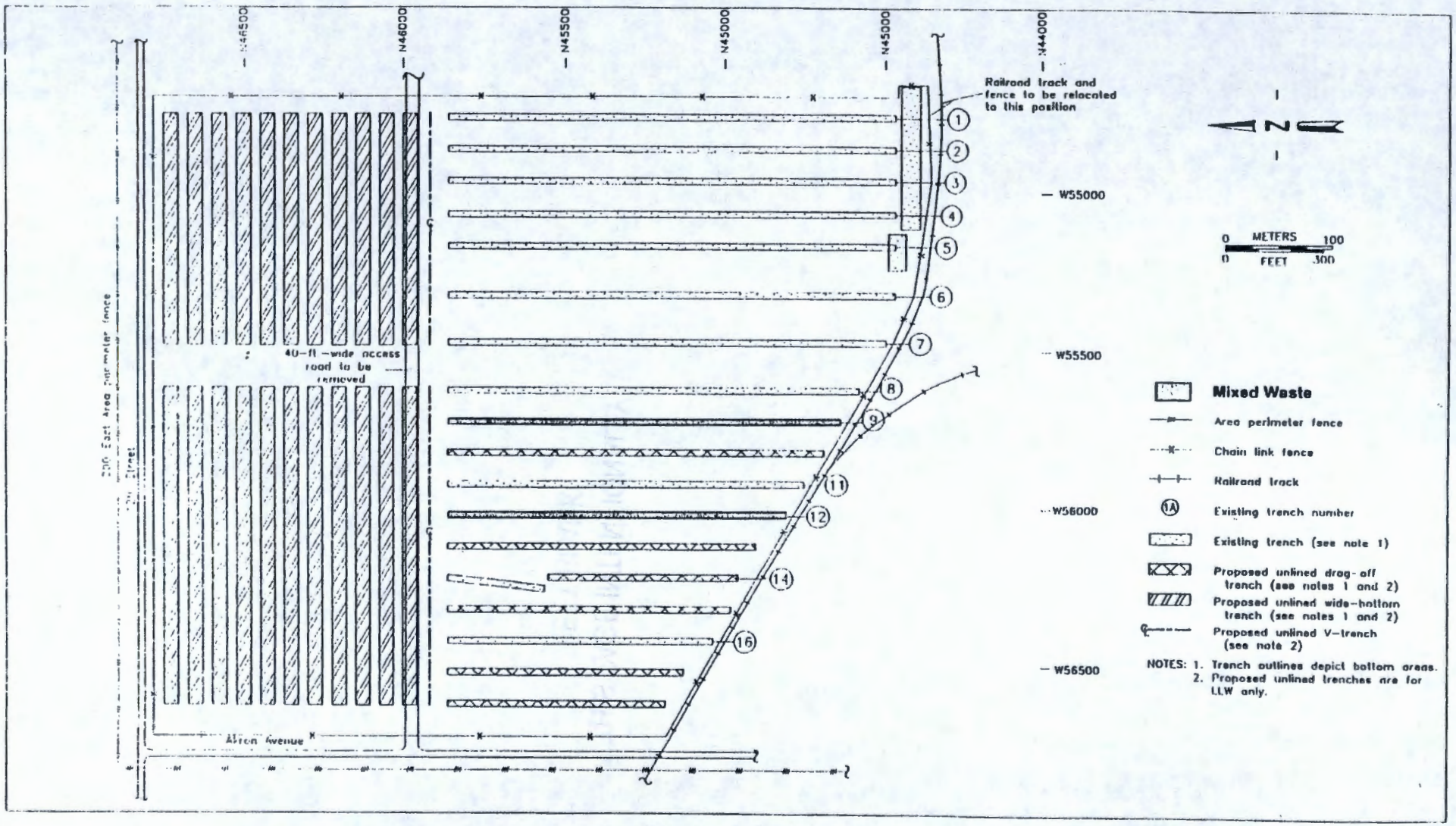
Burial Ground 218-W-4B.

Burial ground 218-W-4B (Figure A-12) began receiving waste in 1968 and consists of 13 trenches and 1 caisson area covering 3.5 Hectares (8.6 acres). The trenches contain mixed and retrievable transuranic waste and were operated before 1984. Trench 14 contains 12 caissons for remote handled alpha bearing waste and beta-gamma waste. These caissons are not currently receiving waste.

Burial Ground 218-W-5.

Burial ground 218-W-5 is 431 Hectares (1064 acres) located on the west side of the 200 West area. Figure A-13 shows 84 acres which began receiving waste in 1986. This acreage consists of 35 trenches, with eventual expansion to 57 trenches. The

Low Level Burial Ground 218-E-10



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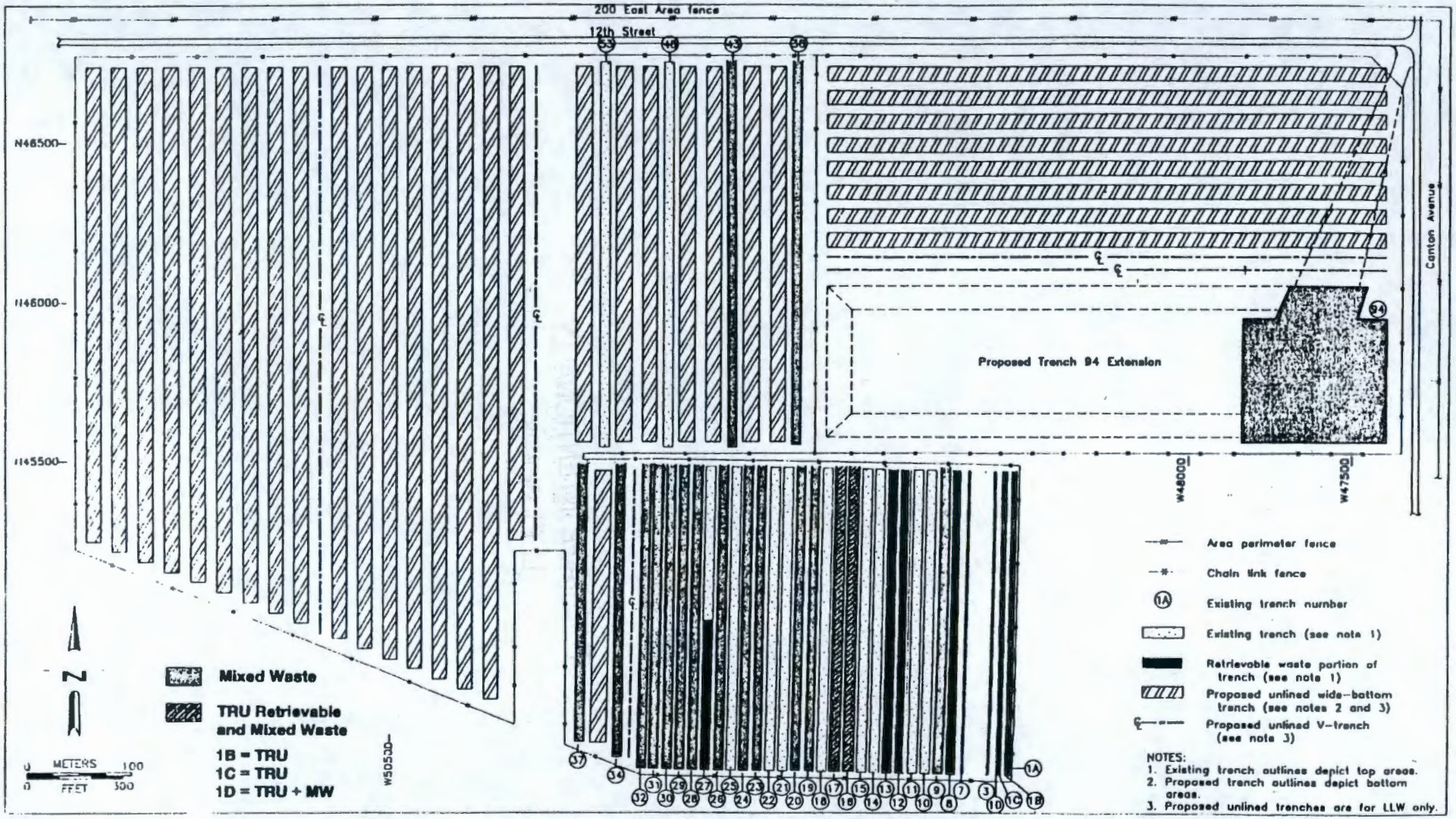
Low Level Burial Ground 218-E-12B



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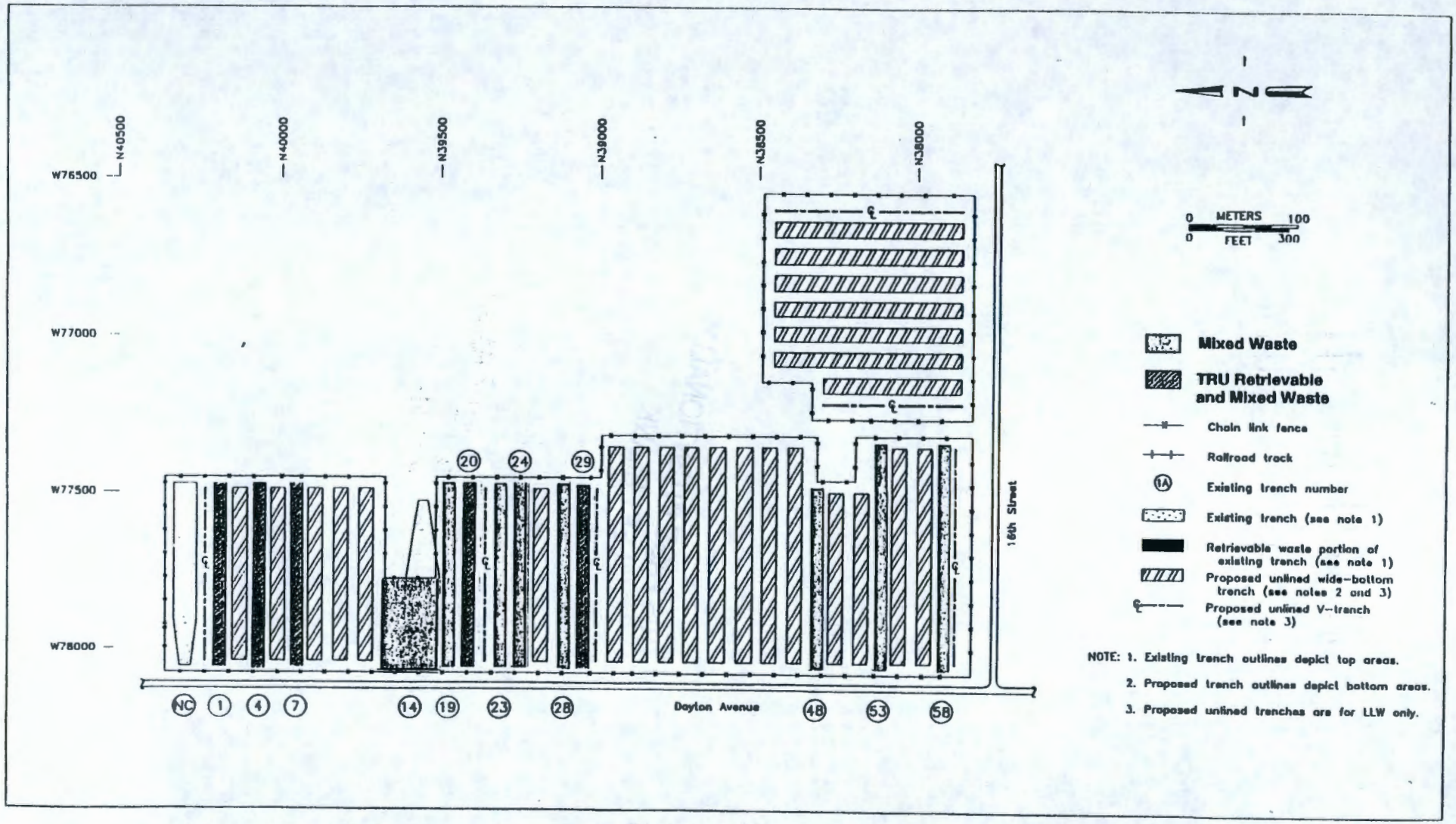
Low Level Burial Ground 218-W-4C



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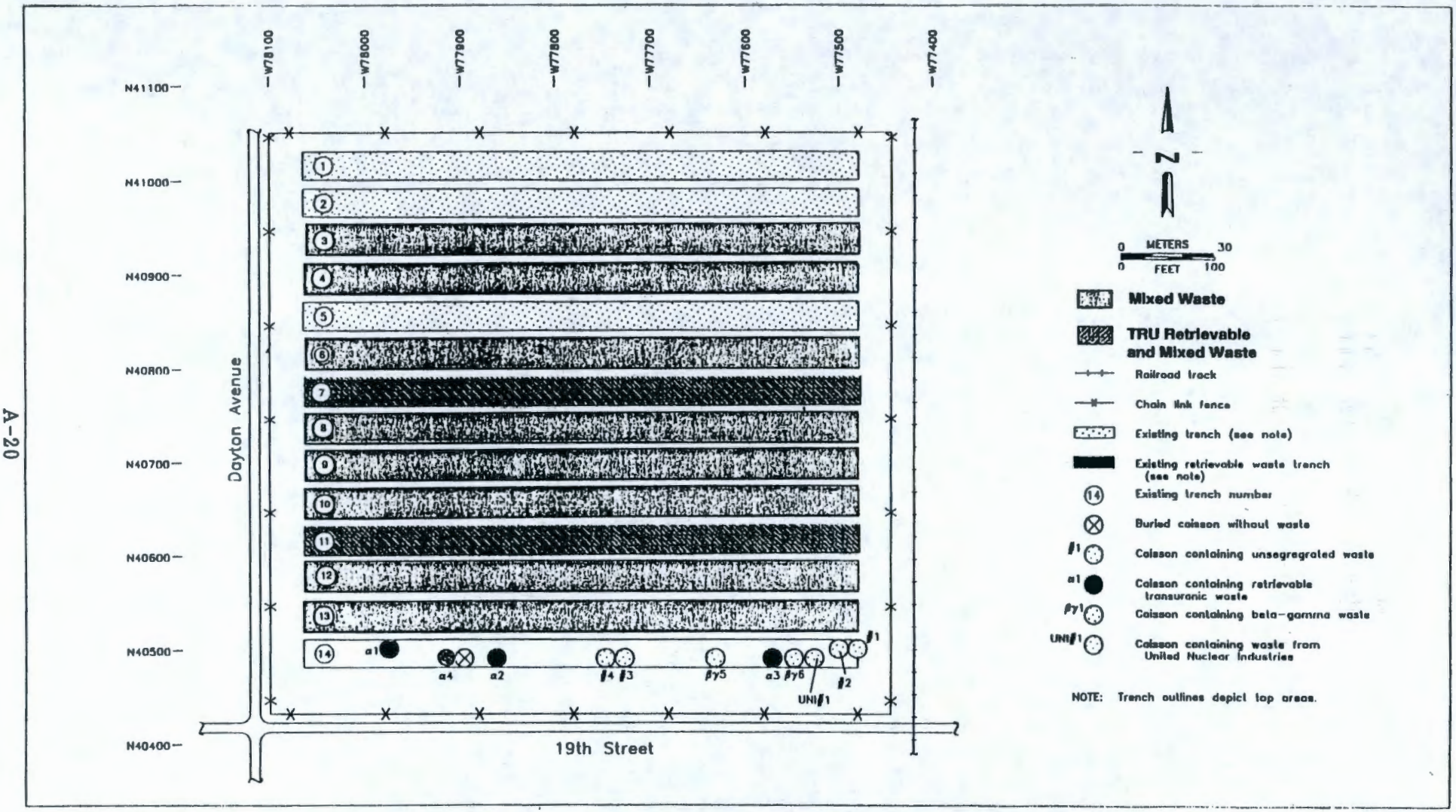
Low Level Burial Ground 218-W-4B



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Low Level Burial Ground 218-W-5

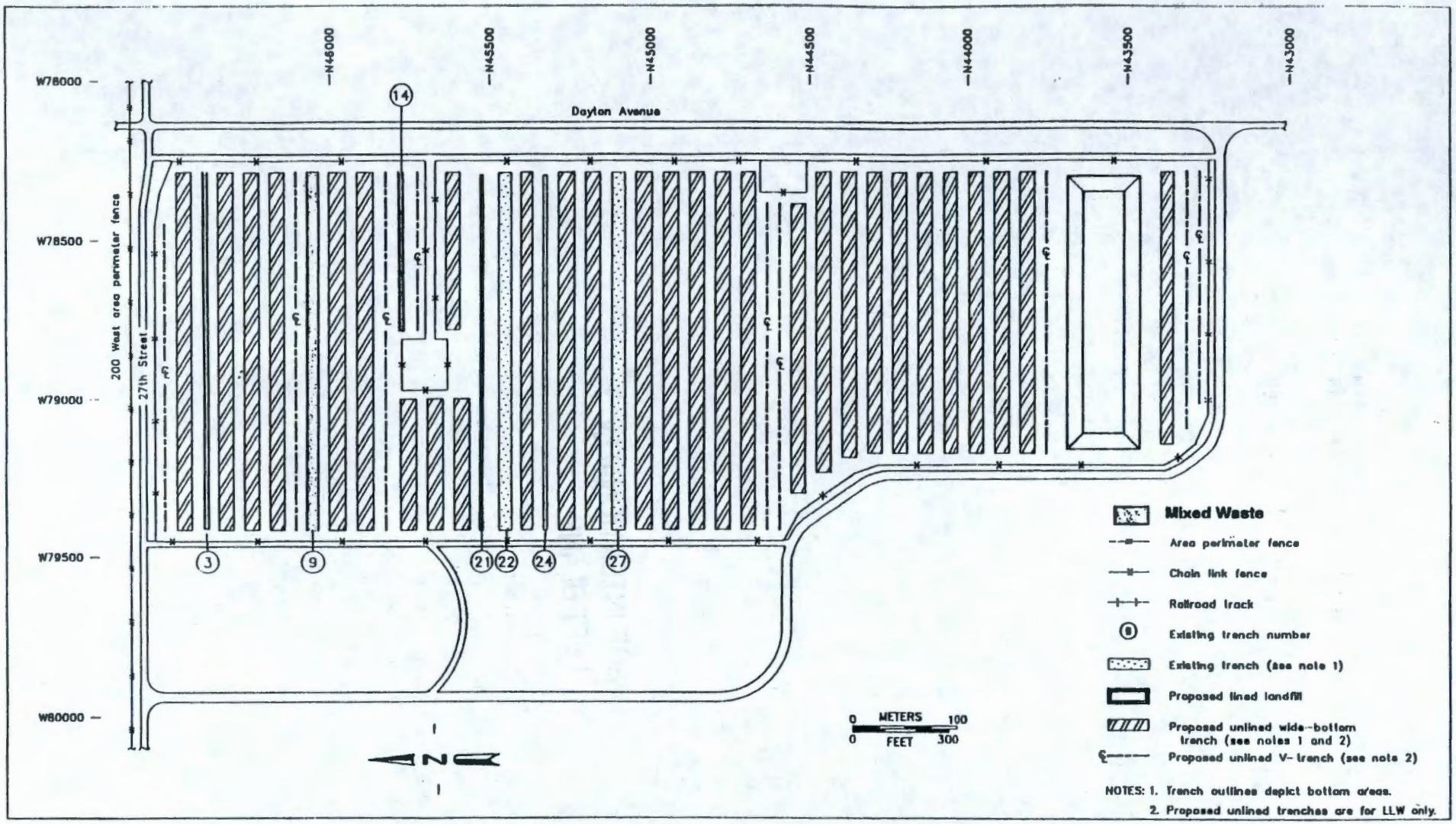

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Figure A-13

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trenches contain low-level mixed waste that includes lead bricks and shielding. Low-level waste also is placed in this landfill. Engineering study work is planned for the development of the remaining 397 Hectares (980 acres). (Figure A-14) identifies 218-W-5 area located generally west of the Central Waste Complex within in the fenced area of 200 West. This area has two distinct site characteristics. The south portion of this piece of 218-W-5 is an area which is approximately 240 Hectares (594 acres) in size. It is a deep depression with elevations varying up to 24.4 meters (80 feet) from a mean elevation at the WRAP facilities. Depending on the desired disposal configuration/method, waste form to be disposed, and regulatory requirements, preliminary calculations show that it is possible to dispose of in excess of 23 million cubic meters (30 million cubic yards) of combined daily cover and waste. The north piece of 218-W-5 is approximately 156.2 Hectares (386 acres) in size. This portion is a ridge or plateau area that varies up to 22.9 meters (75 feet) higher that the mean elevation of the WRAP facilities. There are no current volumetric estimates for waste disposal in the north area. Future planning by Decontamination and Decommissioning utilizes a portion of the 218-W-5 development area for disposal of the 100 area production reactors.

Burial Ground 218-W-3A

Burial ground 218-W-3A (Figure A-15) began receiving waste in 1970 and consists of 61 trenches covering 20.4 Hectares (50.3 acres). Waste stored or disposed of includes mixed, transuranic, low-level, and retrievable waste. Examples of waste placed in this burial ground include ion-exchange resins, industrial waste, failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, and accessories. The burial ground also stores RH-TRU.

Burial Ground 218-W-3AE.

Burial ground 218-W-3AE (Figure A-16) began receiving waste in 1981 and consists of 31 trenches covering 20 Hectares (49.4 acres). Waste in this burial ground includes low-level and mixed waste. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and industrial waste.

Burial Ground 218-W-6.

Burial ground 218-W-6 (Figure A-17) has not received any waste to date. When developed, this burial ground will consist of 35 trenches and will cover approximately 18 Hectares (44.5 acres). Figure A-17 shows the proposed trenches in burial ground 218-W-6 as designed for closure and post-closure requirements.

Burial Ground 618-12

Engineering work is in progress on Environmental Restoration Disposal Facility a solid

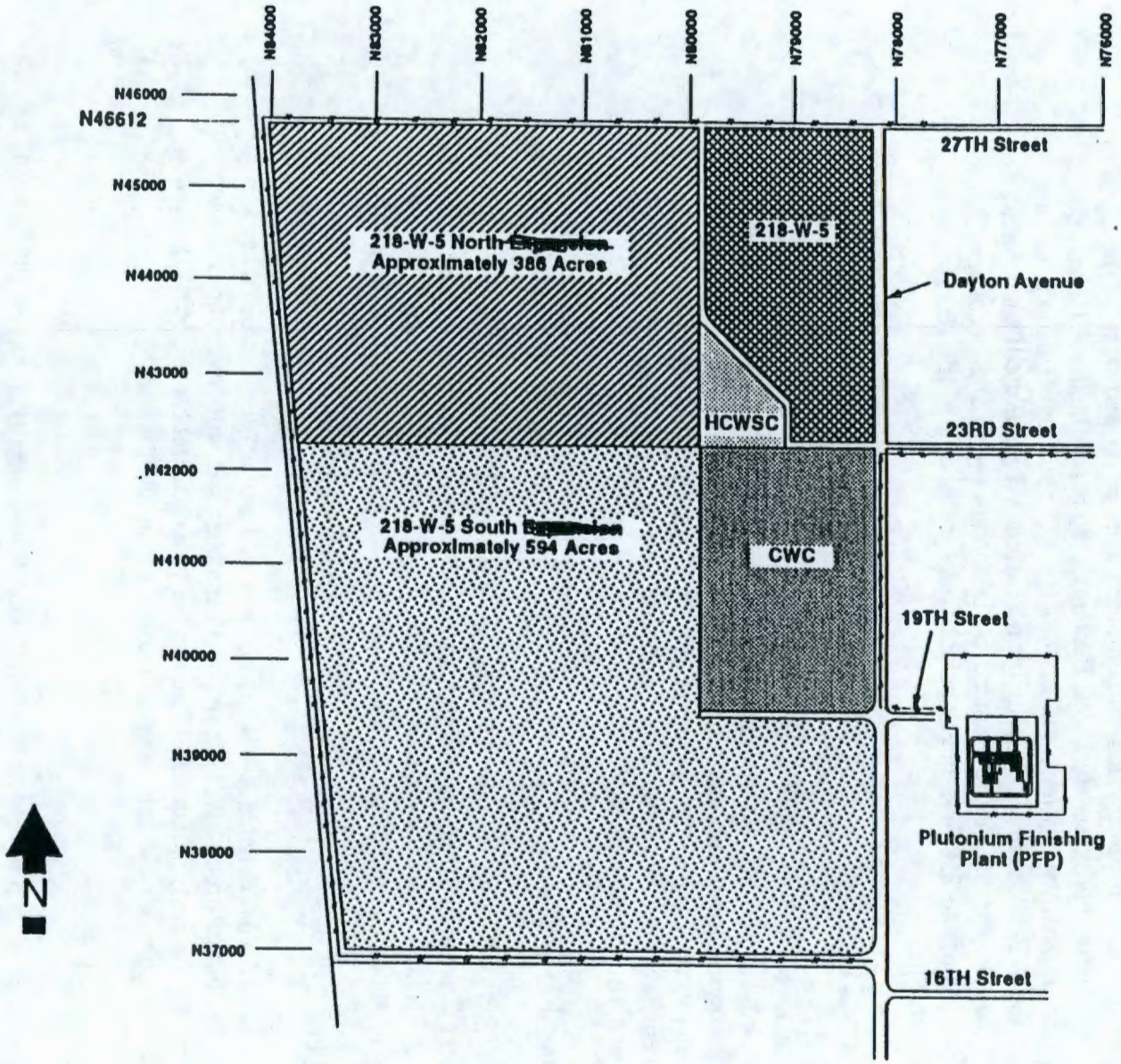

Figure A-14. Low-Level Waste Burial Ground 218-W-5

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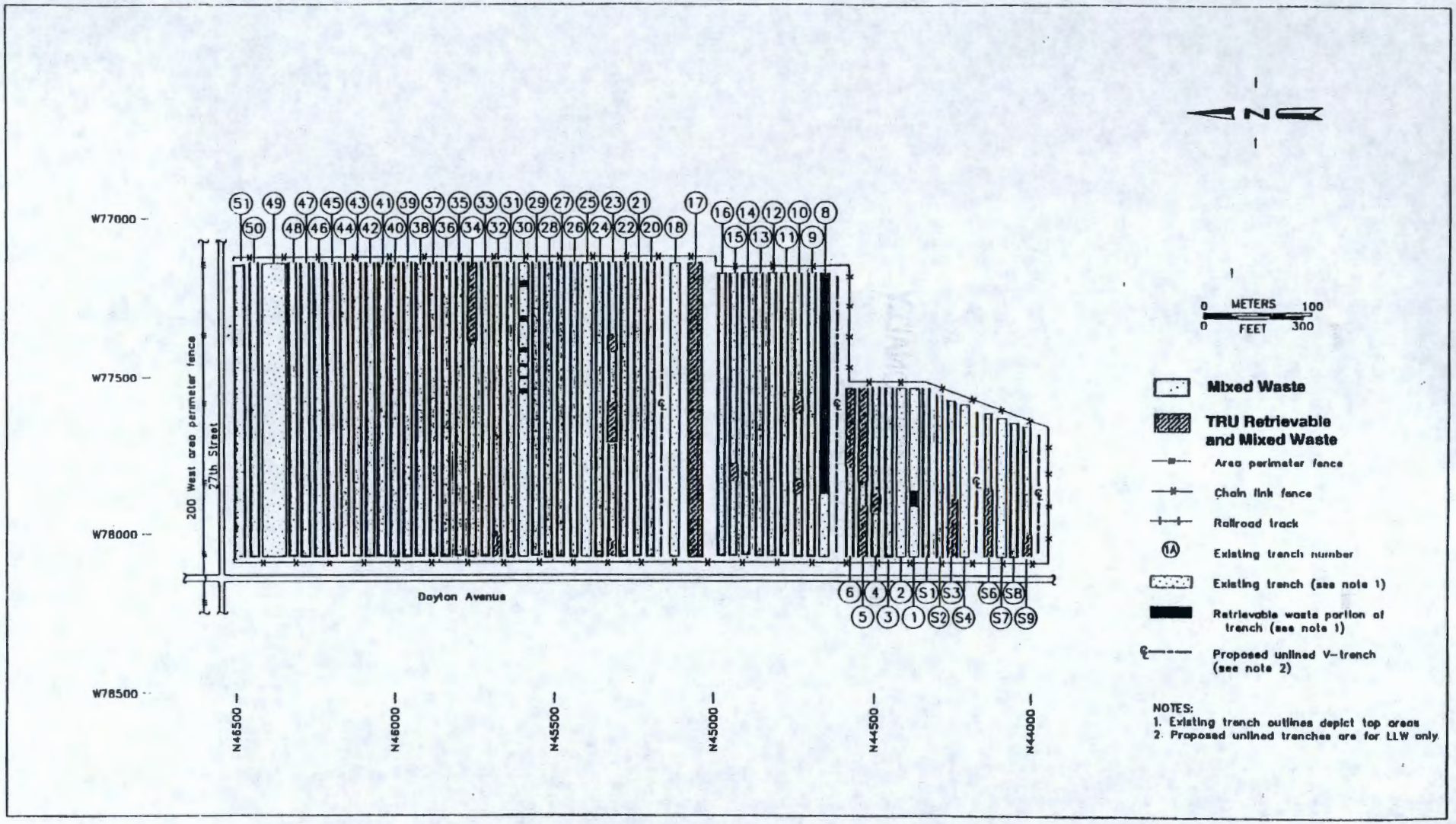
Low Level Burial Ground 218-W-3A



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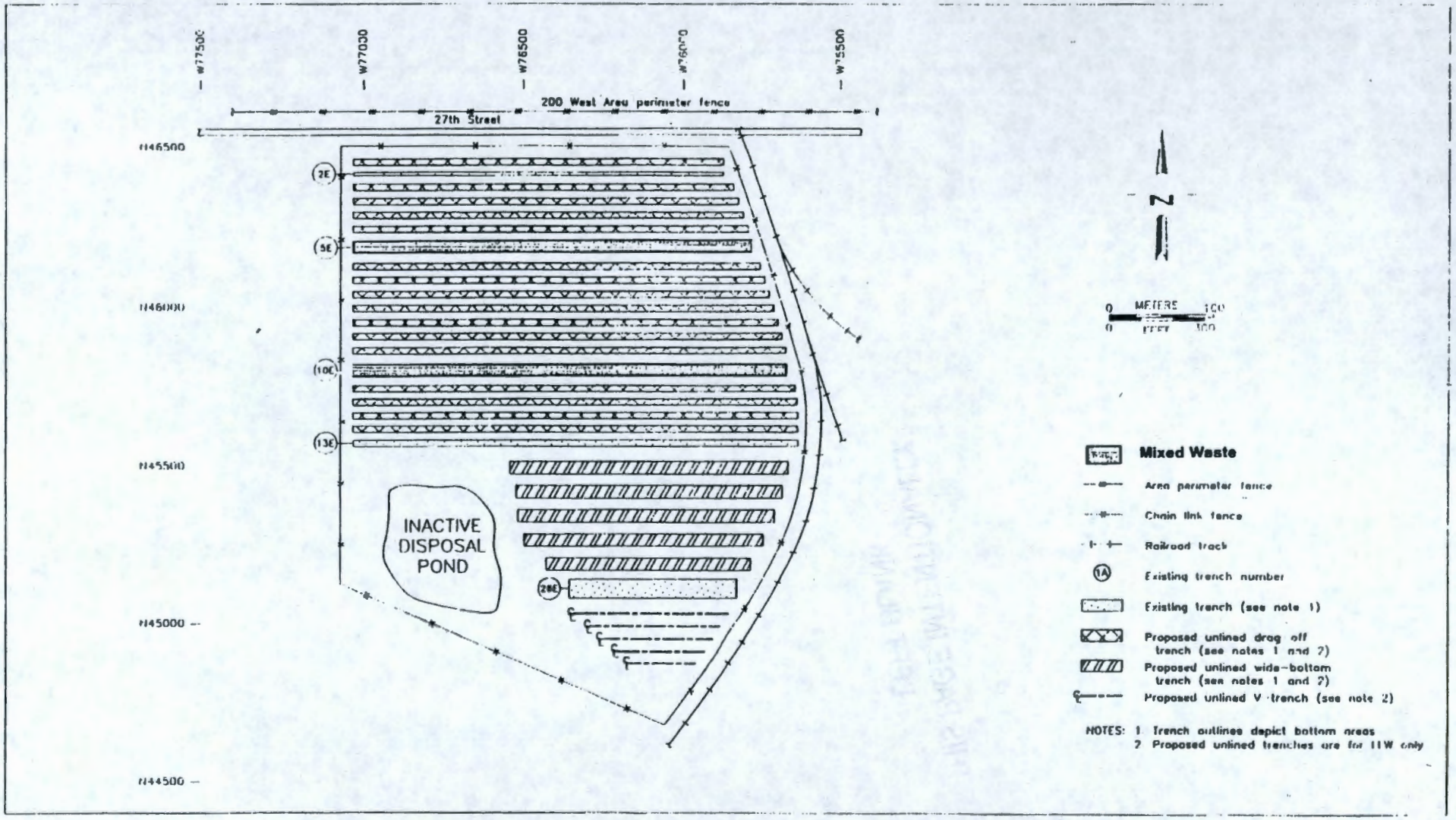
Low Level Burial Ground 218-W-3AE



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Low Level Burial Ground 218-W-6

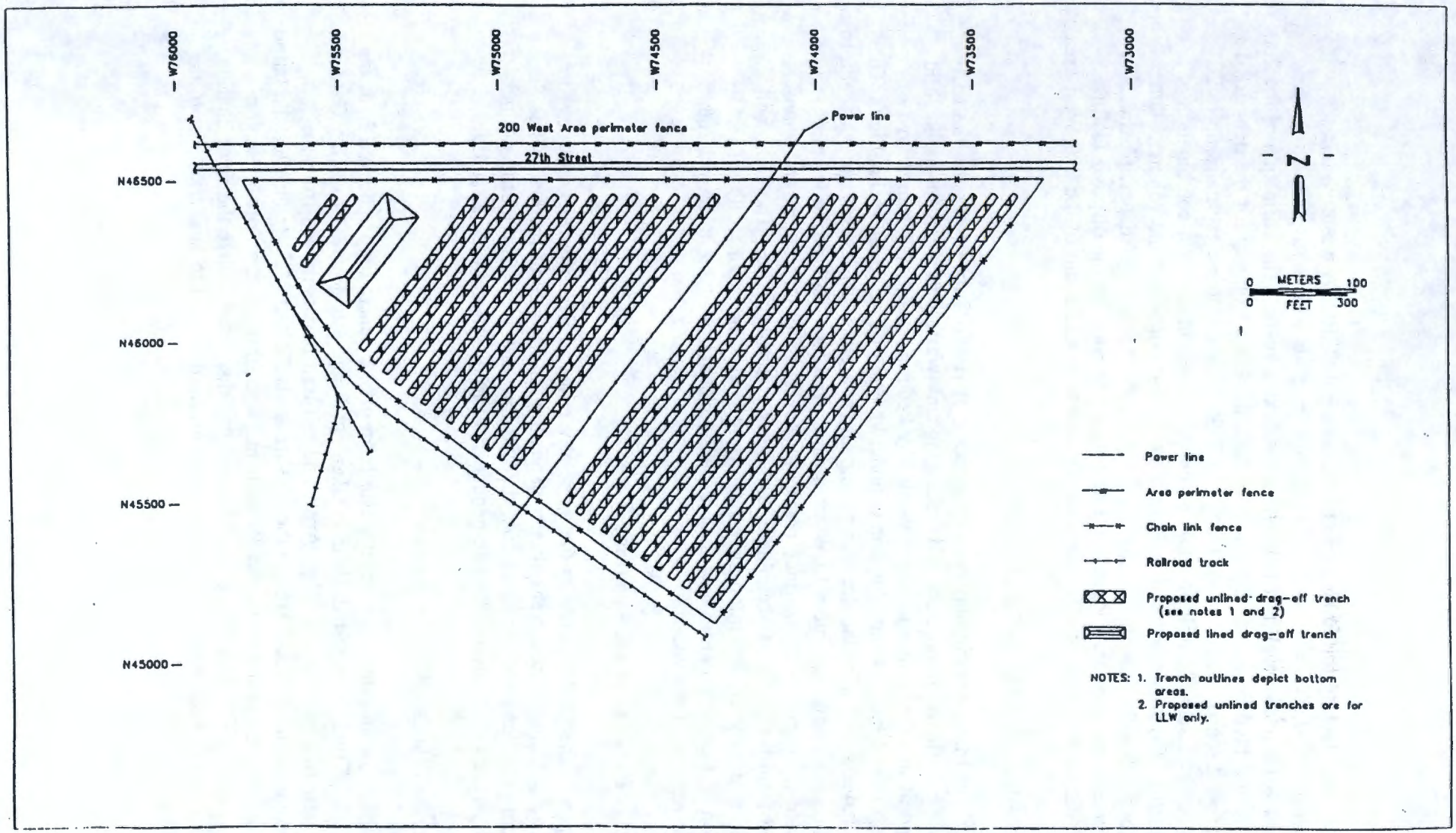

Figure A-17

waste disposal facility for Environmental Restoration CERCLA waste volumes. Approximately 50,000 cubic yards of contaminated soils will be disposed in the new 200 West MLLW disposal facilities within the next 5 years. The utilization of the 200 West disposal facilities (currently under construction) is a stop gap for the new 618-12 burial ground scheduled for waste receipt in 1996. Total volume estimates up to 20 million cubic meters (26 million cubic yards) have been made for a combination of waste forms. Contaminated soil makes up the largest portion of the volume. Other waste forms include construction debris, glass, paper, metal pipe/shapes, plastics and etc. Current activities are focused on Engineering Studies for the disposal facilities, and site characterization of a six square mile area west and south of the 200 West area.

Liquid LLW Grout/Vitrification Facilities

A Grout Treatment Facility has been constructed at Hanford for processing the LLW fraction of the liquid radioactive and hazardous tank waste into a cement-based solid for disposal in near-surface concrete vaults. A Federal Facility Agreement and Consent Order Change Control action is underway on this treatment technology. The change request embodies the decision to implement a glass low level waste form and to design, construct and operate a LLW vitrification facility. This action is being performed in concert with the three parties to the Tri Party Agreement and values received from the public, stakeholders, and other affected parties. The DOE will maintain in a stand by condition the capability to restart the grout facility if its operation is necessary before new double shell tanks are available to provide tank space to resolve safety issues.

(3) Low-Level Burial Grounds Roadways

Waste is shipped to the LLBG in trucks that generally range in size from pickup trucks to Submarine Reactor Compartment transporters, depending on the size of the load. The Site roadway system provides good access to both the 200 East and West Area burial grounds which currently receive all low-level waste generated from onsite and offsite facilities.

Offsite Waste Transport

Truck and rail transported low-level waste from offsite generators is checked in at the 1100 Area. Truck transported waste is taken out Route 4 to Route 3 to either Gate 609 or Gate 611 into the 200 West Area, and rail transport is moved from the Richland yards in the 1100 Area to the 200 areas via "B" and "C" track. Offsite barge transported waste via the Columbia River is managed through the Port of Benton facilities at the 3000 Area. Tug and barge river transporters utilize the river landing south of the 300 Area where waste containers are transitioned to land transport to the 200 Areas.

Low-Level Burial Grounds Railroad Access

Shipments are made during periods of low traffic activity on weekends, or during off-peak traffic hours. All roads that cross or parallel the railroad route are barricaded during the shipment to prevent access within 45.7 meters (150 feet) of the cargo. Train speeds are limited to 24 kilometers per hour (15 miles per hour). The maximum coupling speed is limited to 4.8 kilometers per hour (3 miles per hour). Based on evaluation of risk, rail shipment may be prohibited due to adverse weather conditions. Remote-handled hot cell waste is often transported by railroad cars from on-site facilities to the LLW burial grounds for disposal.

A.3 Waste Acceptance Criteria

A.3.1 Low-Level Burial Ground Operation.

(1) General

Before receipt of waste at the LLBG, the solid waste organization characterizes the waste and designates the waste according to DOE Order 5820.2A, the Washington Administrative Codes 173-303-070 and the *Hanford Site Solid Waste Acceptance Criteria* (WHC-EP-0063). The generator is responsible for packaging the waste according to U.S. Department of Transportation regulations for hazardous materials. The waste can be shipped by the waste generator to the LLBG by truck, or a combination of train, barge, and/or truck transport. Once the shipment is accepted from the transporter, the LLBG personnel select an appropriate landfill disposal trench or storage facility, depending on the type of radioactivity, dangerous waste designation of the contents, and waste packaging.

The waste received by the LLBG is typically packaged in wooden boxes, steel drums, concrete burial vaults, or other approved burial techniques. Mixed waste is received only in approved steel or concrete containers.

(2) Waste Generator Approval Process

Shipment of solid LLW to the Hanford solid LLW facilities shall not be made until the following have occurred: the Operating and Engineering Contractor (OEC) gains written authorization from DOE-RL, Waste Management Division to receive waste from the generator; the generator develops a LLW certification program; the generator transmits a copy of the plan to the OEC; the generator waste streams have been assessed by the OEC to be in compliance with the established Hanford Site Waste Acceptance Criteria; and the generator receives a Storage/Disposal Approval Record (SDAR) from the OEC approving receipt of the specific waste stream. DOE-RL and OEC SDAR approval maybe required on special shipments. Generators are assessed annually to ensure their waste program satisfies *Hanford Site Solid Waste Acceptance Criteria* (WHC-EP-0063).

(3) Waste Characterization

All LLW shall be characterized with sufficient accuracy to permit proper identification, minimization, segregation, transportation, treatment, storage, and disposal. This characterization shall ensure that, upon or immediately after generation and before packaging, the actual physical and chemical characteristics and radionuclide content of the waste are known and recorded for use during all subsequent stages of the waste management process.

All Waste shall be characterized with sufficient accuracy to permit proper certification, shipment, and disposal at Hanford. In addition, the type and quantities of hazardous or dangerous constituents, radionuclides present, and physical and chemical characteristics must be known and recorded on appropriate forms during all stages of the waste management process.

Radioactive waste is to be segregated into the highest category determined from the limits indicated in WHC-EP-0063. Classification is required to provide the physical, chemical, and radionuclide data to support the planning, storage, treatment, and disposal of LLW/MLLW per the regulatory requirements as identified in WHC-EP-0063.

A.4 Disposal Limitations

A.4.1 Prohibited and/or Special Requirements Materials

(1) General

In addition to specific restrictions stated in the Chapters of the Hanford Site Solid Waste Acceptance Criteria (WHC-EP-0063), the following materials are prohibited in radioactive solid waste proposed for storage or disposal at the Hanford Site facilities:

- Liquids (except as packaged in accordance with WHC-EP-0063 or as allowed by Westinghouse Hanford Solid Waste Engineering Analysis)
- Etiologic Agents or infectious wastes
- Radioactive Animal Carcasses (except as packaged in accordance with WHC-EP-0063)
- Reactive metals (prohibited from disposal only; they may be received for storage and future treatment)
- Chemically incompatible materials in any waste container
- Explosives
- Pyrophorics
- Gas cylinders that are not permanently vented
- Chelating compounds (prohibited from disposal only; they may be approved for storage and future treatment on a case-by-case basis See other considerations per WHC-EP-0063

- Unidentified, uncharacterized, or poorly characterized waste
- Waste exceeding Class C limits will not be accepted by Westinghouse Hanford from licensees of the U.S. Nuclear Regulatory Commission or Agreement States except upon specific written approval by the DOE Operations Office, Richland with concurrence of DOE Headquarters. This does not apply to waste owned by DOE but loaned to private sector organizations
- The classification of radioactive constituents is based on preliminary performance assessment. Depending upon the half-life of the constituent and it's concentration, immobilization of the radionuclide may be required prior to disposal. Therefore, long half-life radionuclide (as identified by WHC-EP-0063) will be evaluated by SWEA for disposal acceptability on a case-by-case basis
- The hazardous component of MLLW to be disposed in the LLWB will not exceed limits set forth for LDR.
- Waste packages must meet criticality limits

A.5 Disposal Capacity

A.5.1 200 East

Engineering study work is planned to optimize the total capacity for LLW disposal facilities within the 200 East Area.

A.5.2 200 West

Engineering study work is planned to determine the total capacity for LLW disposal within the 200 West Area. Engineering estimates for disposal indicate that there is 3 million cubic feet of space available for LLW in the 218-W-5, and upon the completion of construction the LLW mixed waste trench in 1995 there will a minimum of 7,646 cubic meters (270,000 cubic feet) (this volume will be increased with planned waste loading optimization) of RCRA compliant disposal space. Also as earlier stated preliminary calculations show that it is possible to dispose of in excess of 23 million cubic meters (30 million cubic yards) of combined daily cover and waste in the 218-W-5 South area (Figure A-14).

A.6 Waste Classification

Hanford solid Waste Classification is in accordance with WHC-EP-0063 Hanford Site Solid Waste Acceptance Criteria which is incompliance with DOE ORDER 5820.2A and Washington Administrative Codes, Dangerous Waste Regulations.

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APPENDIX B:

IDAHO NATIONAL ENGINEERING LABORATORY SITE, IDAHO

Site Contact:

Roger Piscitella (208) 526-1137

B.1 Environmental Conditions

B.1.1 Site Description

The Idaho National Engineering Laboratory (INEL) covers nearly 2,300 km^2 ($\sim$890 mi^2) of dry, cool desert in southeastern Idaho (Figure B-1). Most of this land is undeveloped. Local population centers are Idaho Falls 35 km (21 mi) to the east, Pocatello 71 km (44 mi) to the south, and Arco 11 km (7 mi) to the west. The INEL was established in 1949 to conduct research and development on nuclear reactors and related equipment; since that time 52 reactors have been built on-site and 12 are still operating or operable.

The INEL is a multiprogram laboratory whose primary mission is to provide the nation with innovative nuclear technologies and with unique scientific and engineering capabilities in nonnuclear programs that provide commercialization potential or enhance the quality of the environment. Areas of primary emphasis include nuclear reactor technology research and development, waste management and environmental restoration, advanced energy production and utilization technology development, defense-related support, safety and health, technology transfer, education, and nonnuclear research and development projects.

The INEL site is nearly 63 km (39 mi) long from north to south (extreme latitudes are 43° 26' and 44° 01' N) and about 58 km (36 mi) long at its broadest southern portion (extreme longitudes are 112° 28' and 113° 09' W).

B.1.2 Radioactive Waste Management Complex (RWMC)

The RWMC is located in the southwest portion of the INEL. It was established in 1952 as a disposal site for solid, low-level radioactive and/or mixed waste generated by INEL operations. Its current mission is to provide waste management for the present and future needs of the INEL and to retrieve, examine, and certify stored transuranic (TRU) waste for ultimate shipment to the DOE Waste Isolation Pilot Plant in Carlsbad, New Mexico.

The RWMC encompasses 58 ha (144 acres) and consists of two main disposal and storage areas: the TRU Storage Area and the Subsurface Disposal Area (SDA). Within these areas are smaller, specialized disposal and storage areas (Figure B-2).

Solid radioactive waste generated from national defense and research programs is stored or buried at the RWMC. The facility currently receives solid radioactive low-level waste (LLW) from INEL generators for disposal at the SDA.

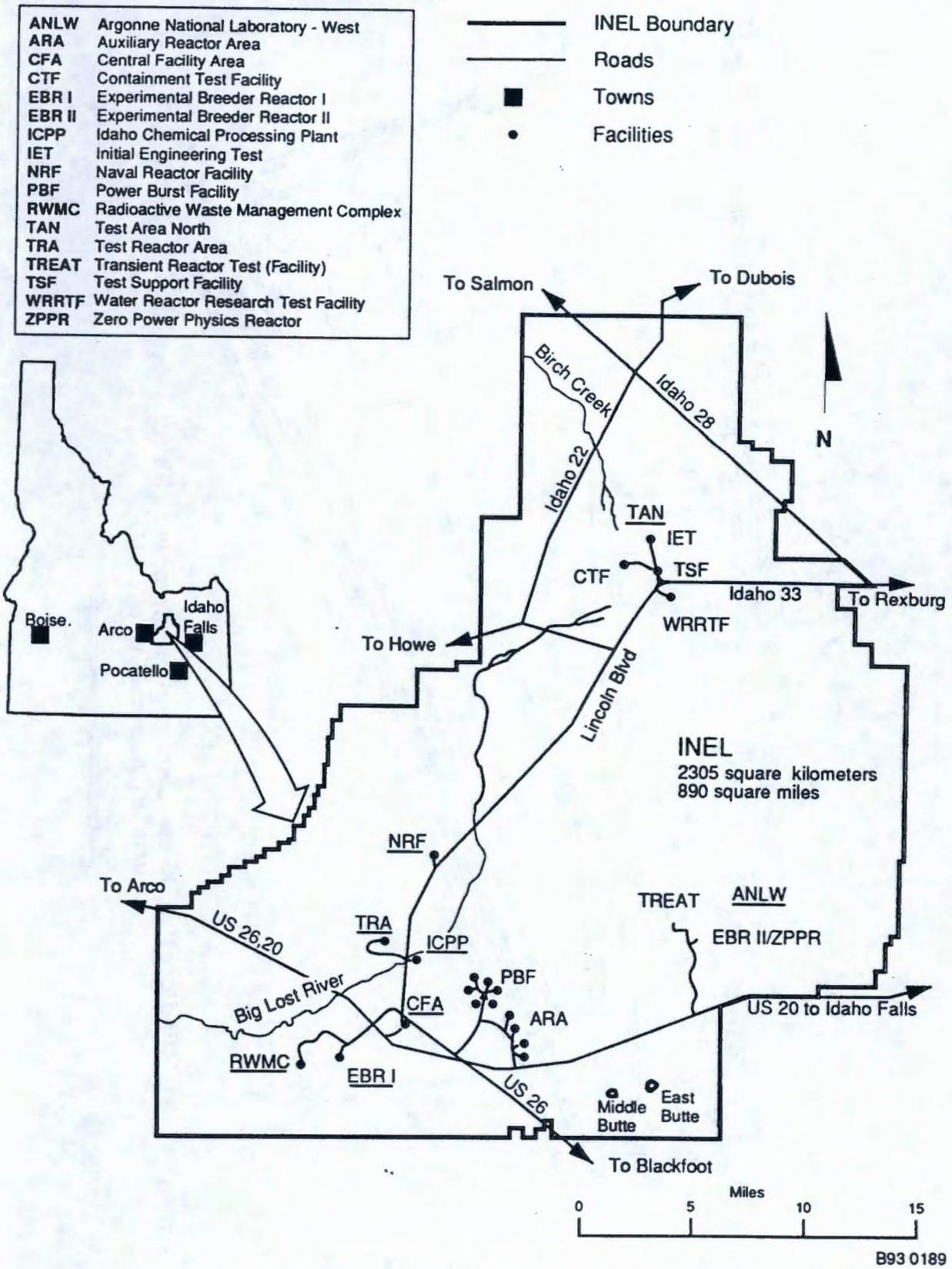

Figure B-1. Map of the INEL Showing the Location of the RWMC

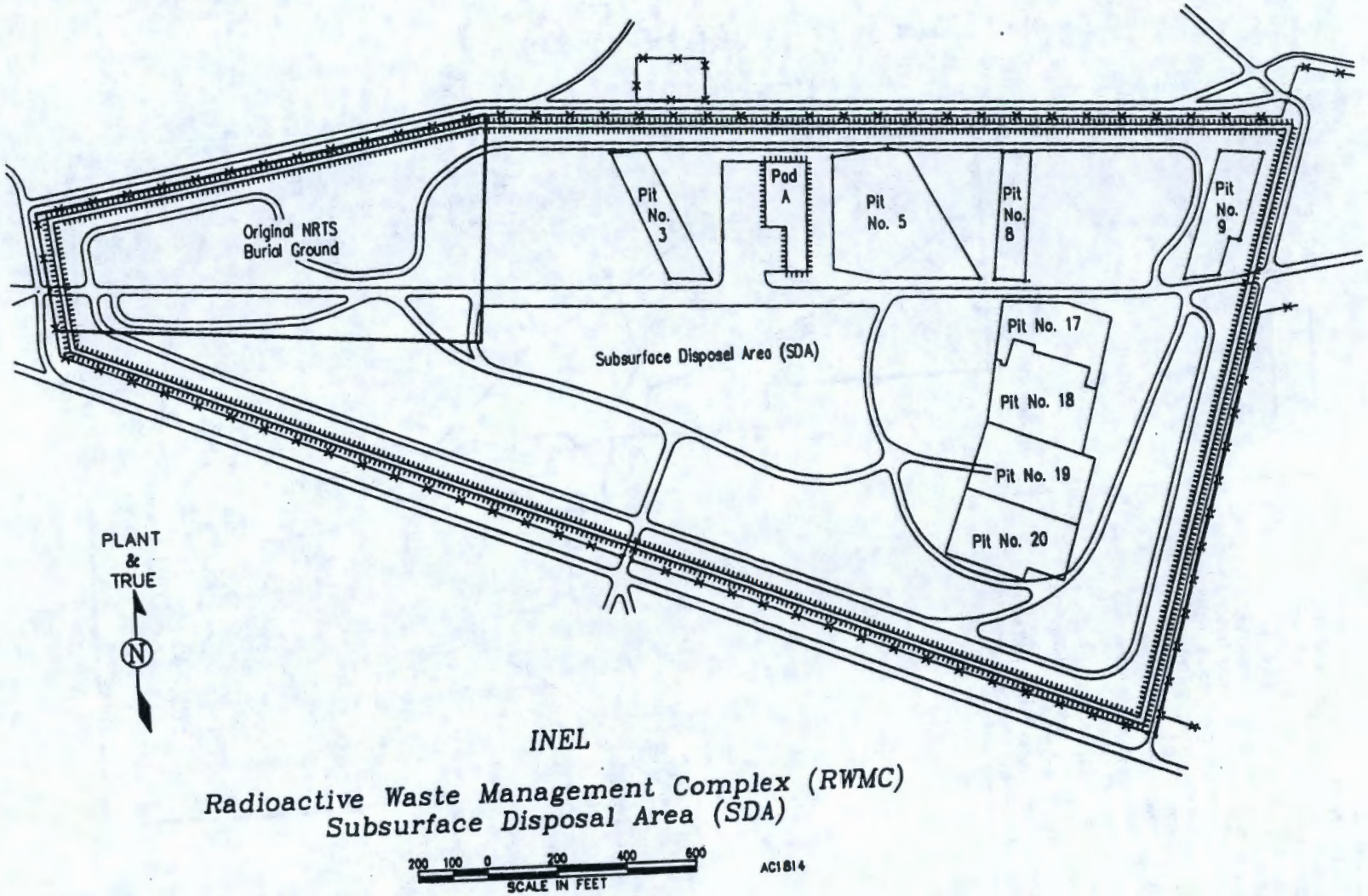

Figure B-2. Plot Plan of SDA

LLW refers to waste that contains radioactivity and is not classified as high-level waste, TRU, spent nuclear fuel, or by-product material as defined by DOE Order 5820.2A. This waste generally has low radiation levels, normally around 20 mrem/h or less at 3 feet from the container surface, with an upper limit of 500 mrem/h. LLW primarily consists of protective clothing, paper, rags, packing material, glassware, tubing, and other general use items.

B.1.3 Topography

The Snake River Plain was formed by the interbedding of volcanic strata with lake and stream deposits. The principal surface materials are basalt, lacustrine and alluvial sediments, slope wash sediments and loess, silicic volcanic rocks, and sedimentary rocks. Geologically recent volcanic activity is evidenced by the presence of numerous lava domes, flows, and cones. Long deep valleys, oriented northwest-southeast, drain onto the plain. The entire plain is surrounded by mountains that rise up to 3,400 m (11,000 ft) above sea level (ASL) (Bonney, 1991).

The INEL is located along the northern edge of the Eastern Snake River Plain, lying at the southern extremity of the Lost River, Lemhi, and Beaverhead mountain ranges. The region is generally flat with a broad volcanic ridge extending from the Craters of the Moon National Monument northeast to the Mud Lake area, crossing the eastern portion of INEL. This broad ridge separates the topographically enclosed Pioneer Basin from the Snake River drainage to the south. Most of the Site lies within the Pioneer Basin. Two rhyolite domes, located in the southwest corner of the Site, rise to 1,949 m (6,394 ft) and 2,013 m (6,605 ft) ASL. A few miles south of the INEL boundary lies Big Southern Butte, another dome with an elevation of 2,310 m (7,576 ft) ASL (Bonney, 1991).

B.1.4 Geology

The Eastern Snake River Plain truncates basin and range structures on the northwest and southeast with approximately 1,200 to 1,400 m (4,000 to 4,600 ft) of relief between the ranges and the relatively flat plain. The Eastern Snake River Plain contains a substantial volume of silicic and basaltic volcanic rocks with relatively minor sediment, except along its margins where drainages emerge from the neighboring highlands (Leeman, 1982). The basalts have displaced the Snake River southward to its present course (Walker, 1964). Although basalt covers three-quarters of the INEL's surface, rhyolite and ash flow tuffs beneath the basalt are more voluminous.

Little Lost River and Birch Creek descend southeast to the plain in broad valleys floored with alluvium and the Big Lost River, which enters the INEL from the west, also descends on a broad alluvial-filled valley. The valleys trend northwest following the folding and faulting in the mountains. Faults showing late movement at the bases of the mountains are common.

The surface of much of the Eastern Snake River Plain is covered by waterborne and windborne soils derived primarily from Cenozoic volcanic and Paleozoic sedimentary rocks from the surrounding mountain ranges (Lost River, Lemhi, and Beaverhead). Underlying the plain are layers of interbedded volcanic and sedimentary rocks, principally basaltic lava with interbeds of sedimentary materials.

B.1.5 Hydrology

Surface water at the INEL comes from streams draining through intermountain valleys to the west and north, localized snowmelt, and rain. Streams entering the INEL include the Big Lost and Little Lost rivers and Birch Creek. Flows from the Little Lost River and Birch Creek are diverted for irrigation before reaching the INEL. Thus, during dry years, water from those streams does not reach the INEL. These three drainages terminate in four playas in the north-central part of the Site. The INEL is not crossed by any perennial streams. All surface outflows are a result of localized runoff.

Except for evaporation, all water on the INEL in the Snake River Plain is recharged to the ground. Water infiltrates from the Big Lost River to the perched groundwater beneath the river and into the Snake River Plain Aquifer. This infiltration has been significant during wet years. At various locations within the INEL there are zones of perched water, the exact extent and volume of which are unknown.

The Snake River Plain Aquifer appears to be a continuous body of groundwater that underlies nearly all of the Eastern Snake River Plain. Approximately 320 km (200 mi) long and 48 to 97 km (30 to 60 mi) wide, it comprises an area of about 25,000 km^2 (9600 mi^2). The depth to the aquifer at the INEL varies from 61 m (200 ft) in the northeast corner to 270 m (900 ft) in the southwest corner. Most of the permeable zones in the aquifer occur along the upper and lower edges of the basaltic flows.

Groundwater in the aquifer flows generally southwest. Average and peak flow rates in the aquifer are difficult to assess. Tracer studies at the INEL indicate natural flow rates of 1.5 to 6.1 m (5 to 20 ft) per day, with an average near 3 m (10 ft) per day. However, these locally measured rates are not necessarily representative of flow rates throughout the aquifer (Robertson et al., 1974).

B.1.6 Climatology

The climate of the INEL is semiarid, with sagebrush-steppe characteristics. The topographic features that affect local weather patterns are the northeast-southwest orientation of the plain and the mountain ranges to the north and west. Air masses entering the Snake River Plain must first cross mountain barriers, where much of the air moisture is precipitated. Thus, annual rainfall at the INEL is light.

Meteorological and climatological data summarized in this subsection are from a monitoring program conducted by the National Oceanic and Atmospheric Administration. Temperature, wind, precipitation, evaporation, and relative humidity measured at locations near the RWMC are included.

Temperature. During the 1950-1978 period of record, the extremes of temperatures at the INEL have varied from -42°C (-43°F) in January to 39°C (102°F) in July. During winter, the average temperature varies from -16 to 13°C (3 to 27°F). For summer, the average temperature varies from 10 to 31°C (50 to 87°F).

Precipitation. The average annual precipitation at the INEL is 22 cm (8.5 in.). The maximum monthly precipitation occurs during May and June, and the minimum during July. There have been 13 occasions from 1950 through 1982 when 2.5 cm (1 in.) of rain or more fell in a 24-hour period at the Central Facilities Area.

Relative Humidity. The relative humidity at the INEL ranges from a monthly average minimum of 15% in August to a monthly average maximum of 89% in February and December. On a daily basis, humidity reaches a maximum just before sunrise, at the time of the lowest temperature, and a minimum late in the afternoon, near the time of the highest temperature.

Wind. The INEL is in a belt of prevailing westerly winds that are normally channeled within the Eastern Snake River Plain. This channeling usually produces a west-southwest or southwest wind at the Site, which at times can be very strong. The greatest frequency of wind is in the spring (Clawson et al., 1989). During the summer months, a sharp reversal in wind direction can occur. Winds flowing from the southwest predominate during daylight hours, and northwesterly winds persist at night. The reversal normally occurs a few hours after sunrise and again shortly after sunset.

The record of average wind speed shows a minimum of 8 kph (5 mph) in December and a maximum of 14.5 kph (9 mph) in April and May. The highest wind speed, based on the maximum hourly average, is 82 kph (51 mph) measured at approximately the 6-m (20-ft) level from the west-southwest. Calm conditions prevail 11% of the time (Bonney, 1991).

Evaporation. While extensive evaporation data has not been collected on the INEL, information is available from the nearby communities of Aberdeen and Kimberly in southeastern Idaho. This information is representative of INEL and indicates that the average annual evaporation rate is about 91 cm (36 in.). Approximately 80% of evaporation occurs during May through October (Clawson et al., 1989).

B.1.7 Land Use

Approximately 95% of INEL land was withdrawn from the public domain. Existing facilities

on the INEL are widely spaced for increased safety and occupy a very small percentage of the available land. Although the INEL is committed to energy research and development, it was designated a National Environmental Research Park in 1975.

Approximately 131,207 ha (325,000 acres) of the INEL are open to controlled grazing by cattle or sheep. Those grazing areas are mutually agreed on by the DOE and the Department of the Interior, and grazing permits are administered through the Bureau of Land Management. Grazing is prohibited within 3 km (2 mi) of any nuclear facility, and no dairy cows are allowed. Because cattle occasionally wander to the edge of the RWMC, waste storage and disposal areas are fenced to exclude them.

Other uses of the land are limited because of the climate, lava flows, and general desert-like soil characteristics. The only lands suitable for farming are near the end of the Big and Little Lost Rivers, near the town of Howe, and to a distance 13 km (8 mi) southeast from Howe. Arable land (with moderate irrigation) is present on both sides of the Big Lost River and between Mud Lake and Howe.

The remainder of the INEL, approximately 65% of the surface area, has a low water-holding capacity, is rocky or covered with basalt, or is classified as having moderate-to-severe limitations for agricultural irrigation.

The Office of Budget and Policy Planning, State of Idaho, indicated that the State does not have plans or policies specifically related to land use either adjacent to, or within the boundaries of, the INEL. The East-Central Idaho Planning and Development Association is a regional economic planning agency serving a nine-county region, most of which encompasses the INEL. Like the State of Idaho, the Association does not have any policies or plans that involve lands or activities near the INEL. Butte County, which encompasses most of the INEL land, is sparsely populated and does not have a policy plan, comprehensive plan, or zoning ordinance specifically related to land use.

B.1.8 Demography

The town nearest to the INEL is Atomic City, which is less than 1.5 km (1 mi) from the southern boundary and has about 25 residents. Arco, 11 km (7 mi) to the west, is the largest boundary community with 1,016 residents. The largest population centers near the INEL are: Blackfoot with 9,646 residents, 37 km (23 mi) to the southeast; Idaho Falls with 43,929 residents, 35 km (21 mi) to the east; and Pocatello with 46,027 residents, 71 km (44 mi) to the south. Overall, approximately 121,000 people reside within an 80-km (50-mi) radius of the INEL's operational center.

B.2 Low-Level Waste Disposal Facilities

B.2.1 Waste Acceptance Criteria

The requirements pertaining to the treatment and disposal of LLW are specified in the INEL Low-Level Radioactive Waste Acceptance Criteria, DOE/ID-10112. These criteria are applicable to the Waste Experimental Reduction Facility (WERF) that treats LLW (incineration, compaction, sizing, etc.,) for disposal at the RWMC and LLW received by the RWMC.

Revision 5 of these requirements has been recently approved by DOE-ID and issued the week of September 13, 1993. These criteria implement the requirements of DOE Order 5820.2A Chapter III and are also consistent with applicable Environmental Protection Agency and Nuclear Regulatory Commission (NRC) requirements.

DOE/ID-10112 prescribes detailed requirements for the waste characterization program which includes the waste characterization report content and format, all specific constituents of concern that require definition, and a verification listing of prohibited materials. A waste certification form, for signature by the designated waste generator manager, is included in this criteria.

Periodic audits of the generating facility by the receiving facility (RWMC) are required by these criteria. In addition, as part of this audit program, waste receiving facilities perform representative sampling of received waste packages. Included in the sampling activities are waste package radiography, gamma spectroscopy analysis, head-gas sampling, radiological measurements, gross weight assessment, physical inspection, and intrusive inspection. However, the major element confirming compliance with these criteria is the generator certification program.

In addition to the prohibited materials defined in DOE Order 5820.2A and 10 CFR 61, these criteria include many facility-specific requirements and other related regulatory criteria such as details for packaging, minimization of void spaces, marking and labeling, requirements for special wastes, and other specific waste management administrative requirements.

A major element of the Waste Acceptance Criteria, DOE/ID-10112, is the implementation of the waste characterization program described under the Waste Certification Program. This characterization program provides specific requirements to identify, analyze, and record all necessary data to characterize each waste stream. In addition, the procedure for analysis and definition of all waste stream constituents of concern is defined in the characterization program. Figure B-3 provides a waste categorization and waste acceptance criteria selection flow chart that identifies how INEL waste is categorized. The flow chart includes other waste category acceptance criteria as well as LLW.

B.2.2 Operational Status

The LLW operations at the INEL include a waste treatment facility, the WERF, and a near-surface LLW disposal facility, the RWMC. The WERF reduces volume and produces improved, stabilized waste packages for disposal at the RWMC, thereby extending the life of

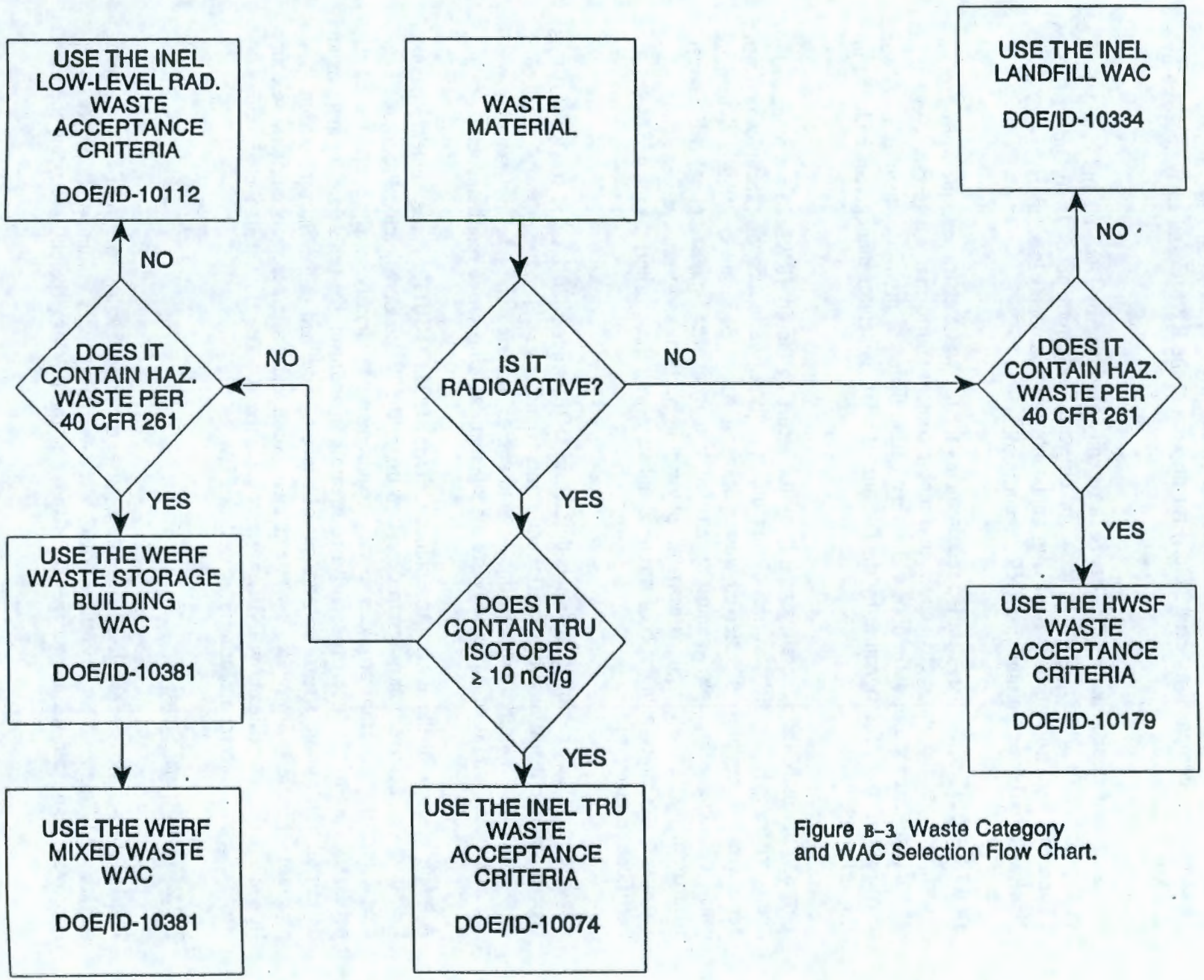

Figure B-3 Waste Category and WAC Selection Flow Chart.

the disposal area and improving disposal area performance. The WERF has the ability to incinerate LLW and stabilize (by cementation) the resulting ash, to compact waste, and to size large metal shapes for volume reduction. WERF has been shut down since February of 1991 for operational upgrades and is scheduled to resume operations in 1994.

The LLW that meets the requirements of the Waste Acceptance Criteria, DOE/ID-10112, is currently being disposed of in the SDA, 36 ha (88 acres) area at the RWMC. Contact-handled LLW (<500 mrem/hr at 1 m) is usually disposed of by high density stacking in segregated pits. Remote handled LLW (>500 mrem/hr at 1 m) is usually disposed of from bottom discharge shielded casks into "soil vaults." A soil vault is a hole that is augured into the ground in predefined areas between existing closed pits and trenches.

There are approximately 208,340 m^3 (281,259 yd^3) of LLW disposed of in the SDA (1952 to 1992). Until 1970, TRU waste and LLW was disposed of in the SDA. Since 1970, only LLW has been placed there and Waste Acceptance Criteria have been expanded to ensure that all current LLW disposal operations meet present requirements. At the present time approximately 66 m^3 (89 yd^3) of INEL-generated LLW, meeting the requirements of the Waste Acceptance Criteria, are disposed of each month.

Figure B-2, the map of the RWMC SDA, shows the active pits (Pits 18 & 19) as well as previously filled and closed areas. There are presently no plans to expand the existing RWMC SDA. Currently, new disposal concepts are being evaluated to establish environmental compliance plans and functional and operational requirements for new disposal facilities.

B.2.3 Capacity

The current disposal capacity remaining available for radioactive LLW in the RWMC SDA is 38,500 m^3 (51,975 yd^3) as of January 1993. This capacity is the space available in the current active pits and does not consider any specific actions to extend the life of the existing disposal facility.

B.2.4 Disposal Limitations

Applicable disposal limitations are described in the INEL Low-Level Radioactive Waste Acceptance Criteria, DOE/ID-10112 (EG&G, 1993). The following materials are specifically prohibited from being received as LLW for disposal at the RWMC:

1. Unpackaged waste materials and materials packaged in unspecified or improperly marked and labeled containers.

2. Nonradioactive materials.

3. Pressurized containers that have not been vented, drained, and crushed or otherwise reconfigured to allow verification.

4. Gaseous radioactive materials present in a gaseous state or in a host medium that will permit gas to be liberated.

5. Radioactive mixed waste as defined in 40 CFR 261.

6. Readily accessible classified materials.

7. Chelating or complexing agents which have the potential for mobilizing radionuclides.

8. Free liquids.

9. Waste classified as Greater-than-Class-C radioactive waste.

10. Pyrophoric radionuclides greater than one percent.

11. Phenolic compounds.

12. Polychlorinated biphenyls greater than 50 ppm.

13. Transuranic wastes.

14. Spent nuclear fuel.

15. High-level waste.

16. Pathogenic wastes.

17. Explosives.

18. Toxic gases, vapors, or fumes.

19. Wastes with pH less than 2.0 or greater than 12.5.

The waste characterization program defined in the Waste Acceptance Criteria (DOE/ID-10112) prescribes detailed requirements to identify these prohibited items.

B.2.5 Waste Classification System

A formal LLW classification similar to that defined in 10 CFR 61 for NRC-regulated LLW is not in place at the INEL. However, the INEL Low-Level Radioactive Waste Acceptance

Criteria, DOE/ID-10112, defines criteria that categorize, characterize, and segregate wastes in a manner that ensures compliance with the waste disposal site's (RWMC-SDA) performance objectives as defined in DOE Order 5280.2A, Section 3a, and 3b. Additionally, the specific prohibition restrictions of 10 CFR 61 [e.g., prohibition of disposing of greater-than-Class-C waste in near-surface disposal] are implemented by DOE/ID-10112.

All parameters necessary to identify specific waste characteristics to support segregation, characterization, and definition of treatment and disposal requirements are required to be defined by the characterization program specified in the criteria (DOE/ID-10112).

B.3 Mixed Low-Level Waste (MLLW) Disposal Facilities

The INEL currently has no disposal facility available for the disposition of MLLW. In 1992 the Mixed and Low-Level Waste Disposal Facility (MLLWDF) project was initiated to provide long-term disposal capability, whether onsite or offsite, for both mixed waste and LLW (Smith et al., 1993). The current LLW disposal site at the RWMC has limited remaining capacity in its current configuration. Studies conducted to date on the MLLWDF project include environmental compliance plans, facility siting studies, development of functional and operational requirements, and a preliminary evaluation of disposal alternatives. The disposal alternatives evaluated include: construction and operation of the MLLWDF; continued disposal at RWMC; shipment offsite for disposal; a combination of the alternatives; and no action. The MLLWDF project is currently in the preconceptual stage of development and no schedule has been developed for possible operation.

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APPENDIX C:

NEVADA TEST SITE, NEVADA

Site Contact:

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C.1 Site Description

The Nevada Test Site (NTS) is a Department of Energy (DOE) nuclear testing facility occupying 3,497 square kilometers (km^2) (1,350 square miles [mi^2]) of federally-owned land in southeastern Nevada's Nye County. The NTS was established in 1951 for the testing of nuclear weapons. The nuclear weapons testing at the site has included both atmospheric and underground detonations. The area's favorable geology, low population density, arid climate, security, available labor sources, reasonable accessibility (including transportation) routes make the site a suitable location for these activities.

The climate is arid with extreme diurnal temperatures. Vegetation is predominantly desert shrubs. NTS is in the Great Basin of the Basin and Range Geologic Province, which is characterized by north-south trending mountains and valleys. Elevations range from 910 m above MSL at Yucca Flats on the east to about 2,400 m above MSL at Pahute Mesa on the west side. Upland areas are steep and dissected. Valleys are gently sloping alluvium-covered bajadas with playas in most of the basins. Ground water (uppermost alluvial aquifer) is roughly 200 m deep in the Frenchman Flat Valley. The underlying carbonate aquifer is thought to flow to the southwest and discharge to the surface about 48 rm (30 mi) southwest of the NTS boundary. The estimated velocity of the carbonate aquifer in the eastern valleys of the NTS is approximately 13 m/yr. The Frenchman Flatt ground water (uppermost alluvial aquifer) is virtually horizontal with little or no lateral movement.

A number of contractors support the DOE and other organizations in the operation of the NTS. Reynolds Electrical and Engineering Co., Inc. (REECo), is the operating contractor at the NTS and provides a number of services, including operation of waste management programs at the NTS. The NTS serves as a disposal site for Low-Level Waste (LLW) generated by Department of Energy (DOE) defense-related facilities and as a storage site for a limited amount of mixed transuranic (MTRU) wastes pending opening of the Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico. REECo is also the operator of the mixed waste management units at the Area 5 Radioactive Waste Management Site (RWMS).

The Manager DOE Nevada Operations Office and the Acting Assistant Manager for Environmental Restoration and Waste Management are the contacts for the mixed and hazardous waste management units that are the subjects of this document. The following individuals presently hold these positions:

Nick C. Aquilina, Manager
DOE Nevada Operations Office
Post Office Box 98518
Las Vegas, NV 89193-8518
(702) 295-3211

Joseph N. Fiore, Acting Assistant Manager
for Environmental Restoration and
Waste Management
DOE Nevada Operations Office
Post Office Box 98518
Las Vegas, NV 89193-8518
(702) 295-7065

The REECo General Manager, and the Manager of the Waste Operations Department are the Operator contacts for the RWMS. The following individuals currently hold these contact positions:

Dale L. Fraser, General Manager
Reynolds Electrical & Engineering Co., Inc.
P.O. Box 98521
Las Vegas, NV 89193-8521
(702) 295-3379

Eugene W. Kendall, Manager
Waste Operations Department
Reynolds Electrical & Engineering Co., Inc.
P.O. Box 98521
Las Vegas, NV 89193-8521
(702) 295-6406

The NTS is situated about 105 km (65 mi) northwest of Las Vegas. The site is bordered to the west, north, and east by the Nellis Air Force Range and the Tonopah Test Range, another government-owned, restricted-access area. The NTS is, therefore, well buffered from private lands as indicated in Figure C-1. The nearest private lands are predominantly rural, undeveloped desert lands. The only major population center in the area is the greater Las Vegas area.

The NTS is accessed from U.S. Highway 95, which roughly forms the southern border of the site as illustrated in Figure C-1. Mercury, the main base camp at the NTS, consists of residential, administrative, and industrial buildings that provide general support to the other areas of the site. Mercury is in the southeast corner of the site, approximately three miles north of Highway 95. It supports a somewhat permanent population of 500 people out of the approximately 3,500 employees who work at the NTS on a daily basis. Mercury has the capacity to support a population of approximately 1,200.

Most of the NTS land is undeveloped.

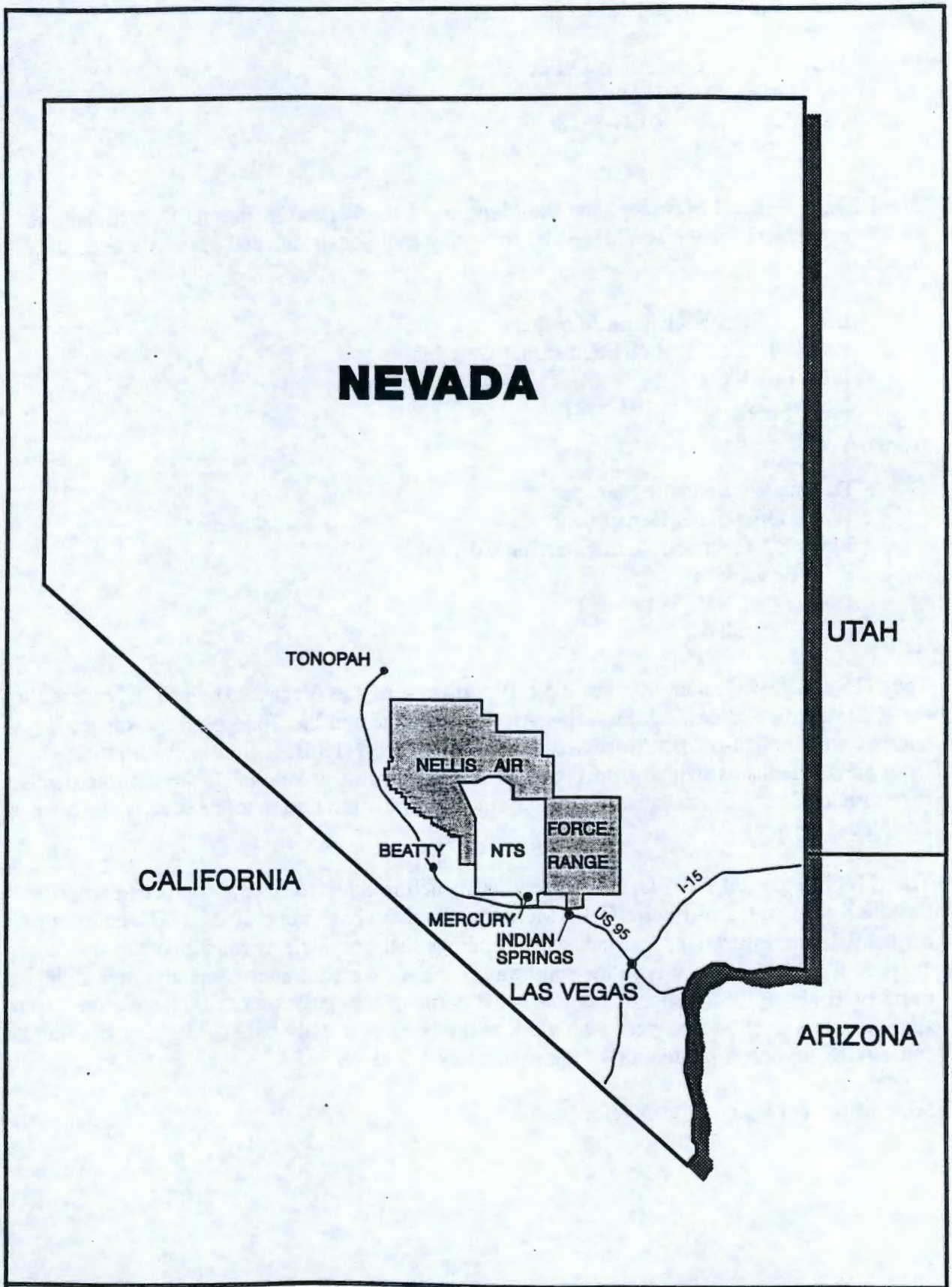

FIGURE C-1. General Location Map.

C.1.1 Area 5 Radioactive Waste Management Site (RWMS)

(1) General

The Area 5 RWMS was formally established in 1978 for the disposal of low-level and classified low-level radioactive waste generated by various NTS operations and by other DOE facilities. The center of the Area 5 RWMS is located at a latitude of N 36°51'18" and a longitude of E 115°57'15". The developed portion of the Area 5 RWMS, illustrated in Figure C-2 occupies 37 hectares (ha) (92-acres) in the southeast corner of the 296-ha (732-acre) designated area. This developed area of the RWMS currently consists of 17 landfill cells (pits and trenches), thirteen greater confinement disposal (GCD) boreholes, a Transuranic (TRU) Waste Storage Pad, and support buildings.

The majority of the LLW disposal at the existing facilities typically consists of contaminated laboratory waste, soil, process waste, and construction debris. Common radioactive constituents of this waste are depleted and enriched uranium, mixed fission products, high specific activity tritium, and waste containing transuranic nuclides at concentrations less than 100 nCi/g. Most of this waste is buried in wooden and metal boxes or drums. The total volume of LLW disposed of at the Area 5 RWMS between 1961 and 1993, is 167,385 m^3 (5,911,158 ft^3) containing 9.77 MCi of radioactivity, the majority of this activity being from tritium.

The existing units within the Area 5 RWMS which are the subject of this document are:

- Pit 3 (P03R/M) for disposal of low-level mixed waste (LLMW)
- The proposed 10-cell Mixed Waste Disposal Unit for disposal of LLMW generated both at the NTS and off-site.
- Pit 4 (P04U) for current Low-Level Waste (LLW) operations
- Pit 6 (P06U) for future LLW operations
- Trench T02C for classified LLW
- Trench T04C for classified LLW

In addition to these facilities U3ahat in Area 3 is used for LLW disposal.

C.1.2 Area 3 RWMS

The Area 3 RWMS is located on Yucca Flat, and covers an area of approximately 20 ha (50 acres). Contaminated debris from the NTS Atmospheric Testing Debris Disposal Program (ATDDP) and packaged bulk LLW from offsite DOE facilities is disposed of in subsidence

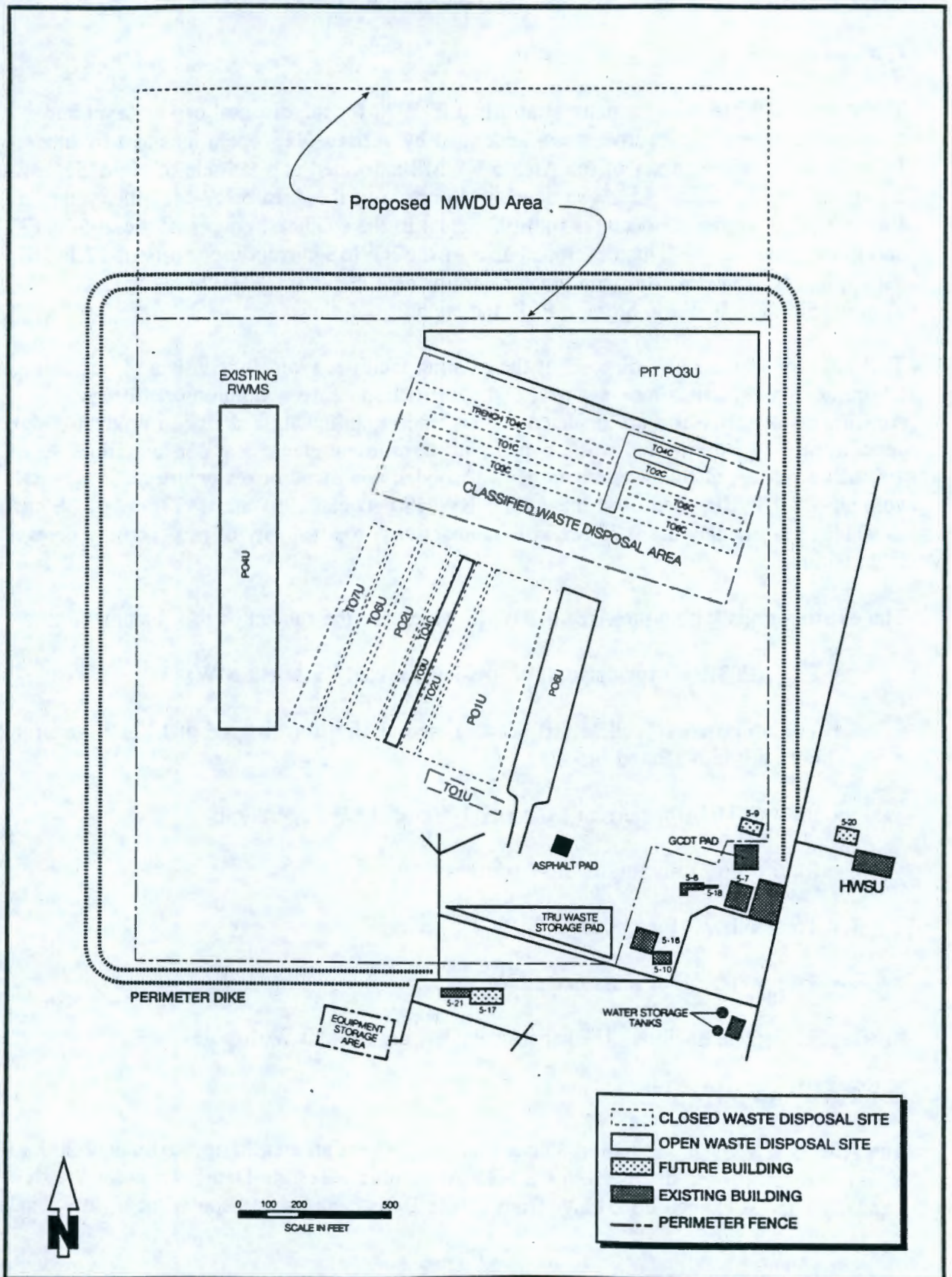

FIGURE C-2. Site Layout of the Area 5 RWMS.

craters that have resulted from the underground nuclear tests. The subsidence craters are selected for disposal cells based upon site geology and the fact that the subsidence that created the cell was detonated well above the ground water table. The top of the ground water table is located at approximately 500 m (1640 ft) below the Yucca Flat surface. To date, all disposal operations have taken place in four subsidence craters: U3ax, U3bl, U3ah, and U3at.

The waste materials are disposed of by using conventional landfill techniques where each layer of waste is covered with three feet of clean fill before additional waste materials are disposed of. The waste is placed to within 1.3 m (4 ft) of the original land surface, and backfilled with earthern material . Upon completion of the final closure, each cell will have to be covered with an engineered, state approved, closure cap.

- U3ahat for MLLW
- U3axbl for LLW
- U3az, U3bg, U3bh are reserve LLW units.

(1) Patterns of Rainfall

The RWMS is located in an arid area which provides a favorable hydrogeologic setting for waste disposal operations. Mean annual precipitation is low 10 cm/yr (4 in./yr). Humidity is low, 2.1 to 4.5 millibars. The annual potential evapotranspiration is over 10 times higher than the annual precipitation. Low rainfall and high evaporation minimizes the potential of recharge to provide a pathway for contaminant migration.

There is little and only temporary surface water and there is no apparent significant connection between surface waters and groundwater in the Frenchman basin.

(2) Hydrology

The saturated aquifers are deep in this area of NTS and are overlain by a thick unsaturated zone. Three major saturated units present in the Frenchman Flat basin are: a valley-fill alluvium, volcanic tuff, and a lower carbonate aquifer. The tuff and carbonate hydrostratigraphic units are subdivided into numerous stratigraphic units. Three pilot wells (Ue-5PW-1, Ue-5PW-2, Ue-5PW-3) have been drilled to the water table 225 m (837 ft) near RWMS.

(3) Unsaturated Zones

The unsaturated zone at the RWMS is composed entirely of heterogenous alluvial sediments, varying in grain size from silt to boulders.

Based on borehole correlations up and downgradient from the RWMS, the unconsolidated alluvium at the RWMS is anticipated to be from 122 to 255 m (400 to greater than 837 ft) thick, possibly underlain by 37 to 113 m (120 to 370 ft) of indurated alluvium. PW-1 showed no induration to a depth of 255 m (837 ft).

C.2 Operational Status

C.2.1 Low-Level Mixed Waste Disposal Unit Pit 3

Pit 3 (P03R/M) (Figure C-2), located in Area 5, is currently an open existing disposal unit which is operating under RCRA interim status. However, as a result of an regulatory action by the State of Nevada, this facility is not currently receiving mixed waste. Resolution of questions regarding the waste analysis program is currently in progress. Upon resolution of these issues, the facility could receive mixed waste for disposal from facilities which have been approved (see Section C. 1) by the Nevada Operations Office.

This landfill unit has accepted pondcrete from the Department of Energy's (DOE) Rocky Flats facility in Colorado. Pondcrete consists of low-level mixed waste (LLMW) sludge from the evaporation of pond liquid from defense processes at the Rocky Flats Plant mixed with cement.

C.2.2 Mixed Waste Disposal Unit

A landfill designated the Mixed Waste Disposal Unit (MWDU) (currently being designed to consist of 10 cells) is proposed for location on approximately 18 ha (45 acres) of the Area 5 RWMS, immediately north of the developed RWMS landfill area (see Figure C-2). The unit has been designed and is included in the NTS RCRA Permit application. In addition the Environmental Assessment for this unit is also being updated. A RCRA Part B Permit application is currently under review by the state of Nevada. The most recent schedule (September 1993) shows completion of the unit in September 1995. Due to permitting, NEPA, and FFCA activities the schedule is subject to change.

C.2.3 Pit 4

Pit 4 (Figure C-2), located in Area 5, is used for the disposal of currently approved LLW streams. Pit 4 was opened on June 21, 1988, and is currently a little over 2/3 full. It is 1000 ft long, 200 ft deep. The waste is stacked by weight with the heaviest drums or boxes on the bottom. LLW drums are disposed of in nests of various sizes. The nest is formed on all sides by boxes. The front bulkhead, made of stacked boxes, is increased in height as drums are placed to provide the crane operator visibility. Waste boxes are stacked in a tiered staircase configuration to within four feet of the natural grade and then covered with approximately eight feet of soil. Final closure will be an engineered cap approved by the appropriate regulatory authority.

C.2.4 Pit 6

Pit 6 (Figures C-2), located in Area 5, was opened in 1990, and is reserved for disposal of LLW. This pit will be used when Pit 4 has reached capacity. It is approximately 630 ft long, 100 ft wide, and 24 ft deep.

C.2.5 T02C

Trench T02C (Figure C-2), located in Area 5, was opened in May of 1988, and is reserved for classified LLW disposal. It is approximately 254 ft long, 40 ft wide, and 20 ft deep.

C.2.6 Trench 4 (T04C)

Trench T04C (Figure C-2) was opened in March of 1969, and is reserved for the disposal of classified low-level waste. It is approximately 340 m (1100 ft) long, 12 m (41 ft) wide, and 6 m (20 ft) deep.

U3ahat - Current Operations

U3ahat is the active disposal cell at the Area 3 RWMS. It currently accepts offsite waste from Fernald Environmental Management Project, Fernald, Ohio. U3ahat was created from two adjacent subsidence craters, U3ah and U3at, with a combined original volume of approximately 15 million cubic feet with a remaining storage capacity of 13,500,000 ft^3.

U3axbl - Awaiting Closure

U3axbl is an inactive, covered disposed cell. Due to the presence of lead in the waste that had been disposed of in the past, U3axbl may contain Mixed Waste. Disposal was discontinued in January 1988, and the site was covered. Formal closure activities will commence when the RCRA closure cap plan is approved.

C.3 Waste Acceptance Criteria

DOE/NV has defined the requirements for all waste generators in the *Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements*, NVO-325, Revision 1 which was developed to address the requirements of DOE Order 5820.2A. NVO-325 also requires consideration applicable elements of DOE Order 5700.6C, *Quality Assurance* and ANSI/ASME NQA-1 *Quality Assurance Program Requirements for Nuclear Facilities*.

C.3.1 Waste Generator Characterization and Certification Program

NVO-325, Rev. 1 requires generators to have a waste characterization program, supported by a DOE Order 5700.6C-based certification program. This waste characterization and

certification program is described in a waste application or in an accompanying document that is submitted to DOE/NV.

(1) Waste Generator Approval Process (Figure C-3)

DOE/NV reviews the generator application, requests additional information if necessary, and then conducts an audit at the generator site. This audit will verify, by examination and evaluation of objective evidence, that the documented program has been adequately implemented. DOE/NV performs a surveillance to verify corrective action as appropriate. When all corrective action is completed, the generator receives approval to ship to NTS from the Manager, DOE/NV. Figure C-3 summarizes the various steps that are involved in the application and waste approval process.

(2) Waste Characterization Program

The generators waste characterization program must include the identification of methods and the establishment of procedures to accurately determine the physical, chemical, and radiological properties of LLW in order to ensure that the waste conforms to the NTS waste acceptance criteria (WAC). This information may be developed utilizing sampling and analysis, process knowledge or some combination of both.

For waste characterized by sampling and analysis the generator must also procure or provide qualified analytical laboratory services. DOE/NV will perform data validation as appropriate.

(3) Waste Stream Criteria

NVO-325 provides detailed requirements for disposal of low-level waste (LLW) and mixed low-level waste (MLLW) and for storage of transuranic (TRU) and mixed transuranic waste (MTRU). MLLW must meet the basic requirements outlined for LLW and then meet additional MLLW criteria. The criteria can be found in Section 5.5 of NVO-325. The criteria include:

- Restrictions on:
  - Free Liquids
  - Hazardous Waste Constituents
  - Particulate
  - Gases
  - Stabilization
  - Etiological Agents
  - Chelation Agents
  - Polychlorinated Biphenyls
  - Explosives and Pyrophorics

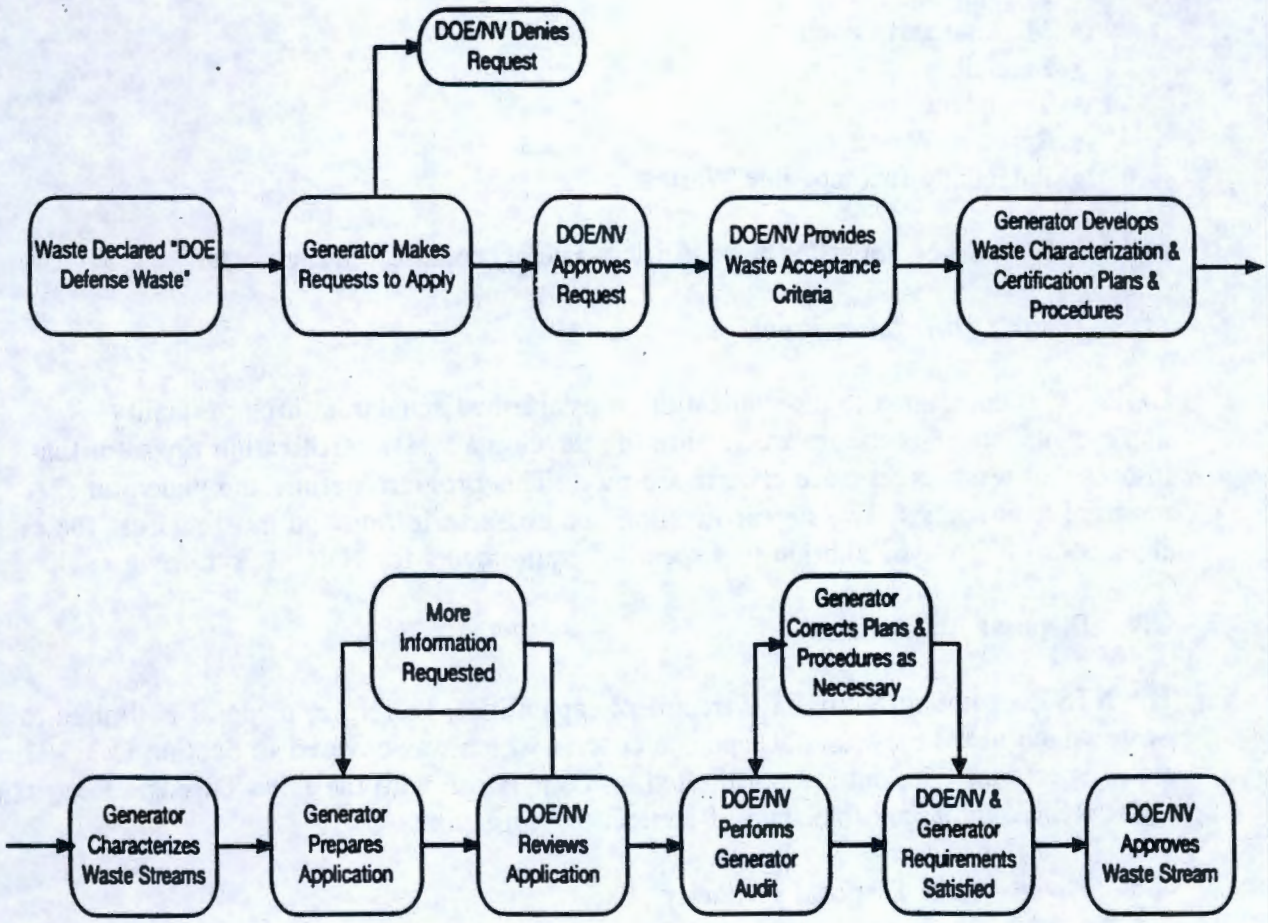

Figure C-3. Waste Acceptance Flow Chart

RER1752.A

- Package Design
- Nuclear Heating
- Radiation Levels
- External Radiation Levels
- Activity Limits
- Multiple Hazards
- Size
- Weight
- Loading
- Marking and Labeling
- Barcoding
- Treatment
- Reactive Wastes
- Potentially Incompatible Wastes

NVO-325 should be consulted for specific waste acceptance requirements.

(4) Waste Certification Program

DOE/NV is committed to the realization of established standards through quality implementation. Generators are required to develop a waste certification program that insures that waste acceptance criteria are met. This program defines the generator QA program as it applies to waste certification and characterization and must address the eighteen elements of NQA-1 in addition to a specific requirements for NVO-325 training.

C.4 Disposal Limitations

The NTS does not currently have treatment capabilities; therefore, disposal is limited to waste which meets the waste acceptance criteria which was covered in Section C.3. These requirements include, but are not limited to, compliance with the Land Disposal Restrictions under RCRA and applicable state-of-generation regulations.

C.5 Mixed Waste Disposal Capacity

C.5.1 Pit 3

Pit 3 process design capacity is 90,250 m^3 (3,190,000 ft^3). The mixed waste expected to be disposed of in Pit 3 (P03R/M) is described in Table C-1. Because of the stringent certification requirements for the acceptance of mixed waste by the NTS, no ignitable, reactive or incompatible wastes are anticipated.

TABLE C-1. General Information - Pit 3

PROCESS CODE:	D80 (LANDFILL DISPOSAL)					
WASTE CODES:	D004	D005	D006	D007	D008	D009
	D010	D011	D018	D022	D035	F001
	F002	F003	F004	F005	F006	F007
	F009	P015	U002	U019	U022	U080
	U159	U209	U239			
PROCESS DESIGN CAPACITY:	12.9 hectare-meters (104.5 acre-feet)					
ESTIMATED ANNUAL QUANTITY OF WASTE:	27,609 metric tons (30,439 tons)					

C.5.2 Mixed Waste Disposal Unit (MWDU)

The Mixed Waste Disposal Unit will be located within the Radioactive Waste Management Site (RWMS) of Area 5. It will initially be permitted for 10 landfill cells for the permanent disposal of Low-Level Mixed Radioactive and Hazardous Waste. Future plans include additional cells on an as needed basis. General site improvements will also include the construction of access roadways, cell access ramps, cell perimeter storm water run-off diversion berms and channels, site security fences, and power distribution facilities. The overall layout is illustrated in Figure C-2.

Each cell is intended to contain approximately 12,040 m^3 (425,152 ft^3) of mixed waste. This capacity figure was obtained by determining the maximum number of 1.2 m (4 ft) x 2.1 m (7 ft) x 1.2 m (4 ft) waste packages which will fit into each cell and using this to calculate a total waste volume. Construction of the first landfill cell within the MWDU will begin upon issuance of a RCRA permit. After each disposal cell has been filled to capacity with mixed waste, clean fill material will be deposited into and above the mixed waste disposal cell and an engineered, state-approved closure cap will be installed. The mixed waste expected to be landfilled in the MWDU cells is described in Table C-2. Because of the stringent certification requirements described in NVO-325 for the acceptance of mixed waste by the NTS, no ignitable, reactive or incompatible wastes are anticipated for disposal at the MWDU.

TABLE C-2. General Information - Mixed Waste Disposal Unit (MWDU)

PROCESS CODE:	D80 (LANDFILL DISPOSAL)					
WASTE CODES:	D004	D005	D006	D007	D008	D009
	D010	D011	D018	D022	D035	F001
	F002	F003	F004	F005	F006	F007
	F009	P015	U002	U019	U022	U080
	U159	U209	U239			
PROCESS DESIGN CAPACITY:	12.0 hectare-meters (97.6 acre-feet)					
ESTIMATED ANNUAL QUANTITY OF WASTE:	35,303 metric tons (38,922 tons)					

C.5.3 Low-Level Waste Disposal Capacity

The NTS current capacity for LLW is summarized in Table C-3.

C.6 Waste Classification

The classification used by the NTS is based on the following documents:

- NVO-325, Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements (June 1992, Rev. 1)
- DOE Order 5820.2A, Radioactive Waste Management
- Title 49 CFR, Department of Transportation Regulations

NVO-325 in addition to providing criteria for chemical constituents, is the base document for radioactivity requirements. Criteria on Nuclear Heating and Radiation Levels can be found in Section 5.5.1, Low-Level Waste Acceptance Criteria. Most of the requirements are based on reference to other DOT and DOE requirements.

DOE Order 5820.2A defines low-level radioactive waste. This definition is the basis of the NTS determination of low-level radioactive waste.

The final set of criteria is based on Department of Transportation regulations. In general, in order for the waste to be shipped to the NTS, it must comply with applicable transportation requirements.

TABLE C-3. Radioactive waste management site LLW Capacity

AREA 5 RWMS						
		ORIGINAL FACILITY CAPACITY		REMAINING DISPOSAL CAPACITY*		
YEAR BUILT	LOCATION	FT^3	M^3	FT^3	M^3	FUNCTION/DESCRIPTION
1987	P04U	4,000,000 ft^3	113,280 m^3	1,1412,316 ft^3	32,347 m^3	LLW DISPOSAL PIT
1990	P06U	1,512,000 ft^3	42,820 m^3	953,559 ft^3	27,002 m^3	LLW DISPOSAL PIT-FURTHER USE
1984	T03U	567,000 ft^3	16,055 m^3	183,654 ft^3	5,200 m^3	LLW DISPOSAL TRENCH
1988	T02C	203,200 ft^3	5,755 m^3	33,237 ft^3	941 m^3	CLASSIFIED LLW DISPOSAL TRENCH
1969	T04C	929,215 ft^3	26,311 m^3	41,823 ft^3	1,184 m^3	CLASSIFIED LLW DISPOSAL TRENCH
AREA 3 RWMS						
1988	U3ahat	15,500,000 ft^3	424,753 m^3	13,500,000 ft^3	382, 277 m^3	SUBSIDENCE CRATER

CONVERSIONS:

$FT^3 \times .02832 = M^3$

* DISPOSAL CAPACITIES AS OF OCTOBER 16, 1992

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APPENDIX D:

LOS ALAMOS NATIONAL LABORATORY, NEW MEXICO

Site Contact:

Tim Sloan (505) 667-7579

D.1 Site Description.

Los Alamos National Laboratory (LANL) is a Department of Energy (DOE) research facility occupying 106.8 km^2 in north-central New Mexico (Figure D-1). LANL was established in 1942 as part of the US Army's Manhattan Project and currently conducts research in nuclear and conventional weapons, nuclear fusion and fission, nuclear safeguards and security, and waste management.

LANL is located in a semiarid, temperate climate with mixed forests and grasslands. The facility is characterized by mesas separated by deep canyons with elevations ranging between 1,890 to 2,380 m above Mean Sea Level (MSL). The region is seismically, volcanically, and geomorphically active. Ground water in the main aquifer is 180 to 365 m below the mesa tops with water present in some canyon bottoms as perched or shallow-alluvium aquifers, and as intermittent or perennial streams. LANL is bounded on the southeast by the Rio Grande River.

The University of California is the prime contractor supporting the DOE at LANL and, as such, designs and operates the waste management programs for the site, including Material Disposal Area (MDA) G for Low Level Waste (LLW), MDA J for non hazardous, administratively controlled wastes, and the proposed Mixed Waste Disposal Facility (MWDF) for land disposal of mixed wastes.

D.2 MDA G Low Level Waste Disposal Site.

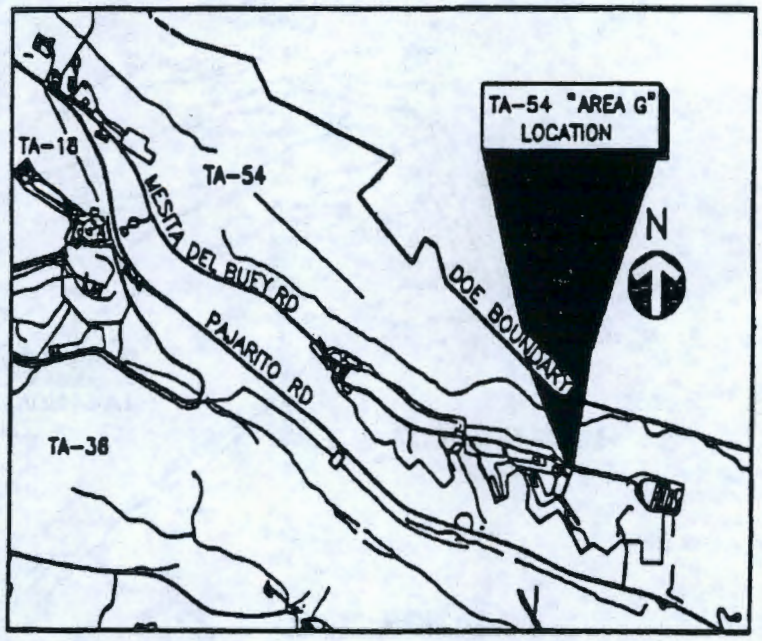
D.2.1 Site Description

Technical Area (TA) 54, MDA G has been operating since 1957 and occupies 64 acres on the southeast end of Mesita del Buey, a finger mesa that is bounded by Canada del Buey Canyon on the north and Pajarito Canyon on the south (Figure D-2). An additional 24 acres, immediately adjacent, are dedicated for future expansion of the LLW disposal area. The current facility consists of 39 landfill cells (pits and trenches), 237 land disposal shafts, and 3 retrievable storage pads (Figure D-3).

TA-54 lies on welded Bandolier Tuff, in the Pinon-Juniper, Ponderosa Pine/Pinon-Juniper and Shrub-Grass-Forb overstory vegetation zones at an elevation of 6,400 feet above sea level (ASL) near its eastern edge to 6,920 feet ASL near its western edge. Soil types in the area include Hackroy sandy loam, Totavi gravelly loamy sand, Nyjack loam, Hackroy-Rock outcrop complex, Servilleta loam, Penistaja sandy loam, Prieta silt loam, and rock outcrop (Nyhan et al., 1978).

The potentiometric surface of the main aquifer in the Los Alamos region lies at 5,680 to 5,880 feet ASL. At TA-54 over 700 feet of unsaturated tuff and volcanic rock separate the surface from the aquifer. There is little potential for downward flow from the surface due to the low moisture conditions of the tuff (IT, 1987a).

Figure D.1 Los Alamos National Laboratory Facility Map



LOCATION MAP

NTS

Figure D.2 TA-54 MDA G Location Map

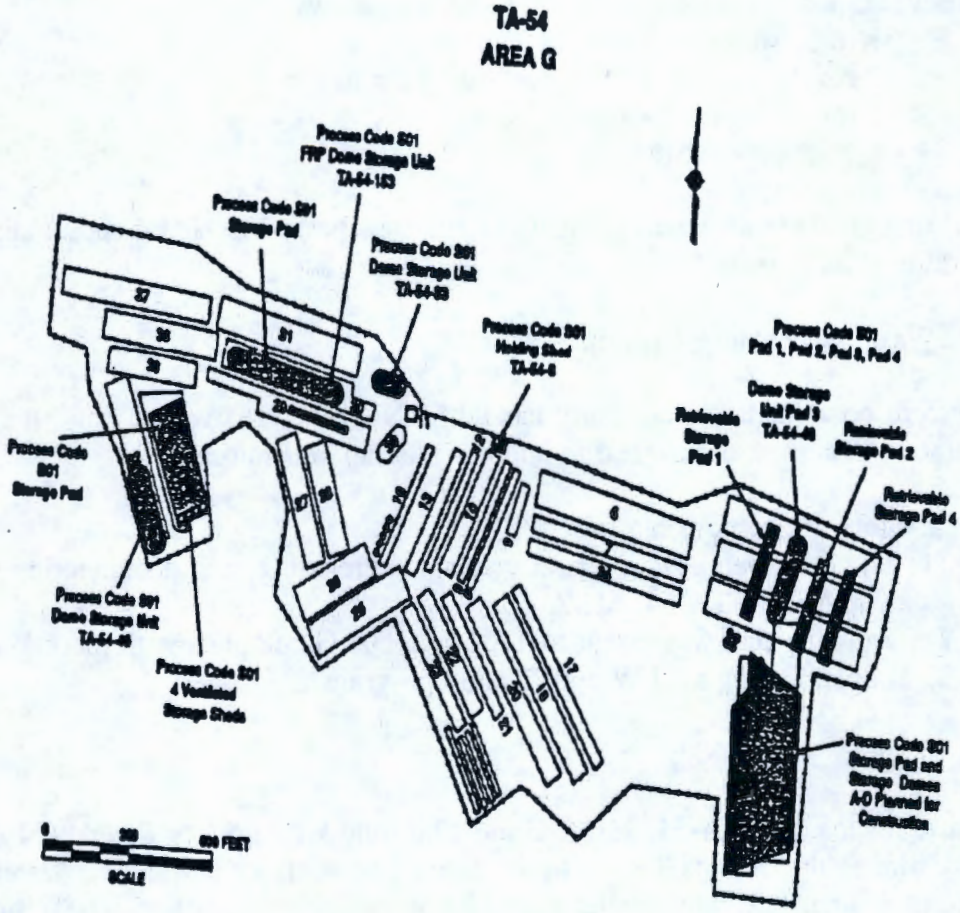


Figure D.3 TA-54 MDA G Facility Map

Note: shaded areas represent active storage units

The floor of Pajarito Canyon, south of TA-54, is underlain by up to 11 feet of alluvial silt, sand, and gravel, above underlying bedrock of welded and non-welded Bandelier Tuff. Investigation of the perched ground water in the alluvium of Pajarito Canyon, has not indicated that there is a hydraulic connection with the main aquifer. The saturated thickness of the Pajarito Canyon alluvium varies, with an 10.01 foot average near TA-54. The flow rate of the perched ground water ranged from 8 to 23 feet per day (IT,1987a). A perched water table was not found in Canada del Buey.[1]

D.2.2 Operational Status

The active disposal units within MDA G are as follows[2]:

Pit 37 for disposal of LLW
Pit 39 for disposal of LLW upon filling Pit 37
Pit 31 for disposal of asbestos LLW
34 LLW disposal shafts

Closed units include 36 landfill cells (pits and trenches), 203 land disposal shafts and 3 retrievable storage units.

D.2.3 Waste Acceptance Criteria

As these disposal facilities currently handle LANL generated wastes only, the Waste Acceptance Criteria are designed to address internal generators.

The generators are responsible for[3]:

1) properly identifying, characterizing, segregating, and documenting waste prior to shipment to TA-54, MDA G.
2) ensuring that waste sent to TA-54, MDA G complies with these WAC.
3) implementing a LLW certification program.

D.2.4 Disposal Limitations

All waste disposed at TA-54, MDA G must be solid with no free liquids (EPA Test Method 9095 - Paint Filter Liquids Test). In the case of powders or particulate wastes, if more than 1 wt-% of the particles are smaller than 10 microns or more that 15 wt-% consists of particles less than 200 microns in size, then the particulate portion of the waste must be immobilized to reduce the inhalation and dispersion risks during handling.

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[1] *TA-54 Operations and Environmental Setting*, Los Alamos National Laboratory.

[2] Francis, Stephen D., Los Alamos National Laboratory, 9/16/93.

[3] *Waste Acceptance Criteria for Solid Low Level Radioactive Waste Disposal at TA-54, Area G*, Los Alamos National Laboratory, 4/30/93.

Pressurized and evacuated containers cannot be disposed unless they are vented to atmospheric pressure.

Restrictions on radionuclide content only relate to:

1) the exclusion of TRU waste.
2) the exclusion of Greater-Than-Class C (GTCC) waste.
3) criticality safety.
4) safe handling during disposal.

RCRA regulated components are not acceptable for disposal at MDA G.

D.2.5 Disposal Capacity

Current remaining disposal capacity at MDA G is approximately 12,500 m^3 which will satisfy LANL needs through the end of FY 1995. The future expansion area will provide for the disposal of an additional 127,000 m^3 of waste.

D.2.6 Waste Classification

The waste classification system in use at LANL is based on the following documents:

1) *Waste Acceptance Criteria for Low-Level Radioactive Waste Disposal at TA-54, Area G.*
2) *Low Level Radioactive Solid Waste*, Administrative Requirement 10-2.
3) *Radioactive Waste Management*, DOE Order 5820.2A.
4) Department of Transportation Regulations, 49 CFR.

D.3 TA-67 Mixed Waste Disposal Facility (Proposed)

D.3.1 Site Description

The projected location of the Mixed Waste Disposal Facility is at TA-67 (Figure D-1). As characterization of this site is currently under way, most of the available information is from draft documents.

The site elevation ranges from approximately 7,300 feet ASL on the western boundary to approximately 7,200 feet ASL on the eastern boundary. The potentiometric surface of the main aquifer in the Los Alamos region lies at 5,680 to 5,880 feet ASL, therefore at TA-67 over 1300 feet of unsaturated tuff and volcanic rock separate the surface from the aquifer.

D.3.2 Operational Status

This facility is currently in the Title I design stage. It is scheduled to begin receiving waste in the 1997-1998 time frame. The RCRA permit application is scheduled for submission in April, 1994.

D.3.3 Waste Acceptance Criteria

This facility is expected to handle LANL generated Environmental Restoration wastes only at this time. Accordingly, the draft Waste Acceptance Criteria are designed to address internal generators.

The generators will be responsible for[4]:

1) properly identifying, characterizing, segregating, and documenting waste prior to shipment to TA-67, MWDF.
2) ensuring that waste sent to TA-67, MWDF complies with these WAC.

D.3.4 Disposal Limitations

All waste disposed at TA-67, MWDF must comply with applicable Land Disposal Restrictions (LDR) as specified under Title 40 CFR 268, Land Disposal Restrictions, unless treated as specified under Title 40 CFR 268, Subpart D, Treatment Standards.

All waste disposed at TA-67, MWDF must be solid with no free liquids (EPA Test Method 9095 - Paint Filter Liquids Test). In the case of powders or particulate wastes, if more than 1 wt-% of the particles are smaller than 10 microns or more that 15 wt-% consists of particles less than 200 microns in size, then the particulate portion of the waste must be immobilized to reduce the inhalation and dispersion risks during handling.

Pressurized and evacuated containers cannot be disposed unless they are vented to atmospheric pressure.

Wastes containing pathogens, infectious wastes, or other etiologic agents as defined in Title 49 CFR 173.386 will not be accepted.

Wastes containing polychlorinated biphenyls (PCB) at greater than 50 ppm will not be accepted.

Asbestos contaminated wastes will not be accepted.

Restrictions on radionuclide content only relate to:

1) the exclusion of TRU waste.
2) the exclusion of Greater-Than-Class C (GTCC) waste.
3) criticality safety.
4) safe handling during disposal.

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[4] *Mixed Waste Storage and Disposal Facility - Draft Waste Acceptance Criteria*, Los Alamos National Laboratory, 6/30/93.

D.3.5 Disposal Capacity

Design capacity for TA-67, MWDF is approximately 400,000 m^3, which is expected to satisfy LANL needs for a 20 year period.

D.3.6 Waste Classification

The waste classification system expected to be used at TA-67, MWDF, is based on the following documents:

1) *Radioactive Waste Management*, DOE Order 5480.2A
2) *Radiation Protection of the Public and the Environment*, DOE Order 5400.5
3) *Nuclear Safety Analysis Report*, DOE Order 5480.23
4) *Guidance on Preliminary Hazard Classification and Accident Analysis Techniques for Compliance with DOE Order 5480.23*, DOE-STD-1013-92
5) *Licensing Requirements for Land Disposal of Radioactive Wastes*, Title 10 CFR 61
6) proposed Title 10 CFR 834
7) *US Environmental Protection Regulations*, Title 40 CFR 260-270
8) *Designation, Reportable Quantities, and Notification*, Title 40 CFR 302
9) *Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements*, Title 49 CFR 172
10) *Shippers-General Requirements for Shipments and Packaging*, Title 49 CFR 173

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APPENDIX E:

OAK RIDGE RESERVATION, TENNESSEE

Site Contact:

Lance Mezga (615) 574-7258

E.1 Site Description

The Oak Ridge Reservation (ORR) consists of some 35,252 acres of federally owned lands waste and south of the population center of Oak Ridge, Tennessee. Owned and controlled by the Department of Energy (DOE), and managed under contract by Martin Marietta Energy Systems, Inc., the ORR contains three major facilities--the Oak Ridge National Laboratory (ORNL), the K-25 Site, and the Oak Ridge Y-12 Plant. These facilities were hurriedly constructed in the early 1940s, as part of the highly secretive Manhattan Project of World War II, for the primary purpose of large-scale production of fissionable material to build the world's first nuclear weapons.

The Oak Ridge climate is typical of the humid southern Appalachian region. The local climate is noticeably influenced by topography. The prevailing winds, as measured by an on-site meteorological tower, are from the southwest and northeast under both stable and unstable conditions. Average monthly wind speeds range from 1.6 m/s (5.2 ft/s) in October to 2.5 m/s (8.2 ft/s) in April. Differences in elevation have a measurable influence on the changes in climate along a northwest-southeast axis. The average annual precipitation measured in the Oak Ridge vicinity is 138 cm (54.4 in.), ranging from 94.9 cm (37.4 in.) to 186.9 cm (76.3 in.). A trace or more of snow has been reported each winter on record; the annual average snowfall is 26.4 cm (10.4 in.).

Site topography is characterized by a series of alternating, elongated, and parallel valley troughs and ridges tending northeast to southwest in general accord with the strike of the underlying rock strata. The valleys have been eroded in areas underlain by the less resistant limestone and shale strata, while the ridges are underlain by more resistant sandstone, shale, and cherty dolomite formations.

Surface elevations range from about 225 m (740 ft) at the Clinch River to about 413 m (1356 ft) at the crest of Melton Hill. The succession of alternating ridges and valleys in the ORNL site area (in order from the Clinch River in the southeast to the northwest) is as follows: Copper Ridge, Melton Valley, Haw Ridge, Bethel Valley, and Chestnut Ridge.

Nine geologic formations or groups ranging in age from Early Cambrian to Early Mississippian have been mapped within the ORR. All the formations are of sedimentary origin, either chemical (limestone and dolomite) or clastic (sandstone and shale). From oldest to youngest, they include the Rome Formation, the Conasauga Group, the Knox Group, the Chickamauga Group, the Sequatchie Formation, the Rockwood Formation, the Chattanooga Shale, the Maury Formation, and the Fort Payne Chert.

Of the nine units mapped within the reservation, the four that underlie ORNL and the WOC drainage basin from northwest to southeast are (1) the Knox Group, a predominantly dolomite strata of Cambrian and Ordovician ages underlying Chestnut Ridge to the north and Melton Hill an d Copper Ridge to the south; (2) the Chickamauga Group of Ordovician age, which underlies the main ORNL complex in Bethel Valley; (3) the Rome Formation, shale,

siltstone and sandstone unit of Cambrian age that underlies Haw Ridge, separating the main ORNL complex from the satellite facilities located in Melton Valley; and (4) the Conasauga Group, Cambrian-age shales interbedded with limestones and siltstone that underlie the waste management TSD facilities in Melton Valley.

The rock is generally covered by a mantle of residual alluvial and colluvial material in places more than 30 m (100 ft) thick. Soils developed on the Rome, Conasauga, and Chickamauga are generally thin [i.e., less than 4.8 m (16 ft) but somewhat thicker where shale is deeply weathered]. Knox residuum is generally thick but irregular.

In the Oak Ridge area the Knox dolomite and the Rome Formation are the principal aquifers. The Conasauga Group is a potential low-yield groundwater source. The Knox, located beneath Chestnut Ridge, is the major aquifer in the WOC basin. The thick, weathered mantle seems to have a high-infiltration capacity and serves as a reservoir feeding large solution cavities in bedrock. Springs at the base of Chestnut Ridge ar a primary natural source of base flow for WOC. Groundwater discharge from the Knox beneath Copper ridge is probably not into WOC basin but, instead, to the southeast along the Clinch River.

The mean yield of springs and wells in the Knox Group used for public and industrial water supplies is 1014 L/min (268 gal/min.). No estimate is available for mean well yield of domestic water wells in the Knox Group.

Depth to the water table varies both spatially and temporally. At a given location, depth to water is generally greatest during the October-December quarter and least during the January-March quarter. In Bethel Valley, depth to water table ranges from 0.30 to 10.66 m (1 to 35 ft), while in Melton Valley the range is from 0.30 to 20.42 (1 to 67 ft). Seasonal fluctuations tend to be greatest beneath hillsides. A seasonal variation of as much as 4.57 m (15 ft) has been reported for Melton Valley. The major portion of the industrial and drinking water supplies in the Oak Ridge area is taken from surface water sources. However, single-family wells are common in adjacent rural areas not served by public water supply systems.

E.1.1 Oak Ridge National Laboratory

ORNL is an internationally renowned R&D facility with major efforts directed at exploring the fission fuel cycle and at developing magnetically-controlled fission reactions. Additional activities at ORNL include solving generic research problems in various energy technologies, materials separation techniques, chemical processes, and biotechnology. ORNL is also a major national producer of the stable radioactive isotopes that are necessary for medical and other types of research. ORNL's energy technology development research also includes residential and commercial energy conservation, renewable energy sources, and coal conversion and utilization.

E.1.2 K-25 Site

Formerly known as the Oak Ridge Gaseous Diffusion Plant, the K-25 Site is located approximately eight miles west of the population center of Oak Ridge, and was commissioned to produce highly enriched uranium, by the gaseous diffusion method, for use in nuclear weapons.

In December, 1987, a decision to permanently shutdown the gaseous diffusion cascade was announced and subsequently implemented. In 1989, Environmental Restoration was designated as Landlord of the site and its funding support for Landlord responsibilities was resumed. Emphasis at the plant began to shift from a single program, production facility to a multiprogram, applied technology facility.

E.1.3 Y-12 Plant

Primary functions of the Y-12 Plant include development and fabrication support for DOE's weapons design laboratories and the processing of source and special nuclear materials (SNM), fabrication support for other DOE plants, and support for other government agencies. The combination of production, development, engineering, and support activities at Y-12 is an integrated capability, not normally available in production complexes.

E.2 Low Level Waste Disposal Site SWSA 6.

ORNL is currently operating Solid Waste Storage Area (SWSA) 6 as a disposal site for LLW. This site has been used by ORNL since 1969 for the disposal of on-site generated LLW. ORNL has also been developing SWSA 7 since 1979 as an additional disposal site for LLW.

Future operations at SWSA 6 will gradually phase out below-grade disposal and use only above-grade tumulus disposal. Another site is being planned.

SWSA 6 is located in the southwest region of the ORR. Development of this 27.2 ha (68-acre) site was started in 1959. An 2.4-m-high (8-ft) chain-link fence with barbed wire outriggers encloses the area. The operational life of SWSA 6, under the current rate of waste generation and improved disposal criteria, is estimated to be through the mid-2000s (see the following subsection). Less than 12 ha (30 acres) of usable land is available in the 27.2 ha (68-acre) tract.

Since 1986, SWSA 6 has utilized a variety of GCD techniques for the disposal of ORNL LLW including the use of below-grade concrete silos and wells and an above-grade tumulus demonstration project. The method of disposal currently used for each waste type disposed of in SWSA 6 is presented in Table E-1.

Table E-1. Disposal Method for Waste Currently Disposed in Solid Waste Disposal Area 6	
Waste Type	Disposal Method
Contact-handled low-level waste (LLW)	Concrete silos/tumulus
Asbestos	Concrete silos

Below grade disposal concrete silos. Concrete silos are used for CH LLW. These concrete silos are located in separate areas of SWSA 6. A concrete silo is constructed of two 16-gauge, corrugated steel pipes-one 2.4 m (8 ft) in diameter and the other 2.7 m (9 ft) in diameter. The smaller pipe is concentrically placed inside the larger pipe, and both are placed vertically in a trench. The annular space between the two pipes is filed with concrete. The pipes range from 4.3 to 6 m (14 to 20 ft) in length, depending on the depth of the water table at a given location. A wire reinforced, 30.48-cm-thick (12-in.) concrete pad is poured in the bottom of the silo.

The silos are aligned in clusters within the trench. The depth of the trench is always located and dug with its lowest point in a minimum of 0.60 m (2 ft) above the maximum water table evaluation. A 3-in.-diam polyvinylchloride (PVC) pipe with a bottom cap is used as a monitoring well and placed to the low point of the trench between each silo. A 3-in. PVC monitoring well without a bottom cap is installed inside each silo with the bottom resting on the concrete pad. The bottom 0.60 to 0.91 m (2 to 3 ft) of each monitoring well is slotted to allow collection of liquids for sampling and quarterly monitoring of the hydrological isolation of the silos.

Fill dirt is placed around the silos, leaving the tops of the silos at finish grade. As the fill settles, more fill is added as required to provide water runoff away from the silo. Each silo is identified by a unique number such as TL-XXX (trench/low range). The silo is capped with a 30.48-cm-thick (12-in.) steel-reinforced concrete cap.

Above-grade tumulus disposal. Above-grade tumulus disposal is the preferred method for disposal of LLW in SWSA 6. Tumuli I and II were used for the disposal of LLW in SWSA 6 from April 1988 through December 1991. Use of the Class L-II (Class L-II waste refers to waste which consists primarily of fission product radionuclides with half lives of 30 years or less suitable for disposal in engineered facilities designed to isolate LLW from the environment and the public) IWMF for LLW disposal in SWSA 6 began in late 1991 and will continue until new disposal facilities are operational.

Tumulus Demonstration Disposal Project (TDDP). Tumulus disposal involves the placement of containerized LLW into concrete rectangular vaults that are subsequently loaded and stacked on a curbed concrete pad and capped with natural materials. The TDDP was

developed and implemented as part of the former LLWDDD Program. The Tumulus I pad was constructed in SWSA 6 during early 1987. Actual loading of concrete vaults onto the pad began in April 1988. The Tumulus I pad was filled to capacity in June 1990, and a plastic cover was installed over the entire assembly. A total of 290 vaults [approximately 784 m^3 (28,000 ft^3)] were placed on the Tumulus I pad.

The Tumulus I pad is approximately 19.8 x 32 m (65 x 105 ft). The pad was constructed using high-strength (6000 psi) concrete and reinforced using epoxy-coated rebar. The concrete pad varies in thickness from 20.32 cm (8 in.) at the center to 40.64 cm (16 in.) along the perimeter of the pad. The pad has a concrete curb 15.24 cm (6 in.) high along the entire perimeter. Surface drainage channels were constructed north, east, and south of the pad to divert surface runoff away from the pad.

The concrete vaults that are loaded and stacked on the concrete pad are designed to be used a structurally stable overpacks for containerized LLW. The concrete vaults' outer dimensions are 2.39 m (7 ft 10 in.) long; an inner cavity is sized to receive a standard box 1.2 x 1.8 x 1.2 m (4x 6 x 4 ft) and to leave a 10.16-cm (4-in.) annular space. After the containerized solid LLW is placed in the vault, the annular space is filled with concrete, and a precast concrete lid is placed on the vault and sealed with bitumen. The loaded and sealed concrete casks are subsequently placed and stacked on the tumulus pad in rows abutting each other.

Tumulus II Disposal. The Tumulus II pad began operation in October 1990 and was filled to capacity in late 1991. Prior to the operation of the Class IWMF in the southwestern portion of SWSA 6, a total of 220 vaults were placed on the Tumulus II pad.

The Tumulus II pad is located on an approximately 0.40-ha (1-acre) site just north of the Tumulus I pad. The tumulus pad is approximately 18.2 x 27.4 m (60 x 90 ft) and is 30.48 cm (12 in.) thick. The pad was constructed of high-density concrete and reinforced with epoxy-coated steel. The pad has concrete curbs 0.30 m (1 ft) high on the south, east, and west sides. The north side does not have a curb and was used for vehicle access during cask unloading operations. The loading area was adjacent to the north side of the pad and was constructed of crushed stone. Surface drainage channels are constructed north and east of the pad. These channels are connected to the existing surface drainage channels for Tumulus I.

IWMF. The first phase of IWMF was completed in Fy 1992. The disposal capacity of the IWMF is anticipated to be extended with additional pads to be constructed depending on the waste generation rate and development of new Class L-II disposal facilities.

The IWMF occupies an area of approximately 3.8 ha (9.5 acres) in the southwest portion of SWSA 6. Construction will continue over a period of 5 to 6 years, at which time the project is expected to be complete. The first phase will include the construction of two tumulus pads, a loading area, surface drainage channels, under and surface-pad drainage systems, a monitoring/transfer station, and the required utilities. When the disposal capacity of the first pad is depleted, construction of the third pad will be initiated. This process will continue

until six pads have been constructed--utilizing the maximum capacity of the site. Each tumulus pad will be approximately 18.2 x 27.4 m (60 x 90 ft) and 30.48 cm (12 in.) thick. The pads will be constructed using high-density concrete and reinforced with epoxy-coated steel.

E.2.2 Operational Status

Current operations are ongoing for both the Tumulus and Concrete Silo disposal operations. The initial closure of SWSA 6 has already begun, with all disposal operations planned to end in 1998.

E.2.3 Waste Acceptance Criteria

SWSA 6 only accepts wastes generated by facilities on the ORR, thus the waste acceptance criteria (WAC) are designed only for internal generators.

The generators are responsible for:

1. waste minimization.
2. proper package classification, identification and containerization.
3. ensuring WAC are met (ref: Waste Acceptance Criteria for Radioactive Solid Waste Disposal at SWSA-6, WMRA-WMPC-203, Oak Ridge National Laboratory, 4/30/93).
4. implementing a generator waste certification program.

A draft Performance Assessment (PA) for SWSA 6 disposal operations has been completed (ref: TBD), and, when the PA is complete, the WAC will be redone to reflect the performance objectives defined in DOE Order 5820.2A.

E.2.4 Disposal Limitations

All waste disposed of in SWSA 6 must be certified not to contain:

1. free liquids.
2. PCB contaminated materials.
3. compressed gases.
4. hazardous wastes (listed or characteristic as defined in 40 CFR 261 Subpart D and 40 CFR 261 Subpart C, respectively.
5. chelating agents
6. transuranic elements in concentrations greater than 100 nCi/g

E.2.5 Disposal Capacity

SWSA 6 will meet the CH SLLW disposal needs of ORNL through 1998.

E.2.6 Waste Classification/categorization

SLLW shall be classified into one of the following categories:

1. Contact handled (CH) SLLW - Packaged waste with an unshielded container surface radiation dose equivalent rate of less than or equal to 200 mrem/hr.

2. Remote handled (RH) SLLW - Packaged waste with an unshielded container surface radiation dose equivalent rate of greater than 200 mrem/hr.

3. Fissile waste - Solid waste that contains the isotopes U 233, U 235, Pu 238, Pu 239, Pu 241, and/or the elements neptunium, americium, curium, berkelium and californium.

4. Biological Waste - Any waste of a biological nature.

5. Asbestos waste - Any waste containing commercial asbestos or asbestos material.

6. Naturally Occurring and Accelerator Produced Radioactive Material (NARM) - Solid Waste that contains radionuclides which, due to their origin, are not regulated under the Atomic Energy Act of 1954, as amended, but are regulated under the Comprehensive Emergency Response, Compensation and Liability Act (CERCLA).

7. TRU Waste - Waste contaminated with alpha emitting transuranic radionuclides.

A draft Performance Assessment (PA) for SWSA 6 disposal operations has been completed (ref: TBD), and, when the PA is complete, the waste categorization scheme will be altered.

APPENDIX F:

SAVANNAH RIVER SITE, SOUTH CAROLINA

Site Contact:

Joanne M. Steingard (803) 557-9661

F.1 Site Description

Savannah River Site (SRS) is located in south central South Carolina and occupies an almost circular area of approximately 300 square miles (192,000 acres) near the Georgia border and ranges from 25 to 130 m above MSL. See Figure F-1 for the general site location. The major geophysical feature is the Savannah River, which forms the southwestern boundary of the site and is also the South Carolina/Georgia border. The SRS includes portions of Aiken, Barnwell, and Allendale Counties in South Carolina. The site is 25 miles southeast of Augusta, Georgia, 22 miles south of Aiken, South Carolina and 100 miles from the Atlantic Coast. SRS was constructed in 1952 for the purpose of manufacturing special nuclear materials for national defense. However, the production of nuclear materials has been suspended by DOE and the current mission of SRS is focused on environmental restoration and waste management activities. Westinghouse Savannah River Company (WSRC) is the primary contractor supporting the Department Of Energy (DOE) at SRS. As such, WSRC operates several waste management facilities on-site.

SRS currently generates low-level radioactive waste (LLW) in both solid and liquid forms, with the majority being solid. SRS defines LLW in accordance with DOE Order 5820.2A and refers to radioactive waste that does not meet the definition of high-level or transuranic waste. SRS further breaks down low-level waste in two categories: as either low-activity (LAW - waste radiating $<$ 200 mrem/hour) or intermediate waste (ILW - waste radiating $\geq$ 200 mrem/hour). The radiation dose rate shall be measured at a distance of 3 inches from an unshielded container. The site's solid LLW includes such items as protective clothing, tools, and equipment that have become contaminated with small amounts radioactive material. WSRC currently operates a solid waste burial ground, Low-Level Radioactive Waste Disposal Facility (LLRWDF) for the disposal of this LLW waste. However, in 1987, DOE issued guidance which directed that new disposal facilities constructed in humid climates (including the SRS area) must be "decoupled from the ground water table." In order to comply with this directive, a project to build disposal vaults (called the E-Area vaults) for the disposal of LLW was developed. Current LLRWDF and future LLW operations are described in Section 3.9.2.

Some operations at SRS produce hazardous and mixed (waste having both hazardous and radioactive components) waste materials which are regulated under the Resource Conservation and Recovery Act (RCRA) and the Atomic Energy Act. Currently, these hazardous and mixed waste materials are being stored in accordance with RCRA requirements until treatment and disposal capacity is available. Onsite disposal for these wastes has been planned with the development of the Hazardous Waste/Mixed Waste Disposal Facility (HW/MW DF) project. This project is intended to provide management and disposal capabilities for hazardous and mixed (radioactive waste containing hazardous waste components) waste generated at the Savannah River Site (SRS) that cannot be handled at other existing or planned facilities. The HW/MW DF consists of two phases; a disposal facility and a treatment facility. Each of these facilities is to be permitted separately. For the purposes of this report, only the Hazardous Waste/Mixed Waste Disposal Vault

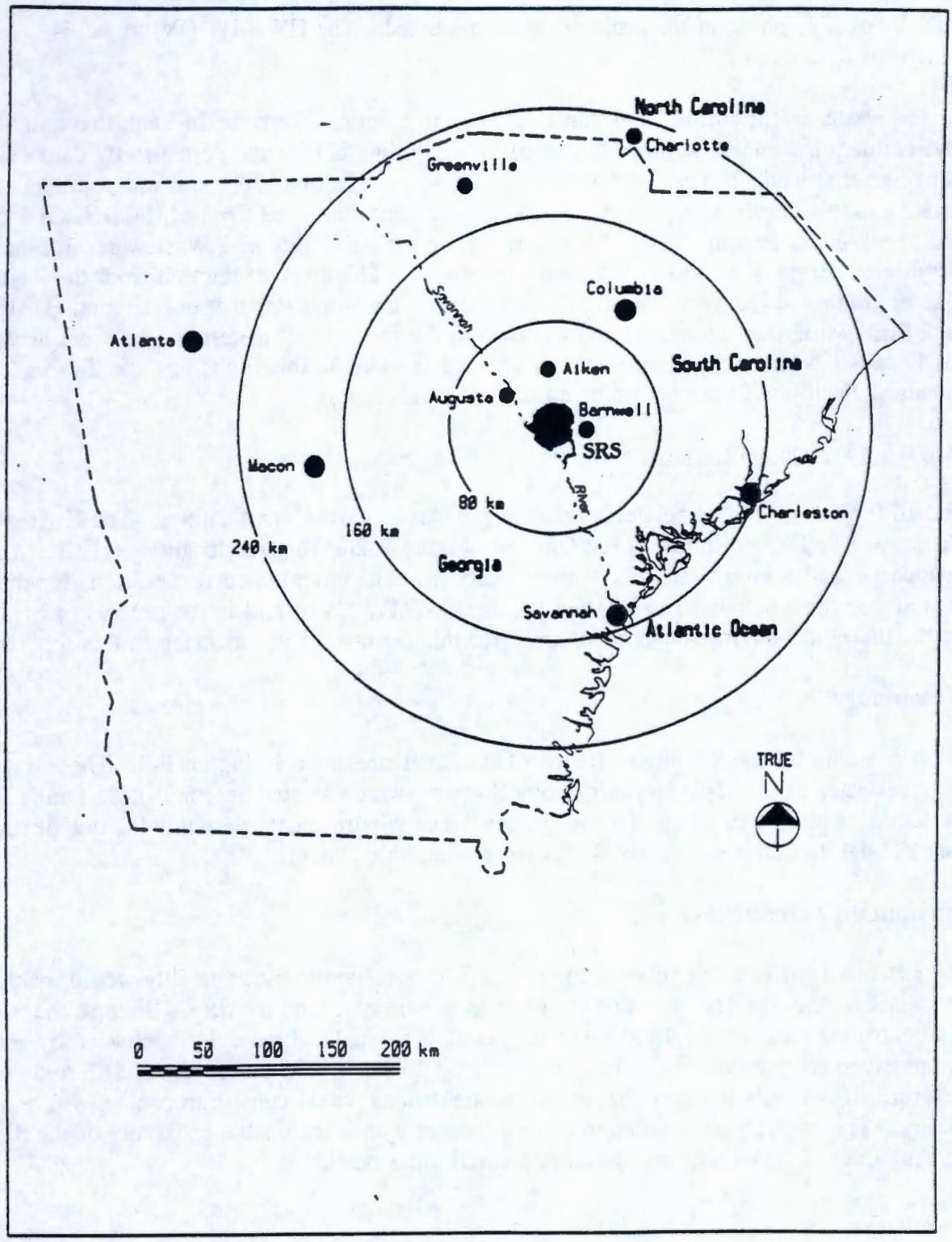


Figure F-1. Location Map: SRS with 240-km Radius

(HW/MW DV) phase of the project will be discussed. The HW/MW DV project is described in Section 3.9.3.

Mixed waste, in the form of a decontaminated salt solution, from the In-Tank Precipitation and Effluent treatment Facilities is treated in a grouting facility and permanently disposed in above-ground vaults at the Z-Area Saltstone Facility. The disposal vaults are permitted under a South Carolina Department of Health and Environmental Control (SCDHEC) Industrial Waste Permit. SCDHEC permits the grouting facility as a Wastewater Treatment Facility by virtue of a "totally enclosed exemption". This is an exemption from the Resource Conservation and Recovery Act (RCRA) regulation and stipulates that only F- and H-Area tank farm waste may be treated and disposed at the facility and therefore, could not accept offsite waste without extensive permit modification. Due to this limitation, the Z-Area Saltstone Facility will not be discussed further in this report.

F.1.1 Environmental Conditions

The LLRWDF is located between the F- and H-Areas separations facilities. The E-Area Vaults will be located in the LLRWDF. See Figure F-2(a) for area locations relative to site boundaries and Figure F-2(b) for facility locations. The environmental conditions for the area are outlined below. The location for the HW/MW DV is still in the process of being sited; therefore, environmental conditions for this facility are not included in this report.

Meteorology

Windrose data for the vicinity of the two facilities is presented in Figure F-3. These data were collected at the H-Area meteorological tower, which located approximately 1 mile from the facilities in an area of similar topography. The windrose data shown is for one of seven Pasquill stability classes, namely the extremely unstable classes.

Population Characteristics

The potentially affected population for any accidents related to either facility would include personnel on the Site and the general public in the areas around the SRS. Because the SRS is a controlled area, access by the general public is limited and carefully controlled by active and passive security systems. The general public does not have access to the SRS and therefore, it is highly unlikely that off-plant populations would come into contact with either facility. The two largest population centers located within reasonable proximity of the Site are Augusta (25 miles northwest) and Aiken (20 miles north).

Seismicity

The SRS is in an area that has rather low seismic frequency. Based on three centuries of recorded history of earthquakes, an earthquake above Intensity VII in the Modified Mercalli Scale (MM) would not be expected at the SRS. Only two earthquakes of Intensity VII or

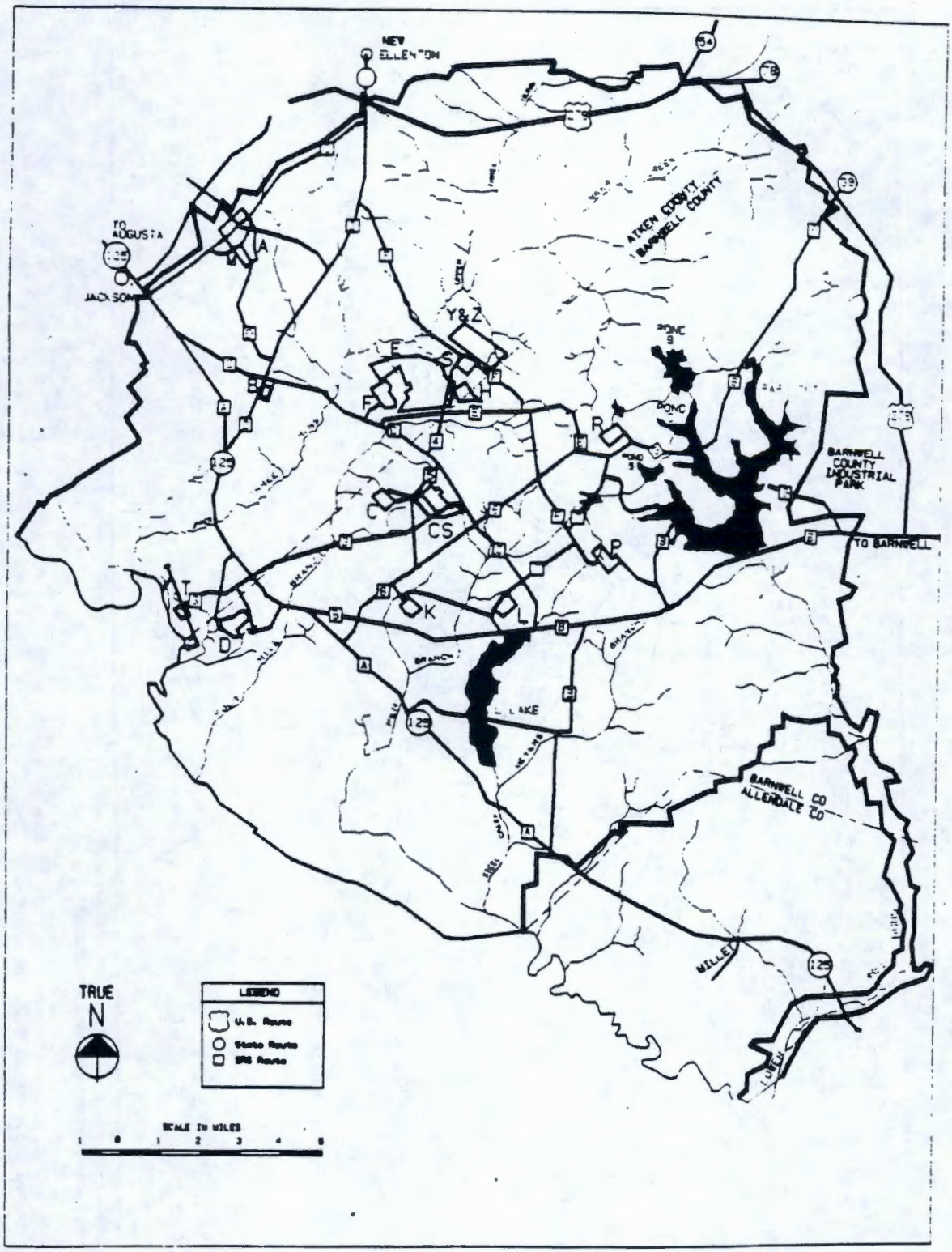


Figure F-2(a). Area Location Map

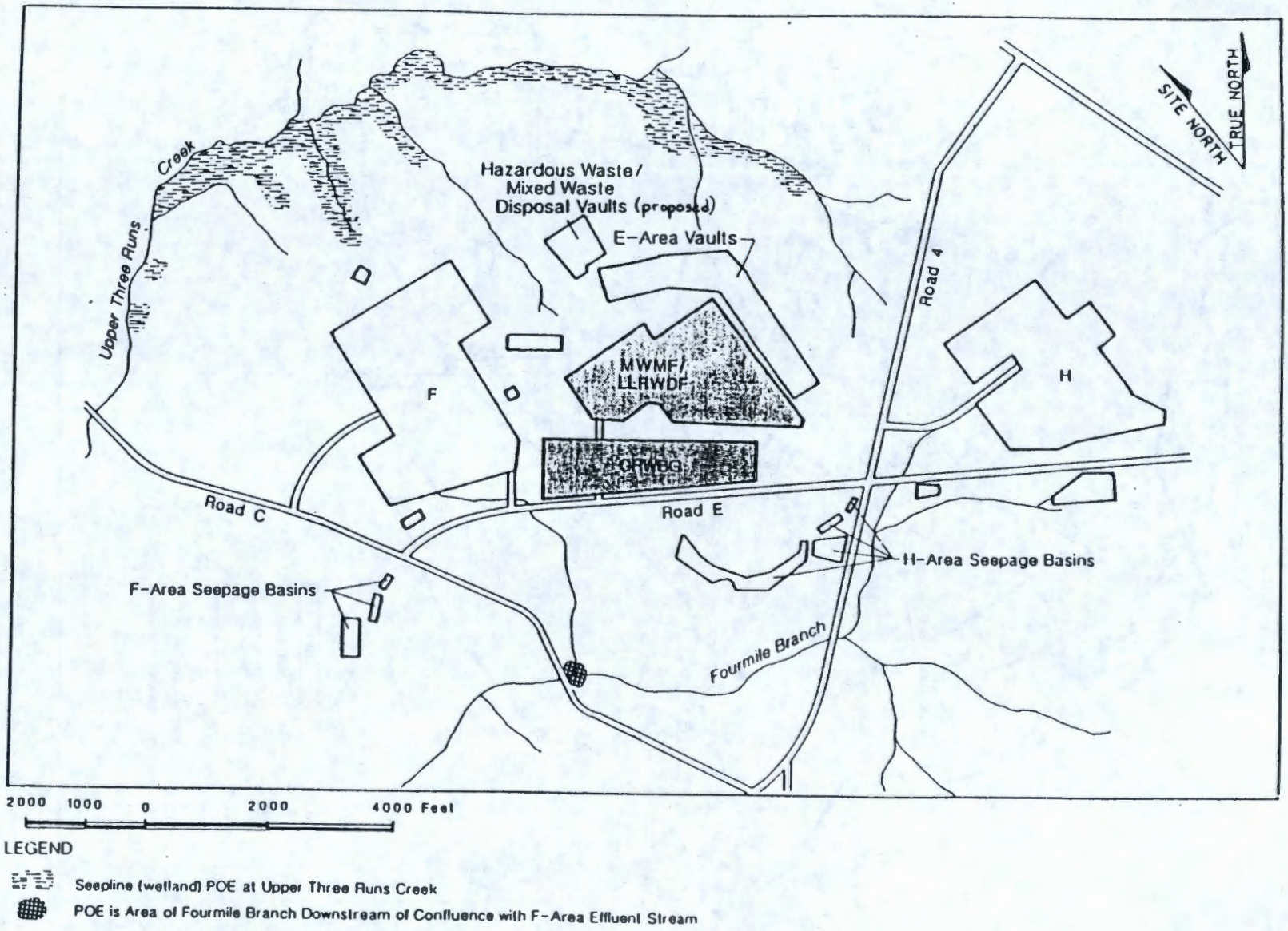
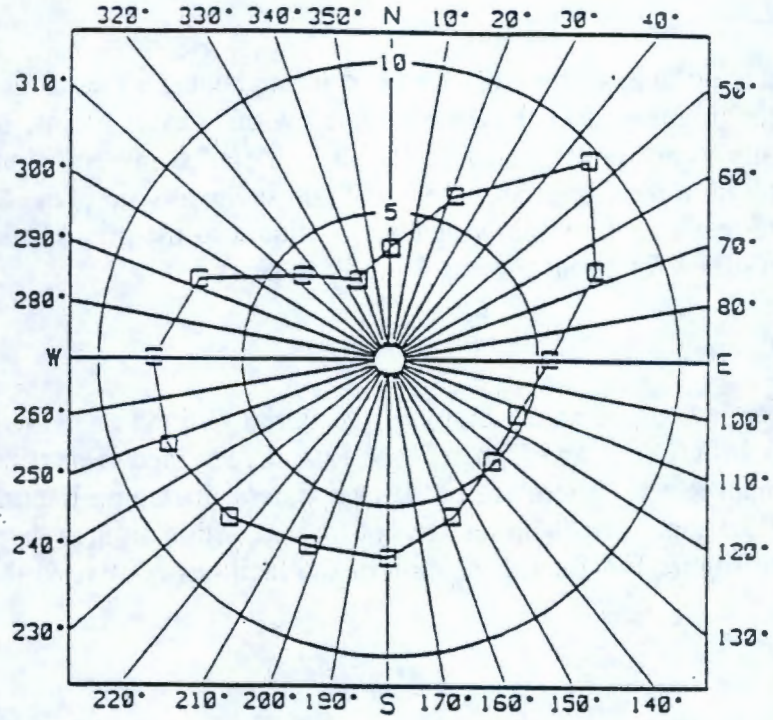


Figure F-2(b). Detailed Site Location Map



TOWER - M-32

WINDROSE DATA

MINIMUM DATE MMDDYY 10182
MINIMUM TIME ZULU 0000
ENTRIES ALL CLASSES 35252

MINIMUM DATE MMDDYY 123186
MAXIMUM TIME ZULU 2400
ENTRIES THIS CLASSES 35252

DIRECTION	SPEED IN METERS/SEC 0-2	2-4	4-6	6-8	8-12	>12	AVERAGE SPEED	TOTAL TOT
N	284	571	463	89	13	0	2.96	1328
NNE	190	896	911	131	13	0	3.31	2141
NE	234	1341	1559	229	18	0	3.38	3381
ENE	229	1256	1078	122	1	0	3.19	2696
E	191	988	737	85	2	0	3.13	1995
ESE	128	832	631	102	7	0	3.24	1710
SE	153	743	722	106	25	0	3.27	1749
SSE	171	861	927	140	25	0	3.21	2124
S	179	923	1050	226	18	0	3.46	2387
SSW	214	929	1051	218	33	1	3.25	2445
SW	226	1075	1185	228	31	0	3.33	2637
WSW	229	1197	1163	243	71	2	3.38	2901
W	234	1082	1074	342	124	2	3.75	2858
WNW	241	883	922	277	113	2	3.33	2438
NW	197	584	483	125	24	0	2.97	1413
NNW	175	463	299	75	17	0	2.50	1029
NO DIRECT	0	0	0	0	0	0	0.00	0
AVG SPEED	1.25	3.31	4.80	6.64	9.01	13.93	3.25	
TOT ENTRY	3195	4625	4169	2721	535	7		35252

DIRECTION	PERCENT TIME WIND & SPEED 0-2	2-4	4-6	6-8	8-12	>12	TOTAL
N	0.58	1.62	1.30	0.23	0.04	0.00	3.77
NNE	0.54	2.54	2.58	0.37	0.04	0.00	6.07
NE	0.66	3.80	4.42	0.65	0.05	0.00	9.59
ENE	0.65	3.59	3.06	0.35	0.00	0.00	7.65
E	0.54	2.78	2.09	0.24	0.01	0.00	5.66
ESE	0.39	2.36	1.79	0.29	0.02	0.00	4.85
SE	0.43	2.11	2.05	0.30	0.07	0.00	4.96
SSE	0.49	2.44	2.63	0.40	0.07	0.00	6.03
S	0.46	2.62	2.98	0.64	0.05	0.00	6.77
SSW	0.61	2.63	2.98	0.62	0.09	0.00	6.94
SW	0.64	3.05	3.13	0.62	0.09	0.00	7.54
WSW	0.65	3.40	3.29	0.69	0.20	0.01	8.23
W	0.66	3.07	3.05	0.97	0.35	0.01	8.11
WNW	0.68	2.50	2.62	0.79	0.32	0.01	6.92
NW	0.56	1.66	1.37	0.35	0.07	0.00	4.01
NNW	0.50	1.31	0.85	0.21	0.05	0.00	2.92
NO DIRECT	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SOURCE: C.H. HUNTER, WSRC-RP-89

Figure F-3. Windrose in the Vicinity of the LLRWDF

greater have occurred within 200 miles of the site. They were the Charleston, SC event (epicenter 90 miles from the SRS site) and the Union County, SC event (epicenter 100 miles from the SRS).

Subsurface faults do exist in the SRS area and throughout the Piedmont and Atlantic Coastal Plain physiographic provinces. Faults associated with Triassic basins, in particular the Dunbarton Basin border faults, occur under SRS. Detailed investigations of these faults, and of other faults within the Cretaceous Coastal Plain sediments (i.e., the Millet and Pen Branch faults), indicate that no fault underlying SRS continues to the ground surface and none have experienced an offset for about the last 30 million years.

Surface Water

Area surface water bodies in the vicinity of the Burial Ground and HW/MW DV location consist of Four Mile Creek and Upper Three Runs Creek, and their tributaries. All drainage is to the Savannah River. There are no surface waters, including intermittent streams, within 2000 ft of the location. The facilities are not located within an area designated as a 100 year floodplain. See Figure F-4 for the location of the facilities relative to the 100-year floodplain.

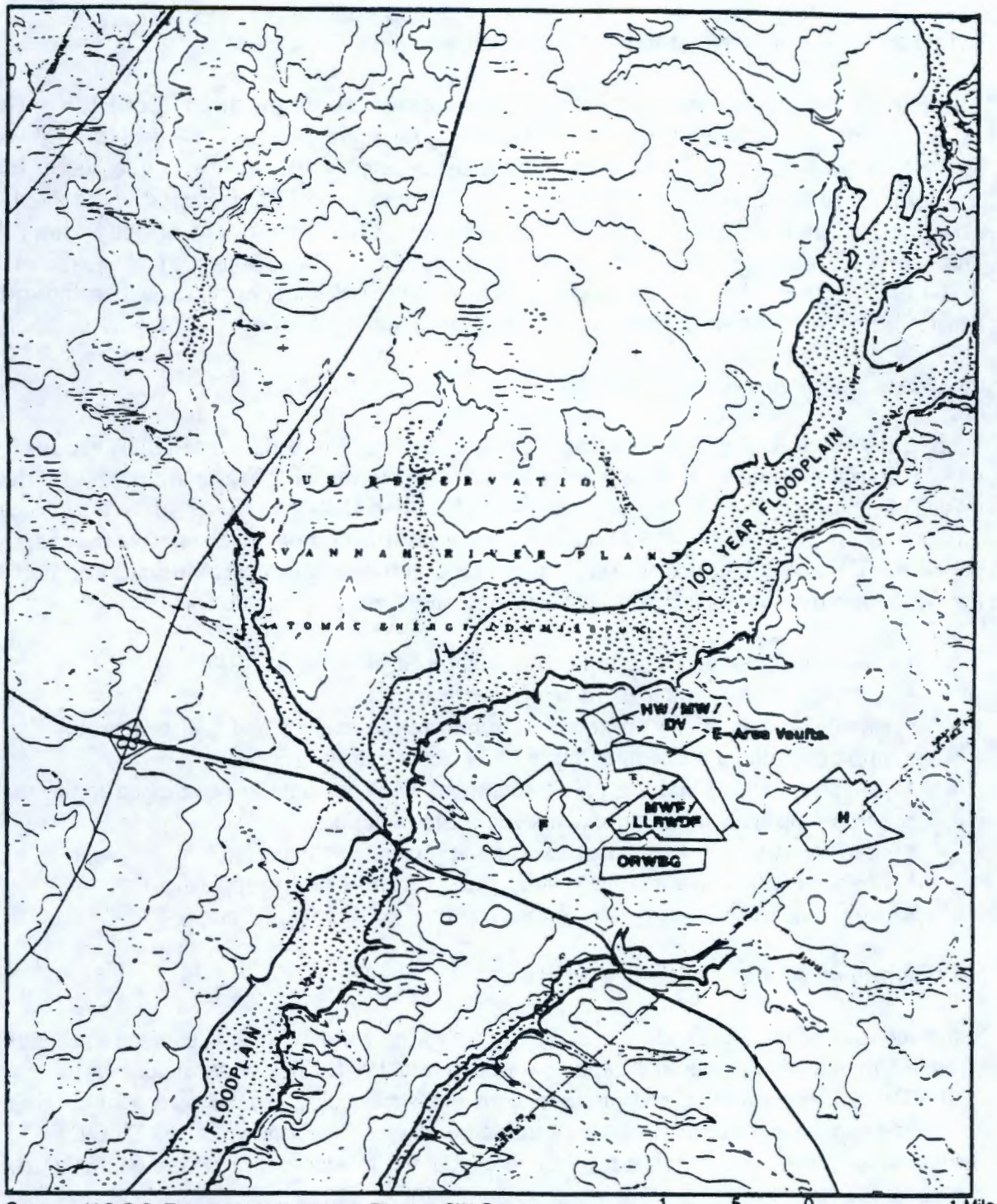
Soils

The stratigraphic section underlying the location consists of nearly a thousand feet of mostly unconsolidated sands, clayey sands, sandy clays, and clays. The principal surface and near-surface soils are clayey sands averaging about 1/3 clay. These soils have demonstrated a good retention capacity for most radionuclides.

F.1.2 LLW Disposal Facilities

Solid, low-level radioactive waste generated at the SRS and some wastes from offsite are disposed at the LLRWDF, formerly called the Low-Level Burial Ground, a 195 acre facility. These wastes have accumulated from operations in the production of nuclear materials for the U.S. Defense Programs since 1953. The LLRWDF consists of two sections. The original, or old, Burial Ground, consists of 76 acres, is designated as Area 643-E, and ceased operations in 1972. Burial operations were phased in during 1969 to 1972 in the present Burial Ground which is designated as Area 643-7E and occupies 119 acres.

Current operations at the LLRWDF require that prior to being placed in the facility, waste has been separated and packaged by the type and amount of radioactivity it contained. Low-activity beta-gamma waste (radiating > 300 mrem/hr) is containerized and disposed of in engineered low-level trenches, which are about 22 feet deep. Sides of the trenches are sloped to prevent cave-ins, and the floors are slightly sloped so that rainwater is collected in a sump for monitoring. The higher-activity portion of the low-level waste is disposed of in separate trenches or in Greater Confinement Disposal, consisting of fiberglass-lined, concrete



Source: U.S.G.S. Topographic Map, New Ellenton SW Quadrangle, Floodplain Date from U.S.G.S.

1 .5 0 1 Mile

Figure F-4. Facility Location Relative to 100-Year Floodplain

cylindrical holes or concrete trenches.

The E-Area vaults were designed for a 20-year operational life for disposal of LLW. Three different types of vaults will be used for proper waste segregation. The Low-Activity Waste (LAW) Vaults will accept LAW. The Intermediate-Level Vaults is designed to accept both tritium ILW (defined as ILW containing $\geq$ 10 Ci/package of TRU isotopes) and non-tritium ILW (defined as ILW containing < 10 Ci/package of TRU isotopes). Currently, one LAW and one ILW vault have been constructed; one more of each is planned to be operational in mid-1997. Eighteen LAW vaults and eight ILW vaults will be constructed according to the project schedule, contingent upon funding and DOE approval.

a) Waste Acceptance Criteria (WAC)

Procedures for accepting nonhazardous, low-level radioactive solid waste (LLW) in the 643-7E Burial Ground or E-Area Vaults are provided in the SRS Waste Acceptance Criteria (WAC) Manual, WSRC -1S as required by DOE Order 5820.2A. Refer to WAC Procedure 3.03 and 3.10 in the WSRC-1S Manual for more information on waste acceptance criteria for the LLRWDF and EAV, respectively. Figure F-5 shows a flow chart outlining the process for waste approval and acceptance. Waste generators are responsible for:

- ensuring prohibited materials are not shipped as LLW to SRS
- adhering to the principles of waste minimization
- establishing auditable programs to minimize the amount of LLW generation
- implementing and documenting a LLW certification program
- providing annual and ten year forecasts of LLW streams to be shipped to the facility
- complying with the requirements for waste containers
- characterizing all waste streams using approved methods
- financing corrective actions required as a result of nonconformance
- providing waste data via the Waste Information Tracking System

b) Operational Status

Some sections of the LLRWDF are currently accepting solid LLW. The current schedule estimates the vaults will begin accepting waste in mid-1994. The waste placed in the LLRWDF will remain there and monitoring of the surrounding groundwater will continue, to detect migrating radionuclides. Post-closure care of closed sections of the LLRWDF (including sections awaiting closure) will be conducted in accordance with a RCRA Part B Permit.

c) Capacity

LAW Vault: Each concrete vault is 643 feet long by 145 feet wide by 27 feet tall with has approximately 1,700,000 cubic feet of disposal capacity.

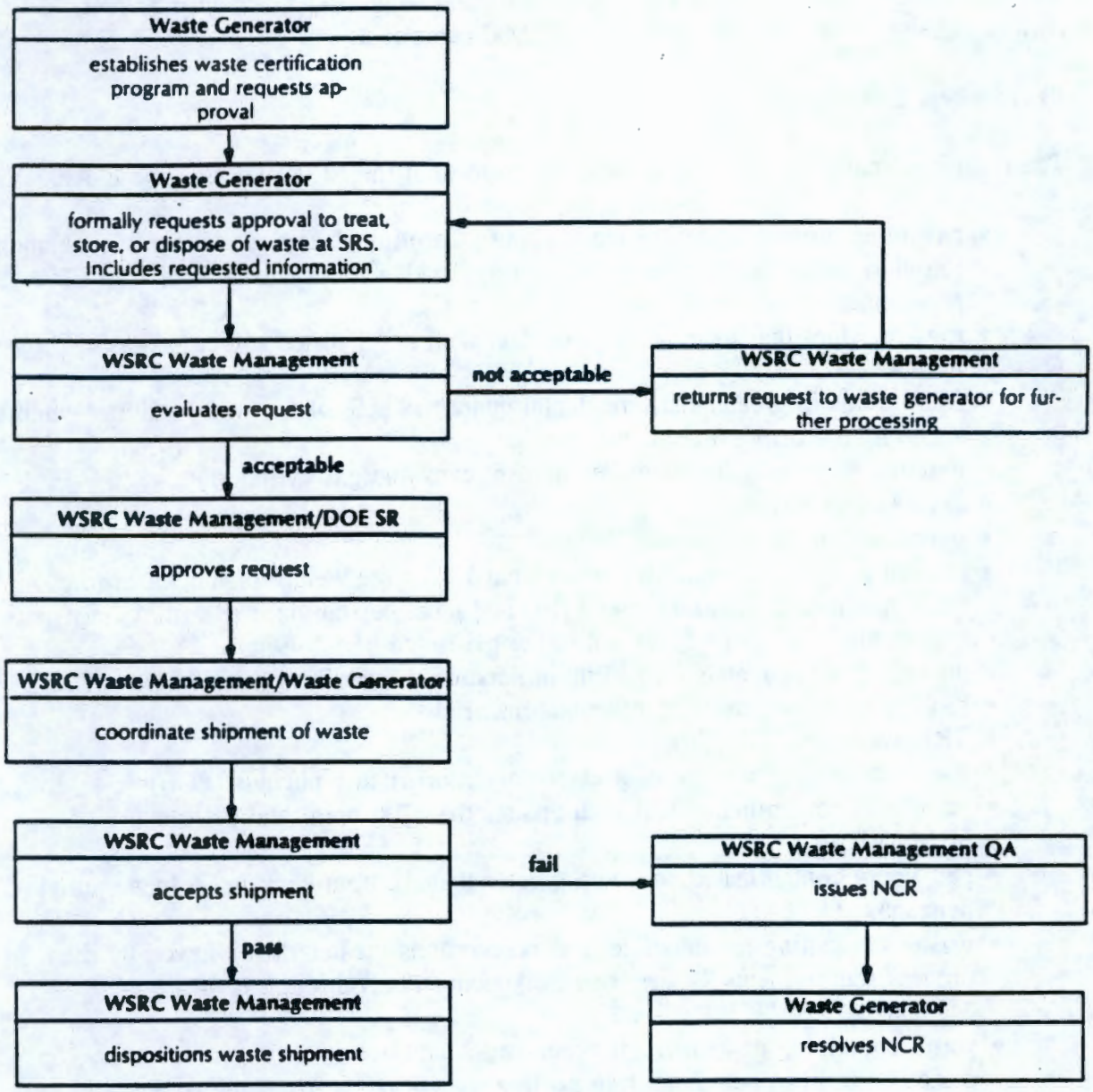


Figure F-5. Flow Chart for Waste Approval and Acceptance

ILW Vault: Each non-tritium ILW vault is 189 feet long by 48 feet wide by 29 feet tall with approximately 200,000 cubic feet of disposal capacity. The tritium vaults are structurally identical to the nontritium ILW vaults except for the length, which is only 57 feet. The tritium vaults have a disposal capacity of 57,000 cubic feet.

d) Disposal Limitations

The following materials are prohibited from disposal at the LLRWDF and the E-Area Vaults:

- hazardous wastes as designated by South Carolina Hazardous Waste Management Regulations (SCWMR) R.61-79.261 (e g. lead, mercury, cadmium) and EPA regulations (40 CFR 261)
- rags or wipes that have come in contact with any F-listed solvent as defined by RCRA.
- free liquids in greater than incidental quantities (1% of the waste volume when the waste is in a disposal container)
- gaseous waste (e.g. unpunctured aerosol cans and gas cylinders)
- explosive materials
- pyrophoric materials
- chelating agents in amounts greater than 1% of the weight of the waste (e.g. ethlyene diamine tetraacetic acid [EDTA] must be stabilized (8% max limit))
- unneutralized acids or bases not in the pH range of 5 to 9
- unreacted alkali metals (e.g., lithium, sodium, potassium)
- biological, pathogenic, or infectious materials
- TRU waste > 100 nCi/g
- waste containing 50 ppm or greater polychlorinated biphenyls (PCB)s
- petroleum contaminated soil with greater than 100 ppm total petroleum hydrocarbons
- petroleum contaminated soil with greater than 10 ppm benzene, toluene, ethyl benzene, xylene
- wastes containing radionuclide in concentrations greater than allowed by the process requirements as specified in Attachments B through F of the WSRC -1S Manual
- waste containing or capable of generating quantities of toxic gases, vapors, or fumes harmful to personnel transporting, handling, or disposing of the waste
- chemically incompatible materials in any waste container or package (refer to Appendix B of the WSRC 1S Manual)
- waste generating a radiation rate greater than 50 R/hr at 1 ft from outer surface of disposal container without prior Solid Waste Management approval
- nitrated organic resins
- waste classified as Greater-Than-Class-C by 10 CFR 61
- waste that has not been certified as described in procedure WAC 2.01 of the WSRC-1S Manual
- LLW packages shall not contain greater than 15% void volume

- the waste shall contain no more than one weight percent of less-than-10-micrometer-diameter particles or 15 weight percent of less than 200-micrometer-diameter particles
- waste packages generating greater than one watt per cubic foot

Procedures WAC 3.03 and 3.10 in the WSRC-1S Manual describe limitations in terms of physical form, radionuclide content, nuclear safety, and heat load limitations for the LLRWDF and EAV, respectively.

F.1.3 Hazardous Waste/Mixed Waste Disposal Vaults (HW/MW DV)

The HW/MW DV will provide above-grade, concrete disposal vaults which are designed to meet applicable United States Environmental Protection Agency (USEPA) and South Carolina Department of Health and Environmental Control (SCDHEC) standards, Department of Energy (DOE) orders, and will conform to the joint design guidance (EPA/NRC, 1987) for mixed waste land disposal facilities issued by the USEPA and Nuclear Regulatory Commission. The HW/MW DV include the ten, above-grade, reinforced concrete disposal vaults which are to be permitted as landfills under the South Carolina Hazardous Waste Management Regulations (SCHWMR) R.61-79.264 Subpart N Standards. The disposal vaults will be designated as Building Numbers 645-1E to 645-10E.

Initially, two of these disposal vaults will be constructed. Four more vaults are planned under the HW/MW Disposal Facility - Vault Expansion project. The disposal facility will be constructed as a final disposal area for treated and stabilized hazardous and mixed waste generated at the SRS. Operations are anticipated to continue for approximately 15 years after startup, based on the current waste generation, forecasted generation rate, and SRS mission. The above-grade vaults have been designed to isolate the disposed waste from the ground water regime, the general environment, and inadvertent human contact.

a) Waste Acceptance Criteria

The HW/MW Disposal Vaults will be used as a permanent disposal site for hazardous and mixed waste generated at several locations at SRS. The first two vaults constructed have been dedicated for the disposal of Consolidated Incineration Facility stabilized ash and blowdown. Waste Acceptance Criteria which conforms to DOE Order 5820.2A will be provided in the SRS WAC Manual, WSRC -1S when developed for the HW/MW DV. The Waste Acceptance Criteria listed in the RCRA Part B permit application for the facility is summarized in Table F-1.

Any waste generator that plans to send waste to the HW/MW Disposal Vaults will be required to develop a waste certification program to ensure all elements of the WAC will be met. As part of the WAC, Waste Management Operations will ensure prior to accepting waste for disposal that the waste meets applicable Land Disposal treatment standards. A

Waste Tracking Record that must accompany a waste shipment requires certification that the waste meets applicable Land Disposal treatment standards.

Wastes will typically be received either in solid metallic forms (e.g., plates or blocks), granular or powdered solids, or as immobilized wastes in a cement matrix. Lead, mercury, cadmium, and chromium are the principal hazardous constituents which will be sent to the HW/MW Disposal Vaults. All disposed wastes will meet applicable Land Disposal treatment standards required by SCHWMR R.61-79.268 and 40 CFR 268.

Table F-1 lists the Waste Acceptance Criteria must be fulfilled prior to acceptance of a waste shipment for disposal. Figure F-5 shows a flow chart outlining the process for waste approval and acceptance.

b) Operational Status

The current project schedule shows the first two vaults operational in 1/99, contingent upon receipt of the RCRA Part B Permit, DOE approval and adequate funding. Title II Design has been completed on the vaults. A RCRA Part B Permit application has been submitted to the South Carolina Department of Health & Environmental Control.

Table F-1. Acceptance Criteria for the HW/MW Disposal Vaults

1.	Completed and approved Waste Profile and Approval Sheet is required.
2.	Waste must be in appropriate containers.
3.	Waste containers must be properly labeled.
4.	Waste number(s) of the waste to be disposed must be shown on Table 2.
5.	Waste must not contain free liquid.
6.	Waste must not be reactive, ignitable, corrosive, nor incompatible.
7.	Waste must comply with applicable land disposal treatment standards.
8.	Containers having a surface radiation count, at 3 inches, in excess of 300 mrem per hour require special approval.
9.	Containers having a smearable radioactive surface contamination greater than the SRS clean area limits will not be accepted.
10.	Each container must have a complete Waste Tracking Record.
11.	Each waste container must be at least 90 percent full for disposal acceptance.

c) Capacity

The approximate outside dimensions of each vault are 205 feet long by 46-1/2 feet wide by 24-2/3 feet high. Each vault contains four individual waste cells with temporary, removable steel covers. Each waste cell is sized to contain the equivalent of 300 4 feet wide by 6 feet long x 4 feet rectangular concrete disposal containers or 2250 55/71-gallon drums.

Due to backlog of wastes, the first two vaults will be dedicated to the disposal of on-site, stabilized Consolidated Incineration Facility ash and blowdown wastes.

d) Disposal Limitations

The following wastes are prohibited from disposal at the HW/MW DV:

- Reactive, ignitable, or incompatible wastes will not be disposed at the facility.
- Free liquids will not be disposed at this site. This will be ensured by requiring the waste be tested using the Paint Filter Test, Method 9095 prior to disposal.
- Any wastes which do not meet applicable Land Disposal treatment standards required by SCHWMR R.61-79.268 and 40 CFR 268 will not be accepted for disposal at the HW/MW DV.
- Any wastes which do not meet the Waste Acceptance Criteria will not be accepted for disposal.
- A site-specific performance assessment will be completed to demonstrate that the HW/MW DV will meet the performance requirements stated in DOE Order 5820.2A. Any wastes not meeting the inventory limits established by the performance assessment will not be accepted for disposal.

Sections C, "Waste Characteristics" and D, "Process Information" of the HW/MW Disposal Vaults Part B permit application describe limitations in terms of disposal container requirements, configuration, and labeling. Criteria for physical form, radionuclide content, nuclear safety, and heat load limitations for the HW/MW DV will be described in the WSRC-1S Manual.

Table F-2. List of SCDHEC/EPA Waste Numbers of Wastes to be Disposed

Characteristic Wastes					
D001	D002	D003	D004	D005	
D006	D007	D008	D009	D010	
D011	D012	D013	D014	D015	
D016	D017	D018	D019	D020	
D021	D022	D023	D024	D025	
D026	D027	D028	D029	D030	
D031	D032	D033	D034	D035	
D036	D037	D038	D039	D040	
D041	D042	D043			
Spent Solvents and Waste Water Treatment Sludge					
F001	F002	F003	F004	F005	
F006	F027				
Toxic Wastes					
U001	U002	U003	U004	U006	U007
U008	U009	U011	U012	U014	U017
U019	U021	U022	U023	U025	U027
U028	U031	U032	U034	U036	U037
U041	U043	U044	U045	U046	U047
U048	U050	U051	U052	U053	U055
U056	U057	U060	U061	U063	U067
U069	U070	U071	U072	U073	U074
U075	U086	U077	U078	U079	U080
U081	U082	U083	U084	U088	U091
U092	U095	U102	U103	U105	U106
U108	U109	U110	U112	U115	U116
U117	U121	U122	U123	U124	U125
U127	U128	U129	U130	U131	U132
U133	U134	U136	U138	U140	U142
U144	U146	U147	U151	U154	U157
U158	U159	U161	U162	U165	U166
U167	U169	U170	U171	U182	U183
U184	U185	U187	U188	U190	U196
U197	U201	U204	U207	U208	U209
U210	U211	U213	U215	U216	U218
U219	U220	U223	U225	U226	U227
U228	U234	U236	U239	U247	U328
U359					
Acute Toxic Waste					
P005	P009	P011	P012	P016	
P017	P018	P022	P023	P024	
P028	P037	P045	P048	P051	
P054	P059	P060	P063	P064	
P068	P069	P070	P077	P089	
P093	P095	P098	P102	P104	
P105	P106	P108	P112	P113	
P116	P119	P120	P123		
Other Designated Wastes					
5555	6666	7777			