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CORRECTIVE ACTION MANAGEMENT UNIT INTERIM MEASURE/INTERIM REMEDIAL ACTION DECISION DOCUMENT AND APPLICATION SUPPORT DOCUMENT

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

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Draft
Corrective Action Management Unit Interim Measure/Interim Remedial Action Decision Document and Application Support Document

Rocky Flats Environmental Technology Site

Rocky Mountain Remediation Services, L.L.C.

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Still meeting Subpart N

October 21, 1996

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ABBREVIATIONS , ACRONYMS, AND INITIALISMS

AEC	United States Atomic Energy Commission
ALARA	as low as reasonably achievable
Am	americium
ARAR	applicable or relevant and appropriate requirements
BMP	Best Management Practices
CAB	Citizens Advisory Board
CAMU	Corrective Action Management Unit
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHWA	Colorado Hazardous Waste Act
cm/sec	centimeters per second
cy	cubic yards
Decision Document	Interim Measure/Interim Remedial Action Decision Document
D&D	Deactivation and Decommissioning
DOE	United States Department of Energy
DOT	United States Department of Transportation
ER	Environmental Restoration
ERDA	Energy Research and Development Administration
ft	feet or foot
FY	fiscal year
HW	hazardous waste
IA	Industrial Area
IA-East	Industrial Area-East
IA-West	Industrial Area-West
IDM	Investigation-Derived Material
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
in.	inch or inches
ITS	Interceptor Trench System
LDR	Land Disposal Restrictions
LLW	low-level waste
LLMW	low-level mixed waste
nCi/g	nanocuries per gram
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination
NSL	New Sanitary Landfill
NTS	Nevada Test Site
OU	Operable Unit

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QA/QC	quality assurance/quality control
QAT	Quality Action Team
PA	Protected Area
PAC	potential areas of concern
PCB	polychlorinated biphenyls
PCE	tetrachloroethene
PPRG	programmatic preliminary remediation goals
Pu	plutonium
RCRA	Resource Conservation and Recovery Act
RWSF	Remediation Waste Storage Facility
SE Quad	southeast quadrant
Site	Rocky Flats Environmental Technology Site
Site Vision	Rocky Flats Conceptual Vision
SW Quad	Southwest Quadrant
TBC	to-be-considered
TCE	trichloroethene
TRU	transuranic
TSCA	Toxic Substance Control Act
U.S.	United States
VOC	volatile organic compounds
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant

Bulk Storage only
2nd will be for container

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400,000 m³ bulk
100,000 m³ container
East of F&S

EXECUTIVE SUMMARY

The Department of Energy is requesting the State of Colorado to designate a corrective action management unit (CAMU) for storage of remediation wastes at the Rocky Flats Environmental Technology Site (RFETS). This CAMU designation is ~~being~~ requested as an option to facilitate risk reduction activities in support of site closure at RFETS. This designation will serve as a contingency in the event assumptions in the Ten Year Plan regarding offsite disposal capabilities prove to be invalid and onsite storage capabilities are necessary to facilitate risk reduction. In addition, clean up levels for radionuclides in soils, still being negotiated at this time, may require additional storage capabilities. The CAMU designation request is presented in the form of this Interim Measures/Interim Remedial Action (IM/IRA) Decision Document and Application Support Document. The facility to be constructed and managed under the CAMU designation would be the Remediation Waste Storage Facility (RWSF).

The CAMU-designated RWFS provides the basis for a cost-effective, flexible, and achievable remediation waste management strategy for RFETS. The overall objective of this designation request is to provide a rationale and proposed alternative that supports the goals of the Rocky Flats Cleanup Agreement (RFCA) and preamble. The CAMU will support the RFCA goal (Preamble, B2(a)) of initially controlling sources of contamination as a priority over off-site shipment. The RWSF CAMU will allow early cleanup to proceed by supplying an on-site destination for remediation wastes.

Only remediation wastes will be managed in this facility. Remediation waste types include contaminated soil collected from cleanup actions, treated and untreated sludge and sediments, Toxic Substance Control Act waste, such as asbestos and PCBs, treatment by-products from groundwater, surface water, and/or soil remedial actions, investigation derived materials (i.e. drill cuttings) from past and future characterization activities and decontamination waste which ~~has been~~ is characterized as hazardous, low- level radioactive, or low-level mixed waste. It is the intent of DOE to request a CAMU for storage only~~, and that all waste will be removed from the RWFS prior to closure~~. The request that CDPHE make a finding of fact as to whether the proposed facility also meets the requirements for a disposal facility, as described in paragraph 80 of the RFCA, is deferred. A determination has not been made on the period of operation of the RWSF or on the closure configuration. The closure configuration is dependent on the final decision for permanent disposal in the CAMU or offsite shipment, and cannot be addressed at this time.

This CAMU decision document details how the CAMU-designated RWSF supports risk reduction and eventual site closure in the following ways:

- Focuses limited funding resources on immediate risk reduction;

- Defers unnecessary treatment costs by not requiring treatment unless it is necessary to protect human health or the environment, while concentrating funding on actual cleanup;

- Provides an option for additional source removals at selected Individual Hazardous Substance Sites IHSSs); and

- Allows DOE to achieve economies of scale, making treatment and eventual disposal less costly and more practical.

This decision document identifies and provides information on how the RWSF will meet all applicable regulatory criteria for CAMU designation by the State of Colorado Department of Public Health and Environment (CDPHE). In addition, this document identifies and implements the other appropriate criteria supporting the selection of the CAMU location and conceptual design. The proposed selection was identified thorough a multi-phase alternatives analysis that evaluated several locations and technologies in order to achieve the objective of supplying a remediation waste storage facility (RWSF). National Environmental Policy Act (NEPA) values were also addressed within this selection process. Preliminary waste acceptance criteria, closure requirements, and a timeline are also included.

Several appendices supporting the decision process and the selected proposed alternative are attached to this document. These include siting studies, design descriptions, risk evaluations, NEPA values, and selection criteria.

Based on the initial screening and the comparison of alternatives, the best approach for a CAMU was determined to be an above-grade, concrete lined cell with primarily bulk placement, ~~to be~~ located in the eastern portion of the Protective Area near the former OU 4 Solar Ponds. This CAMU cell will be designed with a double composite liner and a final composite liner system equivalent to the Resource Conservation and Recovery Act (RCRA) Subtitle "C" requirements, as stated in the Code of Colorado Regulations (CCR) 6 CCR 1007-3, Part 264 Subpart N. Primary and secondary leak detection and collection systems between the two liners will provide further protection. An operational cover will provide isolation of the waste materials during operations The conceptual design includes features that will allow the CAMU to function as a retrievable storage facility include placement of the waste on a concrete floor; interior placement modules; waste containerization as appropriate; and waste mapping.

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1.0 INTRODUCTION

This Decision Document provides the United States Department of Energy's (DOE) technical justification and decision-making process for the option of siting and construction of a bulk storage remediation waste storage facility (RWSF) at the Rocky Flats Environmental Technology Site (the RFETS or Site) (see Figure 1-1). The document also serves as the initial application for designation of the proposed RWSF as a Resource Conservation and Recovery Act (RCRA) Corrective Action Management Unit (CAMU). The CAMU designation is available as a regulatory alternative to facilitate the implementation of reliable, effective, protective and cost-effective remedies. The designation of the facility as a CAMU means more rapid cleanup for a larger volume of waste in a safer manner than the conventional RCRA approach allows. Instead of treating each contaminated area individually, the RWSF CAMU contingency allows for bulk remediation waste to be brought to one centralized facility for management and storage. The CAMU designation of a bulk storage RWSF is necessary as a contingency to achieve the targeted ten-year cleanup goal. The need for a bulk storage CAMU facility is dependent on the final action levels agreed to for radionuclide cleanup objectives. Do we still need it??

The type of wastes to be managed in the facility would consist primarily of low-level, low-level mixed, and hazardous remediation and deactivation and decommissioning (D&D) waste which is amenable to bulk handling and storage. Low-level waste refers to waste with less than 100 nCi/g of alpha radiation.

Within this Decision Document is the information necessary for the Colorado Department of Public Health and Environment (CDPHE) to designate a CAMU with the RWSF being the facility used for storage. This CAMU designation by the CDPHE is required so that the CAMU and RWSF can be included as a regulated unit at the Site. By having a CAMU designation, the DOE can meet the waste management objectives consistent with the recently signed Rocky Flats Cleanup Agreement (RFCA), July 19, 1996 (DOE 1996a). The importance of the CAMU option is also recognized by the State of Colorado's Hazardous Waste Commission when it stated in the introduction of the CAMU Statement of Basis that a CAMU "can facilitate corrective actions" (i.e., environmental cleanups at facilities like the RFETS). Clearly, with the accelerated schedules proposed in the RFCA and Site Vision, the need for the type of flexibility provided by the CAMU approach is required as a contingency.

Does this imply another facility design and for other than storage?

In addition to RFCA, the Draft RFETS 10 Year Plan (TYP) (DOE, 1996b) has been developed to describe how accelerated cleanup and closure of RFETS would be achieved. The TYP addresses the management of remediation waste without a CAMU. Included in the TYP, as Major Decision 5, are assumptions for waste storage and offsite disposal capabilities. Cleanup levels for radionuclides in soils based on future site land use scenarios, are still being negotiated. The outcome of these negotiations will significantly impact the volumes of remediation waste that will be generated at RFETS. The CAMU designation is a contingency in the event a waste storage alternative is needed to effectively conduct the accelerated cleanup of the Site and meets the requirements of RFCA.

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The CAMU area being sought through this Decision Document ~~is~~ will be located within the eastern portion of the Protected Area (PA) of the Site (see Section 7.1). Within this CAMU area, an above-grade concrete-lined storage cell serving as the RWSF will be constructed to store remediation waste primarily in bulk form. The 4.12 acre concrete-lined cell will be designed to hold 100,000 cubic yards (cu yd) of remediation waste; however, the actual capacity can be adjusted because of the conceptual modular design. This RWSF incorporates retrieval and monitoring aspects.

It is the intent of the DOE to request a CAMU for storage only. ~~and that all waste will be removed from the RWSF prior to closure.~~ The request that CDPHE make a finding of fact as to whether the proposed facility also meets the requirements for a disposal facility, as described in Paragraph 80 of the RFCA, is deferred.

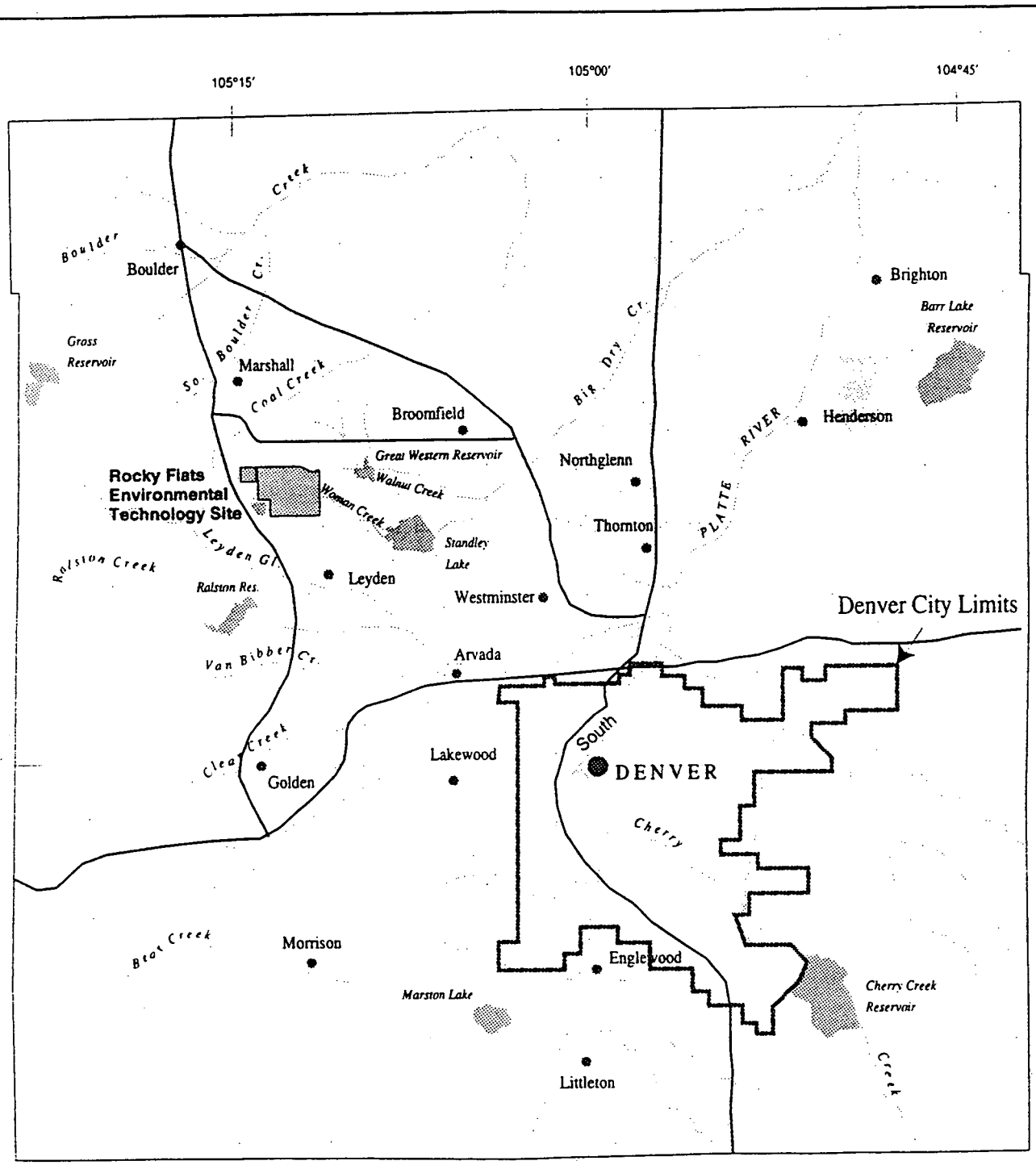

Figure 1-1

LOCATION OF THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

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1.1 Decision Document Organization

This document is divided into nine sections with six appendices. In total, this Decision Document is structured to provide the information required to support the technical justification of the CAMU and to provide sufficient information for the CDPHE to designate the CAMU. This document also provides the decision-making process used by the DOE to arrive at the conclusion that a RWSF is required as a contingency to meet RFCA and Site Vision objectives. With the final selection of the concrete-lined waste cell, this document addresses each of the seven decision-making criteria contained in the State of Colorado's Hazardous Waste Regulations under 6 CCR 1007-3 Part 264 552. By responding to these seven criteria, the DOE has demonstrated and documented the rationale for CDPHE to approve a CAMU. This is followed by an identification of the requirements that a CAMU will need to meet. This, in turn, is followed by an evaluation and recommendation of the specific type of CAMU needed to meet the requirements identified. Opinion!!!

This Introduction presents the objectives of the Decision Document, the role of the CAMU and RWSF at the Site, a general discussion of the Site description as well as the Site history. Section 2 provides a point-by-point discussion of how the proposed CAMU and RWSF meet each of the seven decision criteria under RCRA for the CAMU. It is these criteria which will be used by the CDPHE to make a CAMU determination. Waste characteristics of the material to be stored in the CAMU are presented in Section 3.0. Why use 2 terms??

The development of alternative actions and selection of the preferred alternative for the management of low-level and low-level mixed, and hazardous remediation waste is presented in Section 4.0 through Section 6.0. Section 4.0 addresses substantive criteria as described in paragraphs 80 and 109 of RFCA and regulatory requirements spelled out in 6 CCR 1007-3, Subpart S, Part 264, to obtain CDPHE approval for a CAMU. Section 5.0 describes how the final alternatives for a CAMU were developed. It includes a description of the screening methodology and the description and results of the two screening phases: the facility siting study and the facility design screen. Section 6.0 describes the final comparison of alternatives and the rational for the selected remedy. Section 7.0 is a detailed discussion of the selected remedy (i.e., the concrete lined waste cell located in the eastern portion of the Protected Area). These details include a risk evaluation, waste acceptance criteria, facility operations, National Environmental Policy Act (NEPA) values, and a summary of the value engineering study. The schedule for the design and construction of the RWSF is presented in Section 8.0.

1.2 CAMU DECISION DOCUMENT SCOPE AND OBJECTIVES

The following two sections discuss the scope and objectives for both this Decision Document and the CAMU. The primary objective of this CAMU Decision Document is to provide the CDPHE with sufficient documented justification for the need of a CAMU at the RFETS. In order to meet this primary objective, this document provides information on how the use of a CAMU can meet

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each of the seven decision criterion identified in the CAMU regulations (6 CCR 1007-3, Part 264, Subpart S) as well as the criteria included in paragraph 80 and 109 of the RFCA. This document also provides a description of the decision-making process leading to the conclusion by DOE that a CAMU with a RWSF is critical to the DOE's meeting the objectives of RFCA and the Site Vision.

1.2.1 Scope Description

In discussing the need for a storage facility, this document develops and evaluates the various alternatives available to manage remediation waste, including offsite disposal and various long-term storage options. Offsite disposal is evaluated as the "no action" alternative because the "action" described by this document is CAMU designation and construction of the RWSF. In the decision-making process, a screening phase is used to narrow the various options and a final selection process is used to conclude that the Concrete Lined Waste Cell east of the Solar Ponds is the best approach.

The two screening phases presented are:

1. Siting study to select a suitable location for onsite options.
2. A facility design analysis to evaluate design alternatives for onsite storage.

From the possible locations identified in the siting study, the best location was selected and then used as a basis for the facility design screen. In support of the RFCA, and in order to support the DOE objective of minimizing the area of contamination at RFETS, as well as maximizing to the extent practicable, offsite disposal, the DOE is requesting a CAMU designation for storage only. Any disposal option for the CAMU, as discussed in paragraphs 80 and 109 of RFCA, is currently ~~deferred. All criteria~~ and alternatives selected were developed based upon onsite storage. ~~followed by offsite disposal.~~ The exception was a no-action alternative that examined the impact of immediate offsite disposal.

How could this alternative be considered feasible when the DE showed clearly that if off-site disposal is the final objective, then CAMU is not cost-effect.

Pretreatment of remediation waste for specific Individual Hazardous Substance Sites (IHSS's) is not included in the scope of this document except for the purpose of cost estimating. The reason for this approach is that pretreatment is very specific to an IHSS action and specific waste types. Currently unresolved issues relative to radionuclide cleanup levels in soil also impact this assessment. This pretreatment discussion for each accelerated cleanup action will be included in Proposed Action Memorandum, Interim Measures/Interim Remedial Action Decision Documents, and Proposed Plans, or Remedial Action Plans for each specific IHSS or group of IHSS's; allowing treatment to be tailored to the specific action.

Waste acceptance criteria for the proposed RWSF will be addressed based on applicable RCRA and CERCLA requirements as well as applicable DOE policies. The types of requirements are described in Section 7.6, Conceptual Waste Acceptance Criteria. Waste acceptance criteria and operational details will be submitted during the design review and approval process. The scope of the Decision Document does not provide complete details of design, construction, startup, or

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operations; that information will be covered in subsequent documents following CDPHE designation of the CAMU.

The ability to retrieve and monitor the remediation waste was considered an important part of the decision process, especially in terms of community acceptance. Specific details of environmental monitoring are not in the scope of this document; however, groundwater monitoring is addressed in Section 7.1, and in accordance with 6 CCR 1007-3, Part 264, Subpart F, a groundwater monitoring plan will be prepared. Air monitoring will be addressed in any required Air Pollutant Emission Notices (APENs) and air permitting. Most air monitoring will be focused on construction and operations activities.

~~Final configuration after the stored waste in the RWSF has been removed will be to remove the structure and regrade and revegetate the facility footprint~~. Closure plans will be submitted during the design review process. The disposal option discussed in RFCA paragraph 80 is deferred at this time. ??

1.2.2 Decision Document Objectives

In order to meet the primary objective of documenting the technical justification for the CAMU and RWSF, this document provides information on how the use of a CAMU can meet each of the seven decision criterion identified in the CAMU regulations (6 CCR 1007-3, Part 264, Subpart S). X

The objectives which lead to the determination that a CAMU option is necessary include the following:

1. In support of the RFCA and the TYP, the management of low-level. low-level mixed, and hazardous remediation waste must ensure the safety of the public, RFETS workers, and the environment through reliable, effective, protective and cost-effective management of remediation wastes at the RFETS.

2. A means of consolidating remediation waste in one location is needed to support near-term risk reduction goals while addressing long-term liability and safety issues.

3. The management of low-level, low-level mixed, and hazardous remediation waste must result in a cost-effective solution that can be implemented under existing budgetary constraints.

4. The solution must be compatible with future land uses for the Site and the Site Vision.

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1.2.3 Drivers

Several drivers establish the need for a CAMU designation as a contingency to meet the TYP as well as to serve as the basis for both the scope and the objectives of the Decision Document. These drivers include:

- The Site Vision is to have the Site cleaned to a level that is consistent with planned future land uses within a ten-year time frame, as identified in the TYP, which is a much shorter time frame than was previously considered.

- The need to consolidate waste management (both remediation and "as generated" waste) activities through a unified approach.

- The need to limit placement of remediation waste in existing permitted units because of a lack of storage capacity.

- The need to be cost-effective because of a diminished budget. Limited available resources will be focused on reducing the overall risk at the Site.

The unresolved issue of radionuclide cleanup levels as well as other uncertainties associated with the waste volume estimates for D&D and environmental restoration create a wide range of timely risk reduction and site closure can be diminished through development of a CAMU designated RWSF contingency.

Activities that are planned in future years are in areas that have a high priority from a risk reduction standpoint. Waste materials generated from planned risk reduction activities will include the residuals from trenches T-1, the Mound Site, the 903 Pad and Lip area. The typical media from these areas will be soils, sanitary sludges and drum carcasses. Soils will be excavated from OUs 9 and 10 during the cleanup of tanks T-2, T-3, T-9, T-10, T-14, T-16, and IHSS 129. A small portion of waste will come from specific hot-spot removals. Contaminated Investigation-Derived Materials (IDM) from environmental investigations will also be generated, and may include some IDM already removed from contaminated areas. A map of the OUs at the Site is shown in Figure 1-2. D&D activities associated with buildings in the 400, 700, and 800 areas may contribute substantial volumes of remediation wastes.

Finally, the last driver is the budget. The reality of a diminished budget for cleanup also dictates the need for cost-effectiveness in the direction and scope of the decision-making process. Overall risk reduction at the Site is influenced by the availability of funds and, therefore, the scope of the Decision Document was influenced by the overall Site strategy of reducing risk with limited funding. At the core of this strategy is the concept that it is best to focus available limited resources on reducing the overall risk at the Site. In essence, the Decision Document must determine, given the budget, what remediation waste management strategy can best reduce risk to the environment and the community.

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1.3 SITE DESCRIPTION

The Rocky Flats Environmental Technology Site (Site) is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver (see Figure 1-1). Other surrounding cities include Boulder, Broomfield, Westminster, and Arvada, all of which are located less than 10 miles to the northwest, northeast, east, and southeast of the Site, respectively. The Site consists of approximately 6,550 acres of federal land in Sections 1 through 4, and 9 through 15 of T2S, R70W, 6th Principal Meridian. Most of the structures at the Site are located within a protected central area of approximately 400 acres, and are surrounded by a buffer zone of approximately 6,150 acres.

The Site is bounded on the north by State Highway 128, on the east by Jefferson County Highway 17 (also known as Indiana Street), on the south by agricultural and industrial properties and Highway 72, and on the west by State Highway 93.

The majority of residential use within five miles of the Site is located immediately northeast, east, and southeast of the Site. Commercial development is concentrated near residential developments north and southwest of Standley Lake as well as around Jefferson County Airport, approximately three miles northeast of the Site. Industrial land use within five miles of the Site is currently limited to quarrying and mining operations. Open space lands are located northeast of the Site near the City of Broomfield and in small parcels adjoining major drainages and small neighborhood parks in the cities of Westminster and Arvada. The west, north, and east sides of Standley Lake are encompassed by Standley Lake Park open space. Irrigated and non-irrigated croplands, producing primarily wheat and barley, are located north and northeast of the Site near the cities of Broomfield, Lafayette, Louisville, and Boulder, and in scattered parcels adjacent to the eastern boundary of the Site. Several horse operations and small hay fields are located south of the Site. Future land use in the vicinity of the Site may involve continued urban expansion, increasing the density of residential, commercial, and industrial land use in the areas.

currently or can light ind. or commercial occur?

The Site is a government-owned, contractor-operated facility, that is part of the nationwide Nuclear Weapons Complex. The Rocky Flats Environmental Technology Site was operated for the United States Atomic Energy Commission (AEC) from its inception in 1951 until the AEC was dissolved in January 1975. At that time, responsibility for the Site was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by the United States Department of Energy (DOE) in 1977.

From 1953 through 1989, the RFETS was used to produce components for nuclear weapons from materials such as plutonium, uranium, beryllium, and various alloys of stainless steel. Additional plant missions included plutonium recovery and reprocessing, and waste management. Production activities included metal fabrication and assembly, chemical recovery and purification of process-produced transuranic radionuclides. The consequence of these various activities over nearly 40 years was the contamination of some of the RFETS soils, groundwater, buildings, process pipelines and associated waste management equipment.

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While environmental cleanup and waste management were a part of routine day-to-day operations at the RFETS, national heightened environmental awareness and new environmental regulations have expanded and accelerated both activities. The DOE, in response to these changing conditions and the radical change in global politics, set a new mission for the RFETS focusing on waste management, environmental restoration, and decontamination and decommissioning of facilities. Consistent with this new mission and with a view toward rapid and safe cleanup, the RFCA sets a framework and approach for this final phase of the waste management and cleanup program. The United States Environmental Protection Agency (EPA), the CDPHE, and the DOE have agreed within the RFCA to a wide range of objectives leading to the final disposition of the entire RFETS complex. Among these objectives are important areas necessary to responsibly address the environmental consequences of the past 40 years of operation and production.

Current waste handling practices involve onsite and offsite recycling of hazardous materials, onsite storage of hazardous and radioactive mixed wastes, and offsite disposal of solid radioactive materials at the Nevada Test Site (NTS). Rocky Flats Plant operating procedures historically included both onsite storage and offsite management of hazardous, radioactive, and radioactive mixed wastes.

Historically, the management of RFETS remediation waste has been cumbersome and has frequently required some form of storage. Investigation-derived materials (IDM), which are primarily drill cuttings from environmental investigations, have been placed in 30- and 55-gallon drums and managed as hazardous waste. This process has been labor intensive due to characterization requirements and can, at best, provide only a short-term solution for these materials. A majority of the IDM drums have been released from CERCLA/RCRA management through a risk characterization process.

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2.0 VERIFICATION OF CAMU DESIGNATION CRITERIA

The ability to designate the RWSF as a CAMU is dependent on compliance with the criteria found in 6 CCR 1007-3 264.552 (c), Corrective Active Management Units (CAMU). In order to demonstrate a need for a CAMU at RFETS, these seven criteria were made an integral part of the decision-making process. Each of the seven CAMU criteria listed below is followed by a description of how the selected RWSF remedy demonstrates compliance with the criterion.

1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies.

The CAMU designation of the RWSF would be the cornerstone in successfully completing environmental restoration activities within the accelerated schedule for Site closure proposed in RFCA. The ability of the RWSF to provide readily accessible storage capabilities for large volumes of remediation waste, with generally low levels of contamination, facilitates reliable, effective, protective, and cost effective remedies by:

- Accelerating IHSS closures by providing a facility for interim storage and/or treatment of contaminated material while simultaneously developing cost effective offsite disposal capabilities. Currently, the logistics of offsite disposal limit schedules for closing IHSS. Designation of a CAMU will allow limited resources to be focused on supporting near-term risk reduction.

- Allowing RFETS to maximize economies of scale for treatment, storage, and disposal so that action levels for Site closure can be achieved.

The effectiveness of specific cleanup actions will be enhanced by the availability of the RWSF. This will allow for a more aggressive remediation strategy. Source materials, including contaminated soils that might have been left in place for a number of years as a continuing source of contamination will be removed from the environment and placed in the RWSF.

From a logistical standpoint, the RWSF will offer individual site clean up actions a reliable, readily available facility that can accept large quantities and wide varieties of remediation waste. The waste will not have to be transported offsite, so little in the way of staging and packaging for transportation will be necessary. There will not be the questions of whether a shipment can be transported, whether the shipment will be returned, or whether the facility will be in operation when needed. The RWSF will accept only remediation waste (including D&D waste). The flow of waste into the facility, therefore, will not be impacted by waste from other generators.

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Because of the modular, compartmentalized design of the RWSF, it will be able to accept a wide variety of remediation waste including D&D waste. The waste will not have to be homogeneous. Changes in waste form can be accommodated so that operations will not be held up due to unanticipated conditions in the field. For example, if during remedial excavation of soils, a drum or block of concrete is uncovered, this material can be put into the RWSF without shutting down remedial or RWSF operations or requiring extensive paperwork. Also, a wide variety of waste forms can be accepted so that even if the contaminants change, the RWSF can accommodate that change and the environmental remediation project can proceed without much delay. This availability of immediate storage will facilitate the effectiveness of cleanup actions by allowing all of the contaminants and source materials to be removed at once and with minimal delay.

The RWSF CAMU offers more protectiveness than no action, cap-in-place, or several small storage facilities because it consolidates the remediation waste into an engineered barrier protective of human health and the environment. The remediation waste can be physically removed from an IHSS or building and placed into the RWSF. Additional engineered protection can be provided for the same cost because it is a single large facility as opposed to numerous smaller facilities. Remediation waste that might have been left capped in place or placed in several smaller storage facilities will have the benefit of being centrally located and completely surrounded by multi-layered impermeable protection. In addition, the remediation waste will be monitored at a single location. Any ~~The~~ leachate generated by ~~all~~ the remediation waste can ~~will~~ be isolated, and recovered, and possibly treated at this single location. (organics, etc (things that will not meet 910's WAC)) NO send to existing on-site treatment.

The design proposed was selected based on the ability of the RWSF to provide a low-cost storage alternative while achieving compliance with applicable design standards as well as ensuring protectiveness of human health and the environment. Even with multiple protective design features, the concrete lined cell was still the most cost effective of any design considered. The cost was kept low by utilizing bulk storage in modular compartments as opposed to containers, by keeping the waste onsite for the immediate future, and by using a design that minimizes the footprint and material costs. Another factor that lowered cost was the ability of the RWSF to accept a wide variety of waste forms. The ability to accept the waste from D&D activities represents significant cost savings that can be directly translated into money available for additional Site closure activities.

Contaminated areas require more active management and, therefore, cost more to manage. Sources that may impact other site activities and workers as well as potential exposures to offsite receptors can be removed from the environment sooner if the RWSF is available. This supports the concept of accelerated site closure by allowing previously contaminated areas to be cleaned up to interim cleanup levels agreed to in RFCA rather than closed with contamination above action levels in place. Once contaminant sources

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are removed from the environment through deactivation, D&D, and environmental restoration activities, cost savings can be realized since these areas no longer require active landlord management. This early closure can result in what is termed "mortgage reduction". Savings achieved from reducing the mortgage through these cleanup activities can be applied to accelerate additional activities supporting Site closure.

Treatment requirements which are not necessary to protect human health and the environment can be deferred under the flexibility of the CAMU regulations. This further allows finite resources to be focused on actual cleanup sooner rather than in the future.

2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents.

Not only does the RWSF CAMU not create unacceptable risks but it eliminates risks that might be associated with alternative remedies. The RWSF CAMU minimizes risks to human health and the environment in the following ways:

- Remediation waste is removed from the environment and put into an effective and protective facility. No longer will it be exposed to natural transport phenomena that could spread the contamination.

- Safety precautions will be taken during construction of the facility. All activities will be performed within the extreme safety and radiological protection standards that exist at the Site. Individuals with expertise specific to safety construction will ensure that all construction activities are carried out in a safe manner. Construction quality assurance efforts will ensure that the RWSF will meet all design criteria and performance standards for protectiveness.

are our roads non-public, why does CSP respond to traffic accidents on site?

- Initial transportation of the wastes will be performed in a controlled environment over short distances on non-public roads with minimal or controlled traffic. Operations will be closely monitored and safely controlled. Public exposure will be limited because the waste will not leave the plant site until final closure of the Site rather than throughout the life of site closure operations. Because the distances will be so short and the process will be tightly controlled, the risk of transportation accidents will also be minimized. Administrative and engineered controls will be used to ensure that high winds do not mobilize the contamination during transport. These measures may include precautions such as covered loads, spraying water or other dust suppressants on the loads, high wind shut downs, and other appropriate precautions. Final disposition of the wastes will be conducted once cleanup is complete, allowing resources to be more efficiently focused, economies of scale to be achieved, and support operations to be appropriately scaled.

non public need badge to enter site

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- Safety during filling of the facility will also be closely monitored and controlled. Precautions being considered include spraying the waste for dust suppression, keeping the waste covered, high wind shut downs, and appropriate personal protective equipment. All filling activities will be conducted under appropriate health and safety plans.

Indirect effects and cumulative impacts of the Environmental Restoration program at the Site will be reduced by utilizing the centralized RWSF. Impacts to the environment will be minimized because the footprint of contaminated areas will be reduced to one facility compared to multiple IHSSs that now exist, and the RWSF will be constructed and thus will not impact previously undisturbed areas of the Site.

3) The CAMU shall include uncontaminated areas of the facility, only if including such areas for the purposes of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.

This CAMU criteria was a major influence upon the selection of the RWSF location east of the Solar Ponds. This location is in a contaminated area of the Site. The proposed RWSF location east of the Solar Ponds overlaps with the following areas of contamination:

- **IHSS 165 - The Triangle Area** This IHSS was part of the former OU 6. Drums containing plutonium-bearing wastes were stored in this area. The drums leaked and contaminated the soil. In 1973, 200 cubic yards of soil were removed from this site.

- **IHSS 176 - Swinerton and Walberg Contractor Storage Yard** This IHSS was part of the former OU 10. Water spray from the Solar Ponds blew into this area. Also, leaking drums containing waste oils and volatile organic compounds were stored here. Volatile organic compounds were detected during the soil gas survey characterization of this site.

- **HSS 101 - Solar Ponds Area** These are former OU 4 solar evaporation ponds which were used for storage and evaporation of liquid low-level radioactive waste. All of the sludge has been removed from the Solar Ponds but the liners are still in place. The proposed CAMU location overlaps the eastern edge of the ponds. Additional facilities may be placed on the ponds themselves if expansion of the RWSF is needed and designated in the future. Placement of the facility at this location is expected to facilitate ~~cleanup~~ remediation operations at the Solar Ponds.

- **Building 964** - This building housed low-level waste storage. It was also exposed to the water spray coming from the solar ponds.

Although this area is contaminated, it is not expected that placement of the RWSF in this area will hamper any cleanup operations. Likewise, the levels of contaminants that would be found at the RWSF construction site are not expected to hamper its construction or operation.

4) Areas within that CAMU, where remediation wastes remain in place after closure of the CAMU, shall be managed and contained so as to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment.

This criterion is not applicable. At this time, the intended use of this facility is for monitored, retrievable waste storage.

5) The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). The Department shall designate a CAMU in accordance with the following:

(1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

(2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to hazardous wastes or hazardous constituents.

Once constructed, the facility will expedite remedial activities. Waste will be transported directly from excavation or treatment into the RWSF. Planning documents for cleanups will be simplified since the waste management methodology will be established. It will be possible to establish work crews that could clean up IHSSs in an almost assembly-line fashion, moving from IHSS to IHSS with the necessary equipment while trucks transport the remediation waste to the RWSF. Concurrent to these activities, new modules to the RWSF could be constructed so that there would be sufficient capacity available to accept the waste. Crews could be simultaneously performing deactivation followed by D&D and environmental restoration, moving from building to building, and transporting these waste materials to the RWSF.

6) The CAMU shall enable the use, when appropriate, of treatment technologies (including innovative technologies) to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste that will remain in place after closure.

The selected remedy supports the ability to treat waste before or after placement. Wastes could be treated in-place prior to excavation, after excavation, or because the RWSF design supports retrievability, the waste could be retrieved and treated. It could even be possible to apply some types of innovative technologies in the facility itself since the waste will be completely contained.

The CAMU will also support treatment technologies by acting as a centralized location for remediation waste treatment. This will also allow economies of scale to be achieved so that technologies not cost-effective for small quantities of wastes might be more applied to large volumes.

Temporary or permanent staging areas near the facility could be set up, and mobile or permanent treatment equipment could be bought in. These treatment technologies could include soil washing, solidification, thermal desorption or more innovative technologies identified in the future.

7) The CAMU shall minimize the land area of the facility upon which remediation wastes will remain in place after closure of the CAMU unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). The Department shall designate a CAMU in accordance with the following:

(1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

(2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to hazardous wastes or hazardous constituents.

This criterion is supported by the fact that multiple source areas at RFETS that might have previously been closed in place now have the option of closure to the action levels agreed to in the RFCA. The CAMU will support a bias towards removal rather than isolating sources in place. This will facilitate release of areas at RFETS for future land use, as described in the RFETS Vision.

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3.0 WASTE CHARACTERISTICS

3.1 REMEDIATION WASTE CHARACTERIZATION

General waste types characteristics and volumes which may be placed into the RWSF are described in this section. Identification of waste characteristics, sources and projected volumes for the RWSF clarify and substantiate the need for a contingency to existing waste storage. Only remediation waste will be considered for management in this facility.

Remediation waste is defined as follows by RFCA, part 5, paragraph 25 bf.:

Remediation waste means all: "(1) solid, hazardous, and mixed wastes; (2) all media and debris that contain hazardous substances, listed hazardous or mixed wastes or that exhibit a hazardous characteristic; and (3) all hazardous substances generated from activities regulated under this Agreement as RCRA corrective actions or CERCLA response actions, including decommissioning. Remediation waste does not include wastes generated from other activities. Nothing in this definition confers RCRA or CHWA authority over source, special nuclear, or byproduct material as those terms are defined in the Atomic Energy Act."

The potential contaminants of concern in remediation waste include:

- Radionuclides (such as plutonium, americium, and uranium)
- Metals (such as cadmium and chromium)
- Volatile organic compounds (such as carbon tetrachloride, trichloroethene [TCE], tetrachloroethene [PCE])
- Semivolatile organic compounds
- Asbestos
- Polychlorinated biphenyls (PCBs) (such as Aroclor-1254)

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Low-level waste, as defined by RFCA, is radioactive waste that is not high-level waste, spent nuclear fuel, by-product material, or transuranic waste (although it may contain small amounts of transuranic elements). The majority of the low-level waste managed at the RWSF will have a radionuclide activity much less than 10 nanocuries per gram (nCi/g] based on the Hazard Categorization Analysis (see Section 9.0 References, Kaiser-Hill, 1996a). Residuals from the Solar Evaporation Ponds, such as portions of the liners and sludge, will be considered remediation waste and suitable for placement in the RWSF. No process waste will be accepted. Waste media and forms (e.g., under 6 CCR 1007-3 Part 264.312-264.317, subpart N) for placement in the RWSF were modeled after Landfill restrictions, which include the following:

- No free liquids
- No compressed gases
- No transuranic (TRU) waste
- No incompatible wastes (such as pyrophoric uranium)
- No ignitable or reactive wastes

Remediation waste types include:

- Contaminated soil collected from remedial actions
- Treated and untreated sludge and sediments
- Toxic Substance Control Act (TSCA) waste (such as asbestos and PCBs)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions
- IDM from past and future characterization activities, such as wells, and borings, if the IDM is characterized as hazardous, low-level, or mixed remediation waste
- D&D waste which has been characterized as hazardous, low-level, or mixed waste. D&D waste includes building rubble, equipment, and utilities removed from the building prior to demolition.

The LLMW and HW placed in the RWSF will consist of remediation waste which is currently stored at the Site and the remediation waste which will be generated in the future.

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3.2 REMEDIATION WASTE VOLUME

Waste volume estimates were based on planned risk reduction activities. A preliminary estimate of remediation waste types, and volumes is presented in the Table 3-1. The total volume of remediation waste is estimated to be 123,000 cu yd of which 114,000 cu yd could be placed in a RWSF after treatment. These estimates were based on current information and coincide with the Ten Year Plan waste volumes. These volume estimates are not intended to limit the size of the facility, but serve as a tool to create alternatives for the decision making process.

The actual volume of soil defined by Tier 1 and Tier 2 cleanup levels in RFCA could be larger or smaller because volume estimates were made with preliminary data. Final volumes will be determined in the field based on RFCA action levels and any other negotiated cleanup levels.

Table 3-1 Waste Identification and Volumes for a Remediation Waste Storage Facility

Waste Source (OU/IHSS's)	Description of Media	Waste Type	Estimated Total Volume (cubic yds)	Volume after T. D. Treatment (cubic yds)[1]
OU 4 Solar Ponds				
Liners	Asphaltic Material & Soils	LLMW (rads/metals)	120	120
Sludge [2]	Sludge	LLMW (rads/metals)	6,000	10,000
Accelerated Actions (Top IHSSs)				
OU 2 Trench T-1	Soil, Drums; Pyrophoric U	LLMW (rads/VOC)	1,100	1,100
OU 2 Trench T-3	Soil, Drums, San. Sludge	LLMW (rads/VOC)	1,700	60
OU 2 Trench T-4	Soil, Drums, San. Sludge	LLMW (rads/VOC)	2,100	60
OU 2 Mound Area	Soil & Drums	LLMW (rads/VOC)	600	20
OU 2 903 Pad	Soil & Asphaltic Mat.	LLMW (rads/VOC)	9,800	8,600
OU 2 Lip Area	Soil	LLW (rads)	13,500	13,500
OU 9 Tanks 9 & 10 (includes IHSS 118.1)	Soil, tanks, piping	LLMW (rads/VOC)	2,000	50
OU 9 Tanks 2 & 3	Soil, tanks, piping	LLMW (rads/VOC)	25	25
OU 1 IHSS 119.1	Soil	LLMW (rads/VOC)	1,500	20
OU 9 Tanks 14 & 16	Soil, tanks, piping	LLMW	120	120
OU 10 IHSS 129	Soil	HW (VOC)	2,200	0
Subtotal for Accelerated Actions			34,645	23,555
Investigative Derived Material (IDM)[3]	Drill Cuttings/Soil	LLMW, HW, LLW	1,300	130
D & D Waste[4]	Soil, Debris, rubble, etc.	LLMW, LLW, HW	64,880	64,880
Subtotal			106,945	98,685
Expansion Factor; 15%			16,042	14,803
GRAND TOTAL			122,987	113,488
Revision Date 10/10/96				

1. T.D. Treatment signifies Thermal Desorption Treatment.
2. The volume after treatment accounts for expansion due to the solidification process
3. The 1,300 yd^3 represents an inventory of 4,800 drums of which 1,600 drums or 430 yd^3 meet Tier 1 put back levels and will go to the Sanitary Lakdfill.
4. D&D waste volumes are estimated within a range of 44,880 to 164,880 cu yd.

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4.0 IDENTIFICATION OF SUBSTANTIVE CRITERIA

Paragraph 80 of RFCA provides: "(I)f the application meets the appropriate substantive criteria CDPHE will issue a CAMU designation." Likewise, the CAMU rule, promulgated pursuant to the CHWA, states that "(t)he Department shall specify, in the permit or order, requirements for CAMUs..." (See 6 CCR 1007-3, Part 264.552 [e).

4.1 CAMU Objectives

The designation of a Corrective Action Management Unit must be performed in accordance with the seven criteria enumerated in 6 CCR 1007-3, Part 264.552(c). The seven criteria are, by nature, high level objectives. For that reason, the seven criteria described in section 2 were adapted and used in Section 6.0 as the decision criteria for comparison and selection of an alternative. The seven CAMU objectives include:

1. The CAMU must facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

2. The waste management activities associated with the CAMU must not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents;

3. The CAMU may only include uncontaminated areas of the facility if including such areas is more protective;

4. Where remediation wastes will remain in place after closure the CAMU must be managed and contained so as to control, minimize or eliminate future releases to the extent necessary to protect human health and the environment;

5. The CAMU must expedite the timing of remedial actions;

6. The CAMU must enable the use, when appropriate, of treatment technologies to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste.

7. The CAMU must be placed on the minimal area necessary to provide a reliable, effective, protective, and cost effective remedy.

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4.2 RFCA Requirements

Paragraph 80 of RFCA provides:

> ...that the design criteria for the facility described in this paragraph shall be the same whether the facility is for the retrievable, monitored storage of remediation wastes or for the disposal of remediation wastes. Specifically, the facility described in this paragraph must ensure retrievability of wastes and protection of human health and the environment through a combination of requirements that include, but are not limited to: detection and monitoring/inspection requirements; operating and design requirements, including cap/liner system that meets the requirements as set forth in 6 CCR 1007-3, Part 264, Subpart N; a groundwater monitoring system; and requirements for responding to releases of wastes or constituents from the units. In addition, where necessary for protection of human health and the environment, waste treatment will be required."

In response to RFCA paragraph 80, the following design and operating requirements will be addressed and implemented:

- leak detection;
- inspections;
- a cap that meets RCRA Subpart N requirements;
- a groundwater monitoring system;
- corrective action for releases; and
- a waste acceptance criteria, consistent with design and operation, that provides treatment of wastes where necessary.

The above requirements are discussed in Section 7 for the specific selected alternative, the Concrete Lined Cell. As part of the IM/IRA process, paragraph 109 of RFCA also directs consideration of seven topics, including:

- worker safety;
- protection of human health and the environment;
- transportation;
- facility design, containment, and monitoring;
- institutional controls;
- cost; and
- community acceptance.

4.3 CAMU Requirements

Additional requirements for designation are enumerated in Part 264.552(e) of the CAMU rule. The following are the additional requirements:

- specification of the area configuration, Part 264.552 (e) (1));
- specification of the design requirements (Part 264.532 (e) (2);
- specification of operation requirements (Part 264.552 (e) (2);
- specification of groundwater monitoring requirements (Part 264.552 (e) (3);
- specification of closure and post closure requirements (Part 264.552 (e) (2) that:
  - minimize the need for further maintenance and (Part 264.552 (e) (4) (iii) (A);
  - consider the CAMU design (Part 264.552 (e) (4) (iii) (A);
  - consider the potential for releases (Part 264.552 (e) (4) (iii) (C);
  - consider the physical and chemical characteristics of the waste (Part 2 64.552 (e) (4) (iii) (D);
  - consider hydrological and other environmental conditions at the facility that may influence the migration of any releases (Part 264.552 (e) (4) (iii) (E);
  - consider potential human or environmental exposures to releases (Part 264.552 (e) (4) (iii) (F)
  - requirements for excavation, removal, treatment, or containment of remediation wastes (Part 264.552 (e) (4) (ii) (A);
  - requirements for removal and decontamination of equipment, devices and structures used in remediation waste management activities within the CAMU (Part 264.55 (e) (4) (ii) (C);

Paragraph 80 of RFCA provides: "(I)f the application meets the appropriate substantive criteria CDPHE will issue a CAMU designation." Likewise, the CAMU rule, promulgated pursuant to the CHWA, states that: "(t)he Department shall specify, in the permit or order, requirements for CAMUs..." (See 6 CCR 1007-3 Part 264.552 (e).

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5.0 SCREENING OF ALTERNATIVES

A two-phase decision-making process was developed for screening and selecting remediation waste management storage alternatives that support the best remediation waste management strategy for the Site. The first phase evaluated different onsite locations and the second phase evaluated conceptual storage design alternatives. The onsite location selected was then coupled with the conceptual storage design alternative for inclusion in the Final Comparison of Alternatives. (See Figure 501, Decision Process for Remediation Waste Management).

5.1 PHASE 1 - ONSITE REMEDIATION WASTE STORAGE FACILITY SITING STUDY

The selection of a location for a RWSF at the Site is detailed in Appendix C, Onsite Remediation Waste Storage Facility Siting Study. The objective of Phase I was to evaluate and select an onsite location for a RWSF. The method used was as follows:

- Identify and rank criteria to be used for siting of an onsite RWSF location;
- Develop a methodology for a comparative analysis of different sites;
- Evaluate the criteria subjectively and assign a relative weighting factor to each criteria; and
- Recommend an onsite location based on the above criteria and methodology.

This process is described below.

1. Identify and rank criteria to be used for siting an onsite RWSF location. This criteria required, at a minimum, substantive requirements as discussed in Section 4, as well as general guidelines that had been discussed at various stakeholders meetings regarding a RWSF at the Site. The criteria were then organized into the six major categories summarized below, and further divided into specific issues within each of these major categories. Further details of the criteria are in Appendix D.

    - The ability to designate the RWSF as a Corrective Action Management Unit (CAMU): All CAMU criteria were evaluated, but the deciding criteria was the ability to facilitate the implementability of reliable, effective, protective, and cost-effective remedies, and to not include uncontaminated areas of the Site in the footprint of the RWSF.

    - The ability to ensure the protection of the public, per 6 CCR 1007-2 Part 2, Requirements for Siting of a Hazardous Waste Disposal Site: Although the RWSF is a storage facility, these criteria which relate to long-term disposal were used to

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evaluate locations for storage as an additional degree of protectiveness. There are 12 separate associated criteria under this requirement; a summary of these criteria is as follows:

- Geological and hydrogeological conditions of a site in which hazardous waste is to be disposed shall be such that reasonable assurance is provided that the wastes are isolated within the disposal area and away from natural environmental pathways that could expose the public for 1,000 years;

- Structural-related issues including slope and geotechnical stability will be addressed;

- The immediate area of the site should be in a strata of minimal groundwater flow;

- Relative depth to bedrock and groundwater; and

- The evaluation of the relative distance to the nearest discharge area will include consideration of groundwater flow direction and travel time.

- The ability to support the RFCA. The Preamble to RFCA Section B.2 states: "Waste management activities for low-level, low-level mixed, hazardous, and solid wastes will include a combination of onsite treatment, storage in a retrievable and monitored manner, disposal, and offsite removal. Low-level and low-level mixed wastes generated during cleanup will be stored in a safe, monitored and retrievable manner for near-term shipment offsite, long-term storage with subsequent shipment offsite and/or long-term storage with subsequent disposal onsite of the remaining wastes."

- Cost criteria, including the cost of preconstruction activities, and the following:

  - Building demolition;
  - Subsurface utility line removal and rerouting;
  - Access requirements and power/facility requirements; and
  - The cost of engineering and construction of protective measures.

- Regulatory Support focused on using CDPHE guidelines (Looby, 1995) for onsite waste management of contaminated materials. Key points evaluated include the minimization of the number of disposal sites, consolidation of contaminated materials, and having a centralized site in an area with optimum geologic parameters preferably close to or within the Industrial Area with limited future land use.

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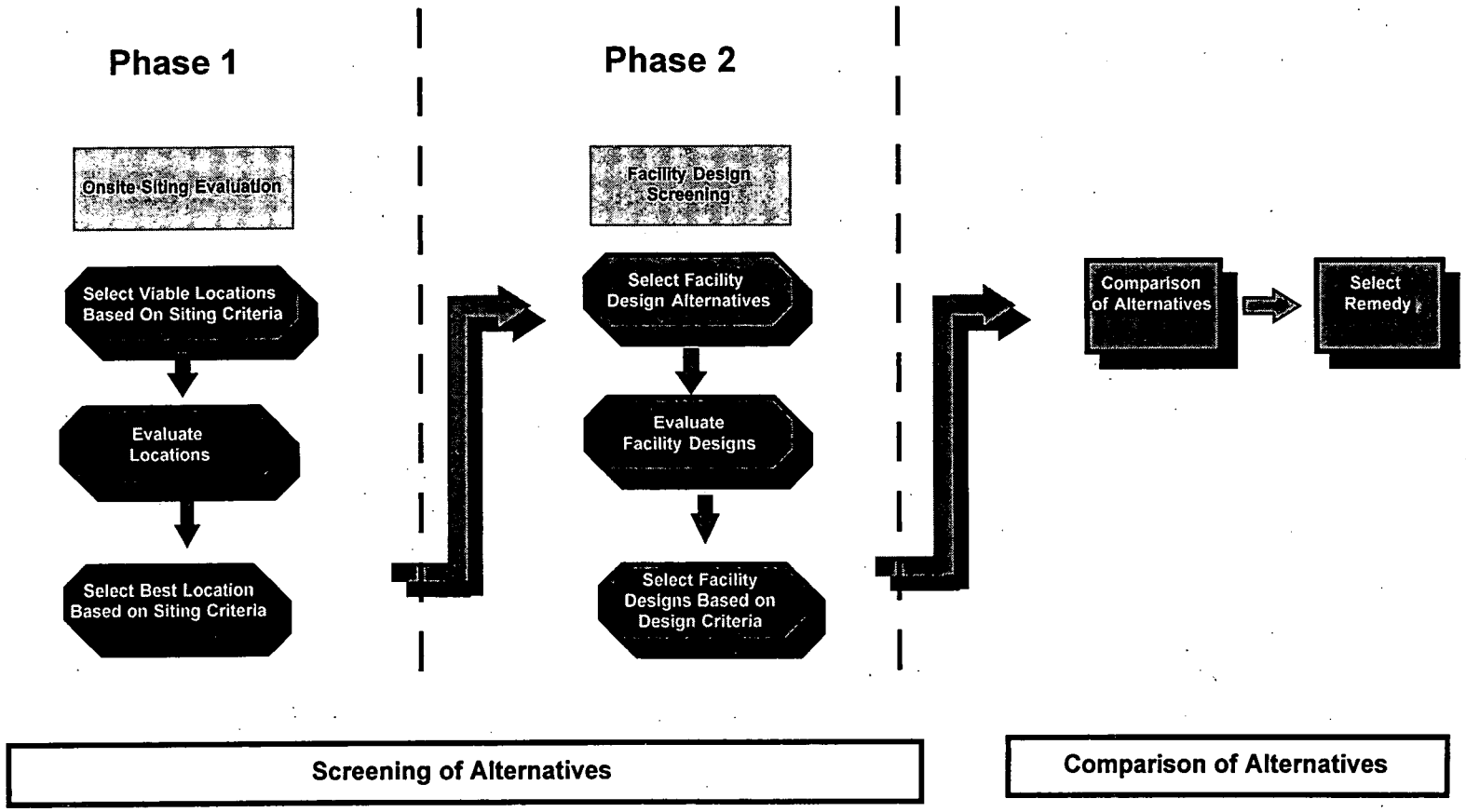
Figure 5-1 Decision Process For Remediation Waste Management



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- Other Stakeholder concerns include the general acceptance of the RWSF by the general public and the Municipal or County governments.

2. Develop a methodology for comparative analysis of the different sites: A basic assumption was that the entire Site, both within the buffer zone and the Industrial Area, would be included in the evaluation. A series of GIS (Geographical Information System) maps were produced to assist in this evaluation. These maps, which included key elements cited in the criteria, were evaluated for being beneficial or adverse to the siting of a RWSF.

   The initial evaluation of the sites reduced the number of potentially useable locations to seven, with four in the buffer zone and three in the Industrial Area.

   Potential Industrial Area sites identified were:

   - Industrial Area-West (IA-West), an area on the west side of the Industrial Area;
   - Industrial Area-East (IA-East), an area on the east side of the Industrial Area; and
   - Solar Ponds, an area adjacent and east of the Solar Pond in the northeast section of the Industrial Area.

   The potential buffer zone sites identified were:

   - The New Sanitary Landfill (NSL);
   - An area encompassing the East Spray Fields (ESF);
   - An area in the southeast quadrant (SE Quad) of the buffer zone; and
   - An area in the southwest quadrant (SW Quad) of the buffer zone.

3. Evaluate the criteria subjectively and assign a relative weighting factor to each of the criteria: For a more detailed description of the methodology see Appendix C, Section C.2.2, Methodology.

   The methodology that was applied began by developing a relative weighting factor (%) based subjectively on the importance of each of the six categories of criteria as shown under Table 5.2 below.

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Next, the categories were divided into 38 specific issues. Each of the issues was subjectively assigned a value between 0 and 3, with a 3 being a more important issue, 1 being less important, and a 0 being a potential fatal flaw.

The next step was to develop a matrix using the 7 locations versus the 38 issues (see Appendix C, Table C-2). A score was assigned relative to the other sites and the criteria being evaluated. A score of 0 for any of the 38 issues would signify a fatal flaw and the site would be withdrawn from further consideration in the evaluation.

Table 5-2 Methodology Weighting Factors

Category	Criteria	Weighting Factor (%)	Number of Specific Issues	Total Number of Points Assigned
1	Corrective Action Management Unit (CAMU)	15	7	19
2	Public Protection (Geotechnical and Hydrological Criteria)	20	12	28
3	Site Special Issues	20	8	15
4	Cost Criteria	15	2	6
5	Regulatory Support	15	5	13
6	Other Stakeholder Concerns	15	4	9
	*** Total**	**100**	**38**	**90**

* A weighted average was arrived at for each of the categories and the values were summed.

4. Recommend an onsite location based on the above criteria and methodology: The location receiving the highest score was the recommended onsite location for a RWSF (see Appendix C, Section C.2.3, Table C-5). The location recommended for a RWSF is the area in the northeast corner of the Industrial Area adjacent and east of the Solar Ponds (see Figure 5-2).

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5.2 PHASE 2 - SCREENING OF ONSITE DESIGN OPTIONS

The objective of Phase 2 was to select and evaluate different design options for an onsite RWSF. A list of innovative RWSF designs was developed. This list was compiled from literature and input from the Citizen's Advisory Board (CAB), current Site practices, and designs in use at other facilities in the United States and Europe. These design options are either actual facilities in use or under consideration elsewhere (see Appendix E, Remediation Waste Storage Facility Design Alternatives).

The following design options were proposed for the screening process:

- Pyramid Design - Bulk waste is enclosed in a rectangular pyramid constructed out of granite blocks; design proposed at a meeting of the CAB by a member of the public; Why just consider granite? That was all that the member of the public wanted. — high availability?
- Metal Buildings - Waste is enclosed in cargo containers placed inside engineered metal buildings on concrete slabs; this is RFETS' current practice to store LLW~~&~~LLMW (TSD 1984)
- Slab on Grade - Waste is stored in cargo containers placed on an abovegrade concrete slab; This is current practice at some DOE/DOD sites;
- Hardened Concrete Vault - Waste in cargo containers is placed in an abovegrade freestanding concrete structure with liners and a leachate collection system; this is a current practice at the DOE Savannah River Site for LLW & LLMW;
- Abovegrade Concrete Lined Cell with bulk placement - Bulk waste is placed in modules in concrete lined cell. Under the cell is a liner and a leachate collection system;
- Abovegrade Concrete Lined Cell in Cargo Containers - Waste in cargo containers is placed in modules in concrete lined cell. Under the cell is a liner and a leachate collection system;
- Abovegrade Storage Cell - Earthen structure similar to a RCRA cell except facility would be constructed Abovegrade with berms and a liner/leachate collection system; design as proposed is similar to current practice around the nation to meet RCRA-Subtitle C, requirements;

- Silo Design - Bulk waste would be placed in concrete cylinders which sit on top of a concrete pad. Under the pad is a liner/leachate collection system; this design was proposed in an interim report by the Idaho National Engineering Laboratory (INEL) (EG&G, 1994);

- Entombment - Waste would be placed in 55 gallon drums and then sealed with grout in concrete boxes which would be stored in a hardened concrete vault. This design was proposed in an interim report by the INEL (EG&G, 1994);

- Waste Pile - Bulk waste is compacted into a rectangular pile with all sides covered with a geomembrane. A liner system would be place under the pile. This design is based on the Interim Remedial Action for Basin F, Rocky Mountain Arsenal

- No Action (i.e., no CAMU designated Remediation Waste Storage Facility) - Remediation waste would have to be treated and shipped to an offsite disposal facility as soon as it is recovered. This alternative was included as required by CERCLA and NEPA.

The initial conceptual design screen, summarized in Table 5-3, which used the same criteria as the Siting Study, narrows the 11 design alternatives to four final design alternatives. Table 5-4 is a comparison of the 11 design alternatives with respect to cost.

As a summary by design alternative, the following results explain the rationale of screening each alternative for the selection of the final four design alternatives.

The Abovegrade Concrete Lined Cell is similar to RCRA Subtitle "C" landfills except that the facility would be built at grade. This facility also incorporates the concept of long-term waste management with protection to the public and the environment by constructing a double liner system with a leachate collection system. The total footprint of this facility is larger than the other options because of the side berms required for construction of the cell. This feature makes the cost higher than the Concrete Lined Cell bulk storage option. Retrievability is more difficult than a concrete lined cell or options utilizing containers. This design was selected because it is a known, proven design that meets RFCA requirements, provides the necessary protection, and is one of the less costly designs evaluated.

This paragraph makes no sense as written. It should be "Abovegrade storage cell"

Explain what? what design?

The Abovegrade Concrete Lined Cell with bulk placement combines features of several alternatives. As a long-term RWSF it provides protection to the public and the environment because of the RCRA double liner system and a leachate collection system that allows for early detection of leaks. This facility would consist of a concrete lined cell with integral walls to separate the remedial waste, which would segregate the waste and provide for retrievability. The waste could be managed in both bulk and containerized forms. The cost for this option was the most reasonable compared to all other options because it offered flexibility

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in waste handling, had a smaller facility footprint, and still offered the necessary protectiveness. The modular design further enhances flexibility as well as enhances waste segregation and retrieval abilities. This design was selected because it meets the substantive criteria, provides the necessary protection and is cost effective.

The previous 2 paragraphs give the impression that 2 designs were selected. Please rewrite this section & clarify your point!!

There was a typo. The first paragraph original read "Above grade storage cell. The second paragraph was originally about the "Concrete lined cell with Bulk placement". This mistake has been corrected. The form "selected" was changed to "not screened out" ~~to clarification~~ to clarify that this is not the final selection step.

Table 5-3 Summary of Facility Design Screen

Facility Design	CAMU Criteria	Public Protection (Geotechnical and Hydrological Criteria)
Pyramid Design	Not effective because of schedule concerns for expediting cleanup and higher costs. Hard to monitor. Reliability is not proven.	Structure could experience differential settlement and breach the barrier. Rigid structure not as elastic as other alternatives.
Silo Design	Minimizes land area by consolidation of waste to one location.	Design provides barriers and leachate collection to protect groundwater and surface water.
Metal Buildings	Intended as a short-term storage option with periodic maintenance. Costs are high due to bulk containers. Large area footprint because of number of buildings required.	Short-term storage. For up to 30 years it would provide adequate protection to environment. Protective barrier is the building shell and containers.
Slab on Grade	This alternative is a short-term storage option. Waste would be more exposed. Land area would be minimized. Retrieval would be more difficult.	Exposes containers to the weather elements, has a greater risk of releases to surface water or groundwater. No barriers.
Hardened Concrete Vault	Not cost-effective because of storage containers and rigid structure. Good retrievability with a larger footprint because of accessible aisles.	Provides multiple barriers to limit release of contaminants with a leachate collection system. Enclosed concrete structure and containers provide additional protection.
Abovegrade Concrete Lined Cell with Bulk Placement	A good mix of cost-effectiveness and protectiveness. Supports expediting cleanup activities because of modular design with integral separation walls for retrievability.	Provides numerous barriers to limit release of contaminants with a leachate collection system.
Abovegrade Concrete Lined Cell In Cargo Containers	Good retrievability but higher costs than Concrete Lined Cell because of waste containers.	Provides numerous barriers to limit release of contaminants with a leachate collection system. Containers provide additional protection.
Abovegrade Storage Cell	Provides good support for remedial activities, minimizes risk of future releases.	Liners and leachate collection system provides reliability, and protection to groundwater.
Waste Pile	Retrieval is difficult, similar to Abovegrade Storage Cell.	Short term Storage. No protective barriers or leachate collection.
Entombment	Good protection to environment and public. Larger footprint because of smaller containers for storage of wastes.	Provides additional barriers other than the multiple liners and leachate detection (i.e., concrete canisters and drums).
No Action	Individual remedial actions will require handling the waste separately by storing with ultimate offsite disposal.	Individual remedial actions will require handling the waste separately by storing with ultimate offsite disposal.

Table 5-3 (continued)

Facility Design	Site Special Issues	Cost Criteria
Pyramid Design	Does not provide an expeditious construction schedule because of logistics in acquiring the granite blocks. Does not support Site Vision.	This design fell in the middle of the range for total life-cycle costs.
Silo Design	Supports Site Vision and RFCA, relatively small footprint.	Cost-effective, third lowest total life-cycle cost due to small footprint .
Metal Buildings	Large footprint because of multiple facilities. Simple design allows quick construction.	Total cost is high due to cost of containers and multiple buildings.
Slab on Grade	Simple design allows quick construction. A short-term storage solution.	Total cost is high due to cost of containers.
Hardened Concrete Vault	Meets this criteria better than most designs, smaller footprint reduces impacts.	This option fell in the upper end of the cost range because of containers and free- standing rigid structure.
Abovegrade Concrete Lined Cell with Bulk Placement	Supports Site Vision and RFCA, small footprint, less impact to other Site programs. Flexible, modular type facility.	Low construction, site preparation, and closure costs yielded the second lowest total life-cycle cost of any of the designs.
Concrete Lined Cell In Cargo Containers	Supports Site Vision and RFCA, less impact to other projects.	This option fell in the middle of the cost range because of the cost of containers.
Abovegrade Storage Cell	Large footprint could cause additional impacts, supports Site Vision and RFCA.	Low total life-cycle cost in spite of high construction costs.
Waste Pile	Short term solution, consolidates wastes to one location, small footprint. Does not support RFCA or necessary requirements	The lowest life cycle costs due to a lack of protective features.
Entombment	The largest footprint of all alternatives. Construction would be very time- consuming and costly.	The most expensive design, highest life-cycle costs because of the double containment (drums and concrete bins).
No Action	Requires offsite disposal which could delay shipments and increase interim storage.	Total life-cycle costs were in the high end of the range because the offsite disposal cost.

Table 5-3 (continued)

Facility Design	Regulatory Support	Other Stakeholder Concerns
Pyramid Design	Design is not state of the art. No barrier systems or leachate detection other than the solid granite walls.	Questionable design/technology. Availability of materials in a timely fashion is uncertain.
Silo Design	Limited flexibility for future uses. Consolidation of waste in one footprint.	Design is not widely used. Protects environment and public. Retrieval would be more difficult.
Metal Buildings	Large footprint, , Poor consolidation of wastes since multiple buildings are required	Excellent retrievability. Proven technology and easy to implement quickly.
Slab on Grade	Small footprint for consolidation of wastes. Not a state of the art facility.	Excellent retrievability. Provides only minimal barriers for protection of environment. Proven technology and easy to implement quickly.
Hardened Concrete Vault	Long-term waste management. Protects environment and public.	Waste is retrievable, but not as retrievable as other designs. Proven technology but it would take more time and effort to construct.
Abovegrade Concrete Lined Cell with Bulk Placement	Long-term waste management that consolidates waste into modular/flexible facility.	Provides good protection to the environment and public health. Good retrievability because of integral dividing walls.
Concrete Lined Cell In Cargo Containers	Long-term waste management that provides good protection to public and environment. Retrievability is a little better because of accessibility to containers.	Provides good protection to the environment and public. Waste is more retrievable because of containerization.
Abovegrade Storage Cell	Provides good protection to the public and environment. Consolidates wastes into one location.	Proven technology because of past performance. Retrievability is achievable but fair because waste is in bulk quantities.
Waste Pile	Short-term solution. Provides good protection to public and environment. Not designed to meet RCRA considerations.	Retrievability is achievable but much more difficult than other designs due to a lack of segregation.
Entombment	Provides enhanced protection to the public and environment by the additional containers. Footprint is enlarged because of unusable/wasted space.	Retrievability is good because waste is segregated in concrete bins and drums. Longer construction schedule because of the complexity and number of drums to handle.
No Action	Increased interim storage until the individual remedial actions can ship waste offsite.	Requires offsite disposal. It would require interim storage and would delay some cleanup activities.

Table 5-4 Comparison of Design Alternative Costs (Cost in thousands of dollars)

Alternative	Abovegrade Waste Cell	Pyramid	Concrete Lined Cell Bulk Placement	Concrete Lined Cell w/Containers	Hardened Concrete Vault
Total Life-Cycle Cost [1]	$118,800	$140,300	$77,320	$165,650	$181,630
Cost of Construction					
Design	$2,200	$2,200	$1,600	$1,600	$2,200
Pre-Construction	$400	$400	$150	$150	$400
Construction	$41,700	$57,900	$18,600	$18,600	$26,000
Total Cost of Construction	$44,300	$60,500	$20,350	$20,350	$28,600
Cost of Site Preparation	$8,800	$14,500	$1,970	$1,970	$6,100
Cost of Closure					
Interim Cap	$5,300	N/A	$5,300	$5,300	$5,300
Interim Closure Care & Monitoring	$13,900	$13,900	$13,000	$10,400	$10,400
Total Cost of Closure	$19,200	$13,900	$18,300	$15,700	$15,700

Diff??

Table 5-4 (cont.) Comparison of Design Alternative Costs (Cost in thousands of dollars

Alternative	Silo Design	Slab on Grade	Metal Buildings	Entombment	Waste Pile	No Action
Total Life-Cycle Cost [1]	$107,300	$141,600	$161,400	$525,000	$36,669	$215,900
Cost of Construction						
Design	$2,000	$300	$2,300	N/A [2]	N/A [2]	N/A [2]
Pre-Construction	$400	$200	$1,300	N/A [2]	N/A [2]	N/A [2]
Construction	$30,400	$3,800	$17,900	N/A [2]	N/A [2]	N/A [2]
Total Cost of Const.	$32,800	$4,300	$21,500	N/A [2]	N/A [2]	N/A [2]
Cost of Site Preparation	$6,100	$6,100	$2,800	N/A [2]	N/A [2]	N/A [2]
Cost of Closure						
Interim Cap	$5,300	N/A	N/A	N/A [2]	N/A [2]	N/A [2]
Interim Closure Care & Monitoring	$13,900	$8,500	$10,400	N/A [2]	N/A [2]	N/A [2]
Total Cost of Closure	$19,200	$8,500	$10,400	N/A [2]	N/A [2]	N/A [2]

Footnotes:
1. Total life-cycle costs also include costs for containers, permitting, operations, contingency, etc. More detailed estimates are presented in Appendix E.
2. Costs for these alternatives were not broken down because of the following:
   - The Entombment costs were based on a projected total cost that did not address specific costs.
   - The Waste Pile costs were based on actual costs from Rocky Mountain Arsenal Cleanup in Colorado
   - These costs were not applicable for The No Action alternative.

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The Abovegrade Concrete Lined Cell in cargo containers is similar to the aforementioned Concrete Lined Cell with bulk placement except that all remedial waste would be stored in cargo containers rather than bulk. A slightly higher degree of protection for the public and the environment is met because the containers act as an additional barrier. The retrievability is enhanced because of the containers, however, the cost is significantly higher than bulk placement. The design was screened out because the ability to put the waste in containers ~~could~~ did not justify the additional cost.

Maybe it could, especially if the alternative was truely based on the statement made on p 1-5. This is really a design for bulk waste with containers. Factor on if we really want containers the metal buildings are better.

The Hardened Concrete Vault alternative is a free standing, totally enclosed concrete structure intended for long-term waste management. Remedial waste would be stored in cargo containers which would be considered a fairly good retrievable option with built in aisles. Protection to the public and the environment is good because of the RCRA double liner system and leachate collection. The cost is high relative to other designs because of the cost of containers and free-standing rigid structure. The ability to monitor the facility is good because of the leachate detection system. This design was not considered as viable as other designs because of its high relative cost and the time and effort it would take to design and construct such a facility would impact remedial activities.

The Silo Design incorporates the concept of long-term waste management by storing remediation wastes in totally enclosed 5,000 cy concrete silos. As in some of the other alternatives, this facility would incorporate a double liner barrier with a leachate detection system. An extra level of protection for the environment and the public is provided because of the concrete silos. The remediation waste is retrievable because of the multiple silos, and the cost is lower than most of the other designs. This design was eliminated because the ability to retrieve waste is not as good as most of the other designs and it offered about the same level of protectiveness as the concrete lined cell but still would cost more.
Slab on Grade is similar to the Metal Buildings alternative from the standpoint of becoming a short-term (i.e., 25-30 yrs.) waste management option. The remedial waste would be placed in stored cargo containers which are stacked on a slab on grade. The slab on grade is open to the environment and would not have any protective liners or barriers underneath. Liners were not deemed necessary because the cargo containers could be inspected and leakage could be detected early on. It is possible to add a liner but the costs would increase. This option would have a high degree of retrievability because of the accessibility to cargo containers. Again, the maximum life cycle of this alternative is approximately 25 to 30 years before the remedial waste was redispositioned. The cost for this option was high because of the additional cost for containers. The alternative was screened out because it could not offer the protectiveness of other designs and yet was more expensive.

Metal Buildings were more expensive than other alternatives because of the cargo containers and the number of buildings. This alternative has no liner system for protection of the environment other than the containers and the building structure which provides adequate

What about metal roofed bldgs w/bulk storage (eg. Sugar, phosphate, many others) Foot print would increase

protection for the life of the facility (25 to 30 years). A liner system was not needed because the containers could be inspected for leaks. A liner system could be added but would increase the total cost of the facility. Although this design supports the intended cycle of the 10 Year Plan, the protectiveness of this design is less than the concrete-lined cell designs and the economies of scale achieved through bulk storage are absent. The facility footprint would be larger than other options because of the required large central corridor for routine access and monitoring. The retrievability of this option is good because of the accessibility to cargo containers. This alternative was not screened out because it is an established design and offers good retrieval and inspection capabilities.

The Entombment alternative protects the public and the environment because of the multiple barrier systems. Again, this facility would incorporate a double liner system with a leachate detection system. This design option stores remediation waste into 55-gal drums which are then stacked as a cluster of eight in concrete bins. The enclosed concrete bins are then stacked within the cell liner. Because of the multiple container/barrier system, the cost for this alternative is the most expensive. The footprint for this facility is larger because of the wasted space within each concrete bin. The retrievability is good for this alternative as well. This alternative was screened out because its cost, large footprint, and the additional time and effort to construct the facility could not be justified by its level of protectiveness.

- is something cheaper than granite - MS plastic?? probably but we tried to work with Ken worth members of public and he wanted granite.

The Pyramid Design was not as favorable as the other design alternatives because of several concerns. Schedule concerns for expediting the remedial actions would be dependent on acquiring the large volume of granite stone and construction. Monitoring and retrieving the remedial waste would be difficult in this structure due to accessibility. The downgradient wells would be the only indication of a contaminated plume. A liner system could be added to this design but would increase the total cost and the cost is already one of the highest of any of the alternatives examined.. The remedial waste is not segregated but is stored in a bulk capacity. The facility is a totally enclosed rigid structure and would require stringent design standards to prevent differential settlement which could crack mortar joints and ultimately breach the barrier. From this standpoint, long-term maintenance would be required. This alternative was screened out because of cost, concerns about settling, the availability of materials, and concerns about the facilities ability to contain and monitor the waste.

The Waste Pile alternative is a short-term waste management solution. The remediation waste is enclosed with a surrounding geomembrane . The facility footprint would generally be smaller than the other alternatives because the waste is stored as bulk. The retrievability is achievable but at a lesser degree and is measured similar to the Abovegrade Waste Cell. Logistics of daily operations would be difficult because the waste pile would be open to the environment. The protectiveness of this design is poor. The design does not support the active management of waste as envisioned in the 10 Year Plan nor does it meet the basic requirements for a CAMU described in RFCA. This alternative was screened out because of poor protectiveness, an inability to support cleanup operations and an inability to meet 6 CCR 1007-3 Part 264, Subpart N as required by RFCA.

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The No Action Alternative is carried throughout the screening process because of the requirements of NEPA and CERCLA as a baseline. The No Action Alternative essentially means the remediation waste is prepared for offsite disposal and no CAMU designation is obtained . If the No Action Alternative was followed through, and no long-term onsite RWSF was planned for, then the individual remedial actions would have to handle their wastes at the time of generation. This would result in an early expenditure of funds to meet treatment, transportation, and disposal costs which would limit the funds available for actual cleanup activities in support of site closure.

The four selected alternatives that reached the final screening were as follows:

- Abovegrade Storage Cell;
- Abovegrade Concrete Lined Cell with bulk placement;
- Metal Buildings; and
- No Action Alternative.

Several factors affected the selection of these alternatives for the final comparison which are explained below.

The Abovegrade Storage Cell is similar to the standard hazardous waste landfill built to RCRA Subtitle "C" standards. This facility would be built above the existing grade to prevent groundwater infiltration. This design, as well as the Concrete Lined Cell are proven technology. As with the Concrete Lined Cell, the liners and leachate collection system provide the ability to detect leaks and recover contaminants prior to entering the environment. This facility offers flexibility, retrievability and still remains one of the least expensive over the long term. In addition, this design supports the RFCA in terms of design requirements, and supports the 10 Year Plan by providing the necessary flexibility.

The abovegrade Concrete Lined Cell with bulk placement (Concrete Lined Cell) was selected for the final comparison for several reasons. The concrete cell adds another layer of protectiveness to groundwater from the leachate generated during placement and storage operations. This design is flexible and allows for modular installation that will optimize the sizing of the cells and timing of the installation as waste is generated. This design will also expedite risk reduction activities under the Site Vision because of the flexibility. The first module will be sized for 25,000 to 33,000 cu yd of waste, and therefore, can be installed more quickly. Subsequent cells would be added as needed up to a total capacity of approximately 100,000 cu yd. A fair degree of retrievability is maintained because a combination of containers and bulk storage is utilized. This allows the flexibility to utilize the facility for either short-term or long-term storage.

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What about bulk?

The Metal Buildings alternative was selected for the final screening because it would allow for interim storage of the waste until the final disposition is determined. Storage of waste will allow remediation to proceed in a timely fashion. The waste would be stored in cargo containers and would be fully monitorable and recoverable. It was, therefore, believed that public perception and acceptance of this alternative would be high despite the higher cost and shorter useful life.

The No Action Alternative was selected for the final screening because it must be assessed to meet NEPA values and 10 CFR 1021.321(c) requirements.

The final design alternative comparison used the RFCA criteria, as discussed in Section 6, to select the best alternative.

Scott Surovchak
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6.0 COMPARISON OF ALTERNATIVES

Based on the analysis presented in this decision document, bulk placement of the remediation waste in the Concrete Lined Cell at the Site east of the Solar Pond is the remedy selected for management of remediation waste. The abovegrade Concrete Lined Cell with Bulk Placement was selected from the four final alternatives screened in Section 5.0:

- Abovegrade Storage Cell;
- Abovegrade Concrete Lined Cell with bulk placement;
- Metal Buildings; and
- No Action Alternative.

These four design alternatives were compared using the seven RFCA criteria from Paragraph 109a (DOE, 1996a) to select the best Alternative for remediation waste management at the Site. The seven RFCA criteria are as follows:

1) Worker Safety;
2) Protection of Public Health and the Environment;
3) Transportation;
4) Facility Design, Containment and Monitoring;
5) Institutional Controls;
6) Cost; and
7) Community Acceptance.

Two other criteria have been included that address NEPA values:

- Short-Term Effectiveness; and
- Long-Term Effectiveness and Permanence.

A summary of the final comparison of Alternatives is given in Table 6-1. Statements concerning public acceptance serve as placeholders and will be modified based on public input as the review cycle progresses.

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Table 6-1 Summary of the Final Alternative Comparison for Remediation a Waste Storage Facility

Final Design Alternative	RFCA Criteria Worker Safety	Protection of Public Health and the Environment	Transportation	Facility Design, Containment and Monitoring	Institutional Controls
Abovegrade Storage Cell	Risks to workers are similar for all Alternatives considered. Spraying of water during construction will reduce exposure to dust. Location is in a low traffic area.	RCRA double liner system provides groundwater protection. Leakage would be detected in the liner system	Centralized location minimizes transportation requirements onsite. Design and location should have minimal impact on existing traffic patterns.	Liner system provides additional containment plus the ability to detect leaching. Air monitoring could be performed in conjunction with existing RFETS monitoring.	The RFCA acts as an Institutional control requiring continued maintenance of the facility. Since the use of the facility is for short-term storage, controls beyond those inherent in RFCA are not necessary.
Concrete Lined Cell with Bulk Placement	Risks to workers is similar for all Alternatives considered. Spraying of water during construction will reduce exposure to dust. Location is in a low traffic area.	RCRA double liner system provides groundwater protection. Concrete walls and floor provide additional protection. Leakage can be detected and collected prior to reaching liner system.	Centralized location minimizes transportation requirements onsite. Design and location should have minimal impact on existing traffic patterns.	Leachate would be detected and collected in a cell collection system prior to reaching the subsurface liner. Air monitoring would be performed in conjunction with existing RFETS monitoring.	The RFCA acts as an Institutional control requiring continued maintenance of the facility. Since the use of the facility is for short-term storage, then controls beyond those inherent in RFCA are not necessary.
Metal Buildings	Risks to workers is similar for all Alternatives considered. Spraying of water during construction will reduce exposure to dust. Location is in a low traffic area.	Containerized waste and building reduces exposure to the worker and the public. Visual inspections allow leaks to be detected before release to the environment.	Centralized location minimizes transportation requirements onsite. Design and location should have minimal impact on existing traffic patterns.	No liner system would be present; however, waste would be in containers which would be more easily monitored visually. Air monitoring would be performed in conjunction with existing RFETS monitoring.	The RFCA acts as an Institutional control requiring continued maintenance of the facility. Since the use of the facility is for short-term storage, then controls beyond those inherent in RFCA are not necessary.
No Action Alternative	Some increased exposure could occur due to increased transportation requirements. Worker risk is similar to risk for storage Alternatives.	It is assumed that permitted offsite facilities are protective. Increased transportation risks will occur.	Upgrades to existing facilities could be needed to accommodate offsite shipments. Shipments would be transported through several major population centers. by rail or truck .	Off-site facility would offer less containment in terms of design but more containment in terms of geologic setting. The off-site facility would have air and water monitoring capabilities.	Institutional controls would exist for offsite facilities.

Table 6-1 (continued)

Final Design Alternatives	Cost[1]	Community Acceptance	Short-Term Effectiveness	Long-Term Effectiveness and Permanence
Abovegrade Storage Cell	This Alternative has a high total cost of **$119M** and requires a large footprint for the total facility.	Monitoring and retrieving the waste is more difficult with this option.	Reduces waste handling requirements for accelerated actions and D&D projects. Focuses resources on risk reduction.	Provides sufficient permanence for an interim solution. Utilizes natural nondegradable materials in cap and liner design to support long-term use.
Concrete Lined Cell With Bulk Placement	This Alternative has a total life-cycle cost of **$77M**. The cost benefit outweighs other Alternatives and allows more resources to be applied to risk reduction rather than waste management. Option offers an ability to monitor and retrieve waste at a relatively low cost.	This Alternative offers monitoring and retrievability of the remediation waste but physical inspection is not to the degree that metal buildings would offer.	Reduces waste handling requirements for accelerated actions and D&D projects. Modular design allows for rapid construction. Focuses resources on risk reduction.	Provides sufficient permanence for an interim solution. Utilizes natural nondegradable materials in cap and liner design to support long-term use.
Metal Buildings	This Alternative has a life-cycle cost of **$161M**. The high cost is the result of the container costs.	This Alternative combines easy monitoring and retrievability with offsite disposal. Visual leak inspection is possible. Protectiveness is less than other onsite options.	Additional packaging requirements needed to containerized waste. Rapid construction will speed up availability of facility. Focuses resources on risk reduction.	Provides sufficient permanence for an interim solution The buildings themselves are not effective for the long-term due to high maintenance.
No Action Alternative	This Alternative has a life-cycle cost of **$216M**. This cost is driven by the cost for containers, waste treatment, and offsite disposal costs.	Waste would be sent offsite. Waste would be transported near population centers.	Readily available to support on going projects. Additional effort needed for packaging, transportation, and documentation requirements.	All offsite disposal facilities under consideration have been designed for long-term use.

1. Cost estimates, except the No Action Alternative, do not include offsite shipment and disposal which is deferred until closure of the RWSF.

Worker Safety - Each of the Alternatives poses risks to workers. All of the Alternatives will be labor intensive to implement but will not pose any unusual risks. Air monitoring, spraying to minimize dust, and the use of a daily cover will protect plant workers from airborne contaminants during construction and operations. Once constructed, the onsite Alternatives will pose minimal risk to RFETS' workers because engineered barriers will contain the remediation waste. In addition, the selected site is in an area of minimal traffic. Worker safety for the no-action Alternative at offsite location was not evaluated but was assumed to be comparable to the onsite Alternatives.

Protection of Human Health and the Environment - In terms of design, the Concrete-Lined Cell with bulk placement has the most protective design elements. A significant advantage is the leachate collection system in the concrete floor of the cell. Unlike the above-grade storage cell, contaminants could be detected and captured within the cell. In the above-grade storage cell design, the contaminants would be captured in the first or second layer of liners. The metal building Alternative could also contain the leakage in the structure of the facility, itself; however, once the leakage is out of the buildings, contaminants would escape into the environment since there is not a liner system. In contrast, the Concrete Lined Cell has a double liner system.

The no-action Alternative would immediately have to rely on an offsite facility to provide protection. A permitted offsite disposal facility is assumed to afford adequate protectiveness once the waste is placed. Additional risk to human health and the environment would occur as a result of increased handling requirements and transportation. In addition, substantially more treatment, handling, transportation, and disposal costs would be incurred for each IHSS or cleanup action. These additional costs would limit the amount of risk reduction per dollar that could be accomplished. This, in turn, would result in more contaminant sources remaining exposed in the environment and could actually increase the risk to human health and the environment.

All of the Alternatives offer protection from erosion. Likewise, there is little difference among the Alternatives in terms of biological impacts since these impacts are expected to be minimal.

Transportation - The central location of the RWSF will minimize onsite transportation of remediation waste. In addition, the location is in a low traffic area. However, eventual shipment offsite will require additional transportation either by truck or by rail. Offsite shipments would pass through at least two major population centers; there is only one facility currently available to accept low-level and mixed low-level wastes and that would probably be utilized and the routes to this facility are limited. It is possible that under the three onsite storage alternatives that remediation waste could be shipped to Alternative offsite facilities thereby reducing transportation risks. For all of the alternatives, upgrades to RFETS shipping and transportation facilities would be necessary.

Facility Design, Containment and Monitoring - All of the onsite Alternatives have engineered features to provide additional containment and monitoring. The Concrete Lined Cell with bulk placement has the best physical containment because both the cells and the liners have a leachate collection system. The metal building Alternative offers the ability to visually monitor the waste, plus the waste would be in containers and easily retrieved for shipment. The Abovegrade Storage Cell does not offer the same degree of monitoring or containment as the two other onsite options.

Institutional Controls - The selected location in the Solar Ponds Area combined with the RFCA acts as an institutional control since the DOE must comply with paragraph 278 of the RFCA which would require continued maintenance of a containment system in the event that the property is leased or the title is conveyed to another party. Because the RWSF will only be operational as long as operations are continued in the Industrial area, additional institutional controls beyond the existing controls are deemed not necessary. For the no-action Alternative, institutional controls of some form would likely exist; however, DOE and CDPHE involvement in those controls could be minimal.

This is very tough

Cost - Based on near-term costs, the concrete-lined cell was the least expensive ($77,300,000). The no-action Alternative was more expensive ($215,900,000) than the other Alternatives specifically because of the cost of treatment and disposal. This cost is likely to be deferred for the other Alternatives until the waste material is removed from storage. The Abovegrade Storage Cell was more expensive ($118,800,000) than the concrete-lined cell because its footprint was bigger which would require more site preparation and fill material. The cost of the metal buildings ($161,400,000) is also greater than the cost of the concrete-lined cell because of the cost to purchase containers and, again, because of the additional costs incurred by having a larger footprint.

The costs for each Alternative are listed in Table 6-1. A more complete breakdown of costs are in the Alternative descriptions in Appendix E and in the backup for the facility design screen in Appendix F. None of the cost estimates included offsite disposal which was assumed to be deferred until the waste would be removed from storage.

Community Acceptance - The no-action Alternative would best meet the desires of some segments of the local community since this Alternative would remove the waste from the area the earliest; however, other segments of the community might desire storage to allow more time to develop offsite options for transportation, treatment or disposal. The local communities desire to remove the waste must be balanced with the desires of more distant communities that are near waste disposal sites or are on the highways or railways over which the waste must be transported. Because only temporary storage of the waste is being proposed, ultimately there must be some community impact with any of the options. Of the three onsite options, the metal buildings would likely be the most acceptable option to the public since this Alternative offers the ability to inspect the waste in containers and to easily retrieve the containers for offsite shipment. Furthermore, since metal buildings have a limited useful life,

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the community might find this a more acceptable Alternative since it would have a limited ability to provide long-term storage. All of the alternatives have the ability to monitor and retrieve the stored waste.

Short-Term Effectiveness - Because only temporary storage is being considered, the relative importance of the criterion is elevated. Particular emphasis needs to be placed on supporting an accelerated cleanup of RFETS as described by the TYP and the RFCA. One of the main advantages of the onsite alternatives is the ability to defer the cost of offsite disposal. Use of the RWSF would allow the immediate cleanup of high risk IHSSs as well as the D&D of more buildings in a shorter time frame. The RWSF could also impact the plant mortgage by allowing more mortgage reduction activities to occur and thereby reducing the mortgage sooner.

The other issue of short-term effectiveness is logistics. Until a facility is available to handle large volumes of remediation waste, short-term effectiveness at RFETS is limited. Once the RWSF is built, dealing with the remediation waste would be easier than shipment to an offsite facility because packaging, sampling, documentation, and transportation issues would be much easier to address. An Abovegrade Storage Cell and the Concrete Lined Cell would allow bulk waste to be placed in the facility without additional containerization, and onsite transportation requirements would be minimal.

Because of convenience and initial cost, the Abovegrade Storage Cell and the Concrete-Lined Cell would best support the implementation of D&D and Environmental Restoration actions. The metal building Alternative would require some additional packaging effort and the no-action Alternative would require additional preliminary efforts to both package and transport the waste; however; all of the alternatives would require these actions for eventual offsite shipment.

Long-Term Effectiveness and Permanence - Since at the closure of the RWSF, all of the waste is going offsite for disposal, ultimately, the long-term ability of any Alternative is dependent on the offsite disposal facility selected. However, the relative permanence and long-term effectiveness of the selected Alternative is important because they are generally indicative of the facilities protectiveness. Also, permanence allows the flexibility for long-term storage should there be a need.

Of the four alternatives, the Concrete-Lined Cell with bulk waste placement would have the greatest degree of long-term effectiveness and permanence based on the extra protection offered by the 12-inch thick concrete walls and 18-inch thick floor. The internal concrete structure adds both an additional barrier to leakage as well as internal structural support for the facility.

The no-action Alternative and the Abovegrade Storage Cell also offer good long-term effectiveness and permanence. The Abovegrade Storage Cell offers about the same degree

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of permanence as the concrete-lined cell because it would utilize a similar liner system and a contoured, impervious interim cap. However, the Abovegrade Storage Cell would not have the additional protection of the concrete infrastructure of the concrete-lined cell. The metal building Alternative offers the least amount of long-term effectiveness and permanence. Since the facility is only intended for temporary storage this translates into only limited flexibility.

The Concrete-Lined Cell was selected because of the following criteria:

- It is protective of the environment and human health. The engineered features provide additional protection that the other alternatives do not have such as a multiple layer interim cap and an 18-inch concrete floor with its own leachate collection system.

  It provides more flexibility in storage options since it can accommodate either bulk storage or containers. It offers the retrievability needed for short-term storage combined with the protectiveness of a more permanent facility.

- It best supports environmental restoration and D&D activities since bulk waste could go from treatment or excavation right into the facility. The circumvention of the transportation requirements and packaging requirements would allow these activities to become more efficient and cost-effective. In the near-term, it costs less than the no-action Alternative and, therefore, which frees up funding for additional mortgage reduction activities and accelerated environmental actions. It is the least costly of the onsite alternatives.

- This facility would be installed in a modular fashion so that additional cells could be built adjacent to the original cell if needed. The use of modules would allow for some modules to be filled while others are constructed. This creates flexibility for future waste management decisions while not committing funds until necessary. This modular design conforms well to the 10 Year Plan and the RFCA as well as plans for the future use of the Site.

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Scott Surovchak
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7.0 SELECTED REMEDY

7.1 REMEDY DESCRIPTION

This section describes the conceptual design of the selected alternative and gives more detail of how the alternative meets the objectives of the IM/IRA, the RFCA, and CAMU criteria. The basis for the decision to select the specific alternative is described in Section 7.2, with a discussion of how the selected alternative meets the objectives of this IM/IRA that were outlined in Section 1. A Risk Evaluation is provided in Section 7.3 which discusses studies that were performed to provide assurance that the RWSF will meet the siting criteria, design requirements, and monitoring requirements included in RFCA and in the CAMU rule. Section 7.4 discusses technical and administrative controls for the CAMU that will meet the requirements identified in RFCA paragraph 80. Discussion of how NEPA values were addressed throughout the document is included in Section 7.5. Conceptual waste acceptance criteria (WAC) are described in Section 7.6. Section 7.7 discusses operational controls and plans that will control the activities and waste operations of the RWSF.

The selected alternative, the Concrete Lined Cell, will consist of a series of modular cells, each sized for approximately 33,000 cu yd of waste and having a total capacity of up to 100,000 cu yd, as appropriate, to meet storage needs. The concrete-lined cell will be located immediately east of the Solar Ponds in the northeast quadrant of the Protected Area. (See Figure 7-1). This facility would be placed abovegrade with the lowest point of the leak detection system also being abovegrade. The RWSF will be designed with a double composite liner system with modular concrete cells. (See Figures 7-2 and 7-3.) An impervious interim cover will isolate wastes from infiltration and erosion. An example of a type of impervious interim cover is included in Figure 7-3. The liner will comply with RCRA Subtitle "C" requirements as defined in 6 CCR 1007-3, Part 264. For the purpose of costing, the conceptual design currently incorporates the following features:

- self-supporting reinforced concrete structure;
- facility size will be 500 ft long by 360 ft wide and 14 ft deep (approximately 4.13 acres);
- the facility will consist of up to three modules, each 500 ft long by 120 ft wide further sectioned/divided into compartments for waste segregation by bulk or cargo containers;
- a reinforced concrete slab with cast-in-place drain channels and sumps to collect leachate;
- external and internal reinforced concrete walls with integral waterstops;
- a composite double liner and leachate detection/collection system;
- an operational cover to enclose the cell/module during operations for fugitive dust controls and to reduce the generation of leachate;
- an impermeable interim cover system which would slope at a 3% grade; and
- five monitoring wells for groundwater monitoring.

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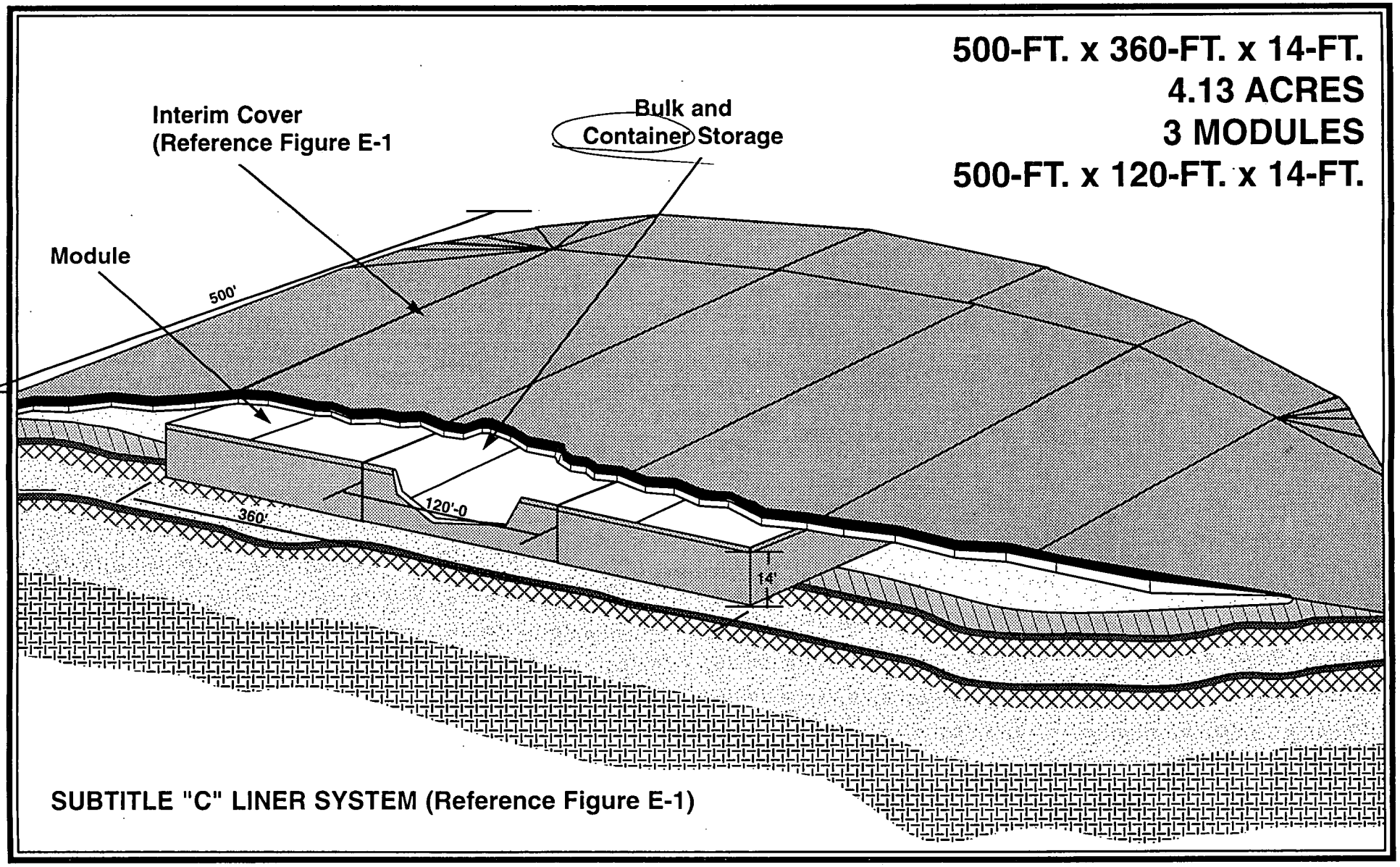

Figure 7-2

CONCRETE-LINED CELL WITH BULK WASTE PLACEMENT

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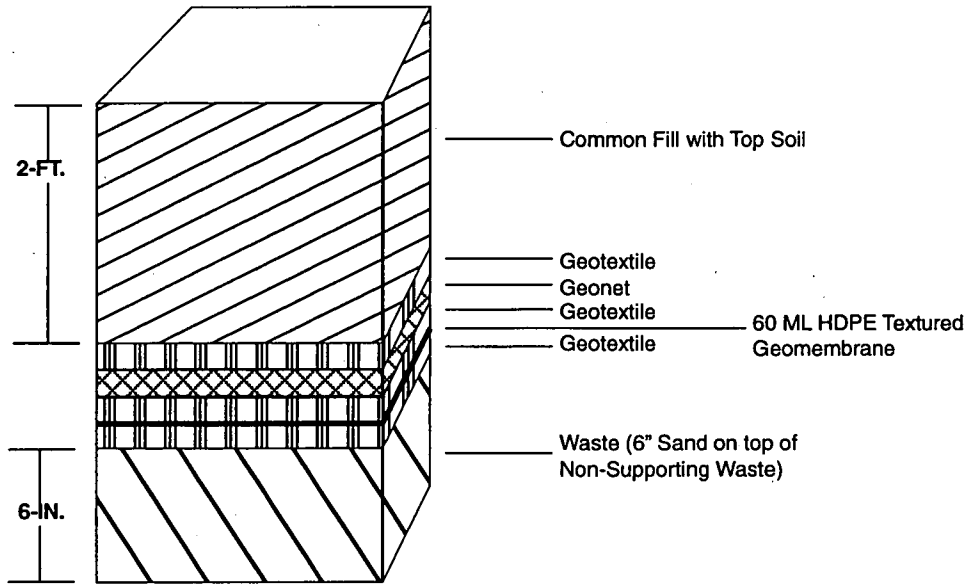
INTERIM CELL COVER



CELL LINER

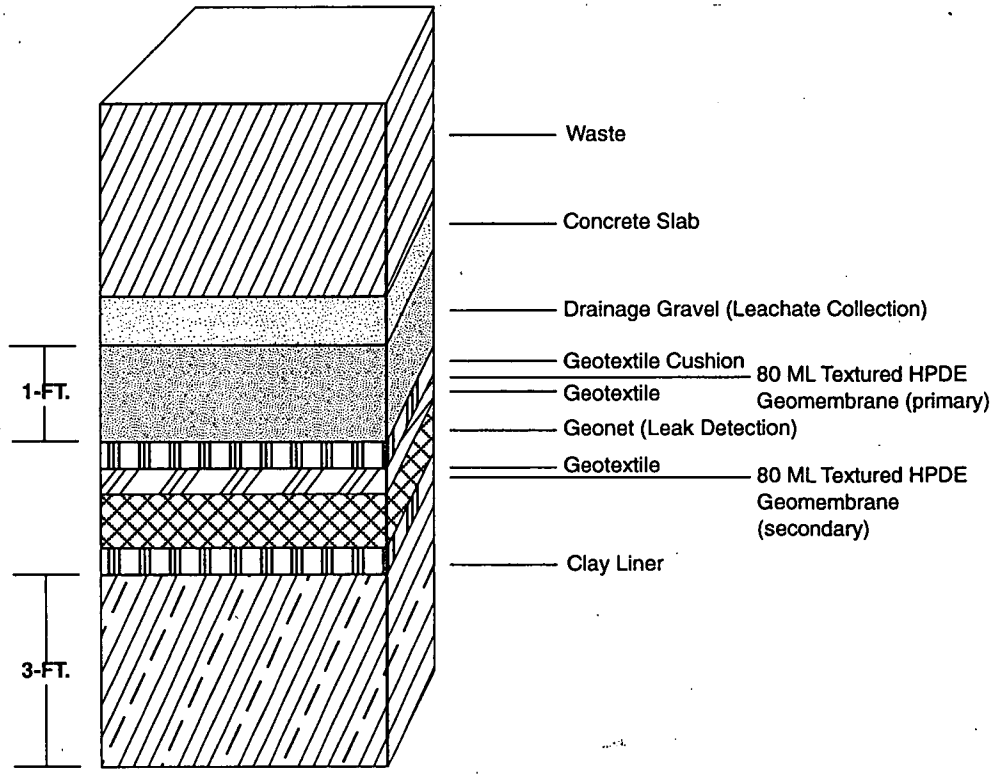


Figure 7-3

ON-SITE FACILITY CROSS SECTION

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The leachate transfer and storage system would be provided to manage leachate that is collected in the RWSF. Leachate will be transferred from the RWSF to a treatment system, as necessary.

Groundwater monitoring will be done in accordance with all applicable rules and regulations, including, but not limited to, CAMU requirements in 6 CCR 1007-3, Section 264, Subpart S and applicable requirements in 6 CCR 1007-3, Subpart F. A groundwater monitoring plan will be prepared in accordance with 6 CCR 1007-3, Subpart F.

During operations, an operational enclosure sprung structure will cover the cell/module to minimize fugitive dust and reduce the infiltration and generation of leachate until the interim cover has been established. Waste will be placed in the facility in bulk or in containers. Additionally, this facility will allow for the options of placing waste in cargo containers or segregating wastes.

Once a module/cell has reached capacity with remediation wastes, an interim cover will be constructed and the temporary sprung structure will be removed. The interim cover will be approximately two feet thick and consist of vegetative cover, drainage layer, and an impervious geosynthetic membrane (e.g., HDPE). The cover will be sloped 3% - 5% to promote drainage.

7.2 DECISION BASIS

A concrete-lined cell in the Solar Ponds Area was selected and justified based on the screening criteria and the final comparison criteria presented in Sections 5 and 6 of this Decision Document. To further support that selection, Section 7.2.1 is an evaluation of the selected remedy in terms of the original objectives of this document as presented in Section 1.0. In order to demonstrate compliance to RFCA, Section 7.2.2 demonstrates how the criteria in paragraphs 80 and 109a of RFCA were considered in the analysis of alternatives and, specifically, how the selected remedy addresses these criteria. Finally, in Section 7.2.3, the basic benefits of the selected remedy are stated to summarize the decision basis.

7.2.1 Objectives

As stated in Section 1.1.1, there are four main objectives of this IM/IRA. The selected remedy meets those objectives in the following manner:

1) In support of the RFCA and the TYP, the management of low-level, low-level mixed and hazardous remediation waste must ensure the safety of the public, RFETS workers, and the environment through reliable, effective, protective, and cost-effective management of remediation wastes at the RFETS.

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The selected remedy addresses this objective through the following safety features:

- all work including construction, filling operations, handling, and transportation will be done under an approved health and safety plan (HASP);
- the remediation waste that would be placed in this facility will generally have very low levels of radionuclides;
- work will be performed under the oversight of industrial hygienists, occupational safety professionals, and radiological engineers;
- workers will be required to undergo extensive training based on the specific hazards of their job;
- a wide range of dust suppression measures will be taken during construction, transportation, handling, and filling operations to ensure that fugitive emissions of vapors or particulates are not generated. Dust control activities during handling, transportation, construction, and placement could include an operational cover, dust suppresion sprays, high wind shutdowns, or other precautions.
- various types of monitoring would be performed to ensure not only the safety of the public and Site workers but also protection of the environment. This would potentially include air monitoring for particulates and contaminants, radiological monitoring, ground water monitoring, and surface water monitoring; and
- once a module or cell is filled, an interim protective cover would be placed over it.

The facility, itself, has numerous design features added to ensure protection of human health and the environment. Some of these protective measure are as follows:

- Leakage will be detectable within the facility, therefore, leachate can be collected prior to reaching the first liner;
- An impervious interim cover will reduce infiltration-related leaching and soil erosion;
- An 18-in. thick reinforced concrete slab floor;
- Waste separation could be done through the use of compartments built into the modular design;
- 12-in. thick reinforced concrete walls;
- Two leachate collection systems, one system will be built into the floor of the facility; the second system will be built into the liner system;
- A multiple-layer liner system that utilizes both synthetic and natural materials; and
- A groundwater monitoring system.

2) A means of consolidating remediation waste in one location is needed to support near-term risk reduction goals while addressing long-term liability and safety issues.

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The location and design were selected to allow large quantities of remediation waste to be consolidated at a single location. Not only does the location and design allow the physical consolidation of the waste but it also allows waste management activities such as operations, monitoring activities, and inspection to be consolidated as well. The use of a modular design allows the RWSF to adjust to the influx of waste media as remedial activities proceed. Although the waste will be consolidated at a single location, the modular design has features that multiple facilities could offer such as:

- The ability to segregate and isolate differing waste types;
- Future modules could have specialized containment and monitoring features should the need arise; and
- The ability to accept either bulk or containerized waste.

3) The management of low-level, low-level mixed, and hazardous remediation waste must result in a cost-effective solution that can be implemented under existing budgetary constraints.

If storage is needed, the Concrete Lined Cell is the most cost-effective of the alternatives considered that could meet RFCA criteria. (The waste pile could not meet the 6 CCR 1007-3, Part 264, Subpart N requirements that were required by RFCA because it did not have a liner system.) Table 7-1 gives the total life cycle costs for all of the design alternatives considered.

Table 7-1 Life Cycle Costs for Design Alternatives

Alternative	Total Life Cycle Cost
Abovegrade Landfill	$118,800,000
Pyramid	$140,300,000
Concrete Lined Cell with bulk placement	**$77,320,000**
Concrete Lined Cell with containers	$165,650,000
Hardened Concrete Vault	$181,630,000
Silo Design	$107,300,000
Slab on Grade	$141,600,000
Metal Buildings	$161,400,000
Entombment	$525,000,000
Waste Pile	$36,669,000
No Action	$215,900,000

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Based on professional judgment, the cost differences between location alternatives were not as significant as cost differences between the design alternatives and the final alternatives.

In the near-term, it is also more cost-effective to store the waste onsite rather than ship it offsite for disposal (No Action); however, in the long term, if it is possible to ship the remediation waste offsite immediately then it is more cost-effective to do so. In terms of cost, the CAMU should still be an alternative to the TYP in case additional storage is needed.

4) The solution must be compatible with future land uses for the Site and the Site Vision.

The selection of a Concrete Lined Cell in the Solar Ponds Area is consistent with future land use, (DOE, 1995a) the Site Vision, (Kaiser-Hill, 1996b) and also the RFCA. The ways that the selected alternative supports the Site Vision and projected land uses are as follows:

- The RWFS is a temporary storage facility which is consistent with the Site Vision goal of dispositioning remedial waste in a safe manner.

- The site selected is in the Industrial Area of the plant and could potentially extend over several IHSSs. Future land use for this area is for limited industrial use. The area near the Solar Ponds is far enough away from any building that might be reused so as not to impact any future Site activities; and

The design and centrally located site facilitates monitoring and maintenance. Monitoring can be performed in conjunction with monitoring activities already required for the industrial area. Existing air monitoring systems can also support monitoring for the RWSF.

7.2.2 Summary of Selection Basis

As part of the effort to define the design concept for the RWSF and in accordance with DOE Order 4010.1a, a Value Engineering Study was performed. In the value engineering analysis method, multiple alternative approaches of accomplishing the project functions are subjected to qualitative and quantitative techniques to determine the value of each. The alternative which represents the highest value is selected for further development.

Four categories of protective elements which were considered essential components of any acceptable design and which also represent the highest costs of implementability and operation of the facility were selected for inclusion in the Value Engineering Study.

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The categories were:

- protective barriers at the bottom of the facility (liners and/or other structures);
- protective barriers at the top of the facility (interim cover and/or other structures);
- waste placement; and
- waste removal (exhumation at end of storage period).

Many combinations of construction and placement were identified that could accomplish the functions associated with the four categories. Application of the value engineering techniques identified a design incorporating a concrete structure, conventional liners, and an interim cover. Waste is placed in bulk (rather than in individual containers) to represent the highest value. The results of the Value Engineering Study independently validated selection of the Concrete Lined Cell with bulk storage attained through the alternatives analysis process.
To support the selection of a Concrete Lined Cell at the Solar Ponds Area, the following advantages are cited:

- The modular design offers the greatest degree of flexibility including the following attributes:

  — a wide variety of waste types can be accepted and kept segregated;

  — debris could be placed in the facility without additional characterization, compaction, or size reduction;

  — the facility can be expanded as needed to meet the needs of cleanup at RFETS as the cleanup progresses;

  — the RWSF can accept both bulk and containerized wastes; and

  — the RWSF can store waste for varying durations.

- The facility would have a high degree of protectiveness because of the concrete containment system, the additional liners in the subsurface liner system, and the interim cover. All of these features offer much greater protection than would be found in a typical storage facility;

- One major advantage is that the concrete containment system allows for the capture of contaminants before they reach the subsurface rather than depending on the liner system. Media below the facility would not be contaminated should leaching occur. The liner system would act only as additional back up barriers or as tertiary containment, rather than as the secondary containment system;

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- The facility is situated in an area where contamination is already present;
- The selected location has strong CDPHE support based on previous input; and
- The facility is centrally located to many of the IHSSs that need remediation.
- The RWSF will minimize indirect effects on the environment by being placed in the Industrial Area where existing infrastructure will support use of the facility.

The RWSF will minimize cumulative effects on the environment by being built on an existing facility in an areas previously contaminated, and thus will not add impacts by disturbing additional areas on the Site.

In selecting a remedy, emphasis was on flexibility and environmental protection. The selected remedy offers a environmental protection, durability, and the ability to safely contain remediation waste for whatever period of time is needed. It is a facility well suited to safely contain the remediation waste for long periods of time which would allow new technologies to be developed to treat or contain the waste or for alternative sites for offsite disposal to be developed. In the decision making process, a key factor to the decision was the potential that if the waste could not be removed in a reasonable time period, flexibility was needed to continue to safely store the waste. This facility can safely store the waste for any duration while still retaining protectiveness.

7.3 RISK EVALUATION

A number of studies have been conducted to provide assurance that the recommended alternative will meet the established criteria for the RWSF. These analyses were conducted to support CAMU criteria for protection of public health and the environment as listed in 6-CCR-1007-3 Part 264.552 (c). The analysis of risk has been divided into the following three main exposure pathways:

- Offsite transport of contaminants through the groundwater to neighboring surface waters;
- Worker exposure to radionuclides during operations; and
- Offsite fugitive dust emissions.

The potential for vertical contaminant migration through underlying geologic strata into the Laramie-Fox Hills aquifer has previously been addressed and is considered to be an unrealistic scenario, (see RMRS, 1996). The most conservative calculations of volatile

organic contaminant transport indicate that travel times of at least 17,000 yr will be required for contaminants to migrate to the deep aquifer, which greatly exceeds the 1,000 yr time-frame considered in this document. The analyses performed in this report confirm the conclusions reached by the U.S. Geological Survey (Hurr, 1976) that plant operations will not impact this aquifer. More information on potential contaminant migration to the Laramie-Fox Hills aquifer is contained within the "White Paper Analysis of Vertical Contaminant Migration Potential" (RMRS, 1996).

Exposures from inadvertent intrusion into the RWSF after closure were also ruled out primarily because waste will be actively managed by inspections and monitoring throughout the life of the facility as per RFCA paragraph 80. In addition, it is assumed that as long as wastes remain on-site in the protected area (PA) and, the site is on the CERCLA National Priorities List (NPL), administrative controls will be required to limit access onto the site and five-year public health reviews will be required to ensure that the remedies used remain protective as long as waste remains onsite. It is also assumed that a fully integrated sitewide monitoring network will remain in effect to detect any releases from this action or any other as long as waste remains on site.

In addition to the pathways analyses referenced above, an analysis of technical and administrative controls is included. These controls are the administrative, design, operational, and post closure practices put in place to ensure releases are prevented or are prevented from impacting human health and the environment. Institutional controls can include deed restrictions, interagency agreements, and other controls.

7.3.1 Offsite transport of contaminants through the groundwater to neighboring surface waters

As with most waste management systems, potential accidental offsite releases to the public or the environment constitute the majority of risk. Siting criteria, design requirements, and facility monitoring requirements have all been established to mitigate the likelihood of a release event occurring. Several studies relative to the location of the RWSF, as well as the design itself, have been conducted to assess the likelihood of a release and the resulting level of contamination associated with such an event. One of the pathways considered was a release of contamination from the facility to groundwater and the subsequent transport of contamination to surface waters, where exposures to the environment or the public could occur. Three integrated studies were conducted to assess what, if any, risks might result from such a release. These are:

- Remediation Waste Storage Facility (RWSF) Particle Tracking Study;
- Leachate Composition Analysis; and
- Discharge Composition Analysis.

The first two studies identified the primary parameters for an exposure to occur, travel times, and source concentrations of contaminants. The final study defined the overall estimated concentrations based upon infiltration through interim and long term cover designs. These studies are attached to the decision document as Appendix H and are summarized below.

7.3.1.1 Remediation Waste Storage Facility Particle Tracking Model

The particle tracking study used a site validated mathematical model to track contaminant flow through the groundwater beneath the RWSF and estimated travel times to neighboring surface waters. Travel times were based upon varying retardation factors for a particle in contaminant categories that include metals, organic compounds, and radionuclides Retardation factors were based upon solubility, adsorption coefficients, and other factors that influence a contaminant's ability to flow freely within the groundwater. The retardation factors have either been obtained from literature values or from Site-specific values. Time frames considered for transport were 30 yr, 500 yr, 1,000 yr and 10,000 yr. The times used all exceed the estimated operational life of the storage facility since the intent of the facility is to support site closure within the 10 Year Plan time frames by providing a facility for storage only. Travel times did not assume any engineered barriers at the top or the base of the RWSF. These times are extremely conservative due to the assumption of no engineered barriers and represent a worse case scenario. In addition to the conservative travel times, the study makes no representation as to what levels of contaminants would reach neighboring surface waters within these time frames but is strictly limited to the travel time for a particle of material.

Metals and radionuclides have extremely high coefficients of adsorption, meaning that metals and radionuclides tend to adhere to clays within the surrounding soils and, therefore, exhibit limited movement. In addition, clay liner systems within the RWSF would further limit migration. The particle tracking models showed that migration would be limited for periods of nearly 1,000 years. Given the engineered barriers designed for the RWSF and the limited operational life cycle, discharges to surface waters are not expected. In addition, given the levels of metals and radionuclides associated with the estimated leachate composition and the estimated infiltration rates into the RWSF, no contaminant levels above stream standards are anticipated within the unit boundary.

Organic compounds present the predominant risk for completing the pathway to neighboring surface waters. The particle tracking model predicts that organics could conceivably reach surface waters within 100 yr without the engineered caps and liner systems designed for the RWSF. Organics levels however, are expected to be very low since thermal desorption technology is currently being used to treat soils and debris prior to disposition into a storage facility. Given the anticipated levels of organics within the leachate, the levels of organics

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discharged to surface waters if a potential release occurred, would be significantly less than what is allowable to protect human health or the environment and would meet all State standards for water. The leak detection system of the liners would signal an alarm before a potential release to the groundwater or surface waters occurred. These results are detailed in the leachate composition analysis and waste composition analysis.

7.3.1.2 Leachate Composition Analysis

This analysis identified an estimated leachate composition that was statistically based upon actual analytical results for areas at RFETS which are considered possible candidate sites for which materials may be placed into the RWSF. Multiple waste streams were used to ensure that the analysis was based upon a representative sample of likely contaminants for RFETS. This analysis considered organics, metals, and radionuclide concentrations (see Table 1, Appendix H).

7.3.1.3 Discharge Composition Analysis

The maximum contaminant concentrations that may occur in groundwater from a potential release from the RWSF were calculated. These calculations were performed on the basis of estimated concentrations of contaminants from the leachate composition analysis and the estimated volumes of leachate anticipated to be generated as a result of moisture infiltration into the RWSF through the interim cover. Two cover scenarios were evaluated, a final closure cover, and a less extensive interim cover. The intent of this analysis was to provide a benchmark for estimating maximum potential values of contaminant discharge via groundwater into neighboring surface waters from the RWSF. This study assumed that no leachate collection was included in the RWSF design. However, both a leachate collection system and liner are designed to capture any discharges from the RWSF eliminating contaminant transport to the groundwater. The discharge composition analysis study would represent a worst case scenario where the leachate collection system would be inoperable. This does not assume a catastrophic breach however, only a failed collection system where leachate would be allowed to accumulate within the liner system and eventually discharge through the liners into the groundwater. Since active management of the system will occur, it is highly unlikely this scenario would exist for a time frame long enough to allow leachate to migrate through the liners. These flow rates were based upon infiltration rates calculated with the HELP model, an EPA approved model for evaluation of engineered barriers (EPA, 1985).

Based upon an estimated waste stream leachate analysis, no discharges to surface waters above action levels is anticipated for either cover scenario. A detailed table listing estimated discharge levels for specific contaminants is included in the study (see Table 3, Appendix H).

7.3.2 Worker Exposure to Radionuclides During Operations

A radiological dose assessment was conducted to assess the maximum radionuclide activities allowable in soils at the RWSF, based on annual exposure limits. The dose assessment used an upper annual exposure limit for a worker of 5,000 mrem/yr (10 CFR 834), and a lower limit of 100 mrem/yr (DOE Order 5400.5). The exposure scenario was for a RWSF operational worker and used site-specific exposure factors. (See Programmatic Risk-Based Preliminary Remediation Goals, Rev 2, DOE 1995).

The soil activity for each individual radionuclide necessary to give a 5,000 mrem annual does to a worker at the RWSF is 64,100 pci/g of americium-241, 74,900 pci/g of plutonium-349, and 1,020,000 pci/g of uranium-238. The activity of each radionuclide to deliver a 100 mrem annual dose is 1,280 pci/g for americium-239, 1,500 pci/g for plutonium-239, and 20,400 pci/g for uranium 238. These activities were calculated separately for each radionuclide. If all were present, the maximum concentration of each to deliver a given dose would be reduced. Actual activities of radionuclides in the RWSF will be much lower than those calculated for even the 100 mrem dose.

Soils and other materials from across the Site will be deposited in the RWSF. Average activities will be well below those calculated above for the 100 mrem annual dose, and are estimated to be below the Tier I Action Levels for radionuclides in surface soils (AM-239 = 215 pci/g, Pu-239 = 1,429 pCi/g, and U-238 = 506 pCi/g, DOE, 1996a). The average activities for soils from the 903 Pad area, which would be deposited in the RWSF, are 10 pCi/g for Am-241, 347 pCi/g for Pu-239/240, and 3 pCi/g for U-238. This indicates that wastes that will be deposited in the RWSF will not pose a radiological health threat to operations personnel. Waste acceptance criteria (WAC) for the facility will establish conservative limits on contaminant levels in deposited wastes, and significant health and safety monitoring will also be conducted.

7.3.3 Fugitive Dust Emissions

The fugitive dust emissions study estimated maximum-allowable activities in wastes deposited in the RWSF to deliver a known dose from airborne radionuclide contaminants, transported with dust particulates, to an offsite human receptor at the RFETS boundary, at 96th and Indiana Street. The study conservatively assumed a five-acre area, continuously exposed to wind erosion, with no effects from operational barriers such as cover on wastes or containers, and 1995 Site meteorological wind data. A fugitive dust emissions factor of 66.84 grams/m^2 was calculated using EPA procedures. A regulatory limit for exposure dose was assumed to be 10 mrem per year.

As in the worker dose calculations reported above, the upper limit activities to deliver the maximum allowable dose (10 mrem/yr) was calculated for each radionuclide. The results estimate that if 100 percent of the dust load at 96th and Indiana was from the RWSF the activities of Am-241 or Pu-239/241 could be up to 220,000 pci/g. The actual contribution of dust from the RWSF would be much less than 100 percent and contributions from the Site would lower the allowable activity, based on air emissions at the RWSF. However, the RWSF WAC will establish administrative controls on maximum contaminant levels at the RWSF that will be well below the level of concern for air emissions.

The average levels of radionuclides in Site soils are much lower than activities necessary to pose a threat to human health of a residential receptor at the RFETS boundary. Average activities were not estimated for contaminated debris resulting from D&D actions. The WAC will need to ensure that levels of radionuclides in debris are controlled within acceptable limits by predisposal decontamination or packaging.

7.4 Technical and Administrative Controls

Technical and administative controls are implemented in order to ensure that human health and the environment are protected from areas where present or past activities preclude unrestricted access or use, controls are implemented. The technical and administrative controls meet the requirements in RFCA paragraph 80 for a CAMU. For the RWSF, controls can be grouped into four major elements:

- Engineering Controls
- Facility Monitoring
- Operational Controls
- Administrative Controls

Engineering Controls - There are specific engineering controls designed into the facility in order to support protection of human health and the environment throughout the operational life of the facility. These include:

- A double liner system designed to detect and collect any leachate generated during operations;

- Interim cover designs which eliminate infiltration to the greatest extent practicable; and

- An internal infrastructure designed to facilitate placement and retrieval of wastes;

Facility Monitoring - In addition to a fully instrumented leak detection system, an extensive monitoring network will ensure no releases pass undetected from the unit boundary. This includes air monitoring stations, groundwater monitoring wells, and surface water monitoring stations. These requirements will also be integrated into the overall RFETS monitoring program to ensure that a comprehensive network is in place to help protect human health and the environment.

Operational controls. Operational controls are put in place to ensure that waste management operations are conducted in such a way as to minimize the risk of release from the facility or exposure to personnel. These include:

- An agency-approved waste acceptance criteria specifying a safety envelope for chemical and physical waste parameters including appropriate treatment requirements.
- An operational health and safety plan approved by the agencies designed to provide operational constraints for personnel protection, weather conditions, decontamination procedures, training requirements, emergency response, and health and safety monitoring.
- Standard operating procedures that establish clear repeatable guideline for conduct of operations.
- Numerous quality assurance procedures from construction quality assurance to procedural audits all designed to ensure the facility and operations meet designated performance standards.
- Closure plans that define how the facility will be decommissioned after the life of the operations and what performance standards need to be met upon closure.

- Contingency and spill response plans will define how the facility responds to a release of waste or constituents from the RWSF.

Administrative controls. Administrative controls are defined to ensure that risk of exposure during construction, operations, and closure are minimized. These include:

- Land use restrictions as defined by future land used plans identified in the RFCA.
- Security plans define site restriction requirements throughout the life of the project.
- Clean up standards which define the level of clean up necessary to certify closure.

In summary, numerous technical and administrative controls will be in place to ensure that all aspects of this effort are conducted in such a way that risks to human health and the environment are minimal.

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7.5 NEPA VALUES

The proposed RWSF will be authorized using a single, integrated Decision Document that will be signed by the DOE, and the State of Colorado, when approved. The Decision Document and review process will satisfy the documentation and procedural requirements of the RFCA. The National Environmental Policy Act (NEPA) process has been integrated into the RFCA documentation and procedure, especially public involvement and decision-making, to reduce duplication and paperwork, and streamline the combined NEPA/CERCLA process. In accordance with the DOE Secretarial Policy issued in June 1994, integrated CERCLA/RCRA documents for environmental clean up activities are to incorporate NEPA values to the extent practical. This policy is intended to minimize the cost and time for document preparation and review while meeting the requirements of both acts.

The analyses required by NEPA are integrated throughout the Decision Document, with a summary of the analyses provided in Appendix I. Based on the analyses, the decision-making process requires no further documentation to complete the NEPA process.

7.6 CONCEPTUAL WASTE ACCEPTANCE CRITERIA

Waste acceptance criteria (WAC) will be developed for the RWSF to ensure that remediation wastes comply with applicable regulatory and site requirements. The WAC will set levels for those criteria that can be quantified. The WAC will undergo review and approval by regulators as part of the detailed Title II design review process. The following objectives would be achieved in compliance with the WAC:

1. Remedial wastes are effectively isolated from potential natural environmental pathways to protect the public health and the environment.

2. RWSF operating personnel and generators ensure continuous protection to the public health and the environment.

3. Characterization data of the remediation waste is documented.

The RWSF would receive remediation wastes from the Site Accelerated Actions and D&D cleanup activities which include the following waste types: RCRA; TSCA; LLW; and/or LLMW. The majority of remediation waste would be handled in large bulk volumes, such as roll off containers or tandem dump trucks, rather than small containerization, such as drums or crates.

7.6.1 Physical and Chemical Compatibility Criteria

The WAC will provide physical and chemical limitations and requirements of the remediation waste and for the proper management. Process knowledge and/or chemical and radiological analyses will become the tools to document accurate characterization of the remedial waste. The following areas represent physical and chemical criteria for remedial waste compliance:

General Requirements

1. Waste in monolithic or particulate form will be accepted for disposal.

2. Waste will contain no free liquids.

3. Lack of free liquids shall be demonstrated by EPA Test Method 9095 (Paint Filter Test) or by EPA Test Method 9096. If the generator determines that the waste form is not conducive to either test method, then documentation must be provided to substantiate the claim that no free liquids are present.

4. Gaseous waste will not be accepted. Compressed gases as defined by Title 49, CFR 173.300, including unpunctured aerosol cans, will not be accepted.

5. Aerosol cans will have punctures. Expended gas cylinders must have the valve mechanism removed and shall meet the requirements of Section 3.2.4 for debris.

6. Pyrophoric waste will not be accepted.

7. Sanitary waste will not be accepted.

8. Personnel protective equipment will be accepted.

Physical Requirements

1. Physical properties of monolithic bulk wastes (e.g. maximum size range, specific weight, moisture content)

2. Physical properties of wastes classified as debris (e.g. maximum size range, specific weight, biodegradable)

3. Conditions for filled and emptied containers (6 CCR 1007-3 Subpart N 264.315)

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4. Prohibitions of containerized gases, free liquids, pyrophorics, and sanitary wastes (6 CCR 1007-3 Subpart N 264.312, 313, and 314)

5. Management of personal protective equipment (e.g. radiological screen of PPE after usage; followed by disposal)

Chemical Requirements

1. Chemical Analyses, acceptable analytical methods, and detection ranges.

2. Prohibited constituents and chemical characteristics including reactive or ignitable substances (e.g. pyrophoric uranium. See 6 CCR 1007-3 Subpart N 264.312.)

3. Chemical compatibilities (6 CCR 1007-3 Subpart N 264.313).

4. pH limitations

5. Composition of waste

7.6.2 Health and Safety - Radioactive Dose Criteria

The WAC will address the radiological limitations and requirements for the waste to meet the CAMU goals and objectives. The RWSF has been categorized as less than a Category 3 Facility and designated as a Radiological Non-nuclear Facility based on a hazard categorization analysis for preliminary threshold quantity of plutonium and other radioactive isotopes (Kaiser-Hill, 1996a). All projects at RFETS are designated under two areas, safety class or non-safety class (NSC). The safety class is further defined by categories such as Category 1 and 2, with Category 1 being the higher risk. Under the non-safety class, Categories 3 and 4 exist. The RWSF was designated as less than a Category 3 Facility which, by definition, is a non-safety class in accordance with the Conduct of Engineering Manual (COEM) Volume 2, Classification of Systems, Components, and Parts; 2-D03-COEM-DES-223 Revision 1. This categorization analysis was based on sampling data from some of the more radioactive IHSSs, such as the Solar Ponds, the 903 Pad, and Lip Area, and the original Process Waste Lines. To be conservative, the highest activity concentration was used. This categorization is the lowest level of risk categorization. The facility will not receive transuranic (TRU) waste. Radiological requirements specified by the WAC include the following:

1. Radiochemical analyses for characterization

2. Threshold limits of radionuclides for the RWSF

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7.7 REMEDIATION WASTE STORAGE FACILITY OPERATIONS

The RWSF will be operated and maintained under a number of administrative requirements to ensure compliance with applicable regulations. Administrative controls will be administered for activities of waste operations in the following areas:

1. WAC documents and forms - These are required to demonstrate compliance with the RWSF WAC.

2. Operating procedures - Procedures for handling and placement of waste, facility maintenance and documentation to ensure safe and efficient operation of the RWSF.

3. Training plans - A plan to administer required training for operating personnel in procedures, safety, and quality assurance.

4. Health & Safety plans - The health and safety requirements for operating personnel to conduct operations in a safe manner.

5. Emergency procedures and plans - The procedures and requirements for operating personnel to enact in the event of an emergency; also known as contingency plans.

6. Limiting operating conditions - Identification of abnormal events which would require operations to temporarily stop activities (e.g. excessive wind velocities, and other weather conditions) to ensure safety to the public, the workers, and the environment.

7. Administrative procedures and plans - Additional procedures and plans to ensure compliance with regulations, DOE orders, and Site rules and policies.

8. Control of fugitive dust emissions - Plan to reduce dust emissions and monitor results to protect the public and workers.

9. Closure Plan - This includes the requirements, procedures, and performance standards used to close the Facility after the end of its operational life. This will be developed in accordance with the applicable state regulations that govern closure of this type of facility including 6 CCR 1007-3 Subpart G.

Additional requirements addressed in the WAC or Facility Operations Plan for compliance are areas addressing administrative controls. The following requirements will ensure the RWSF to be operated in a safe manner:

- Recordkeeping and documentation;
- Waste information from process knowledge and/or sampling and analysis data for waste characterization;
- Quality assurance/quality control (QA/QC) certification program and verification;
- Status reports and waste forecasts;
- Shipment notification; and
- Packaging and labeling requirements.

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Scott Surovchak

8.0 SCHEDULE

This Gantt chart presents project task information as both text and graphics. Information about each task is listed in the Gantt table on the left side of the figure. The Gantt bar chart displays task durations and start and finish dates on a time scale. The relative positions of the task bars show which tasks start and finish before each other and which task overlap other tasks.

In paragraph 109 of RFCA, subparagraphs (b) and (c) durations for the CAMU designation process are given as such:

b. Within 45 days of receipt of DOE's draft IM/IRA, CDPHE shall determine whether the IM/RA meets or fails to meet the criteria in subparagraph (a). If CDPHE determines that the draft fails to meet the criteria, the draft shall, at the end of a 45-day review, explain with specificity the necessary modifications and allow the DOE to resubmit within 30 days, or to invoke dispute resolution within 14 days. If the CDPHE determines that the application meets the criteria described in subparagraph (a), the CDPHE shall issue the draft IM/IRA for public comment for a period of 60 days.

c. Within 30 days of the close to the public comment period, the CDPHE shall review the comments received and modify the draft, if appropriate. The agency shall also prepare a response to significant public comments at this time. At the end of this 30-day period, if the CDPHE still agrees that the IM/IRA, as modified, meets the regulatory criteria for designation and the criteria in paragraph 80, the CDPHE shall designate the storage CAMU. If the CDPHE has determined that the IM/IRA does not meet these same criteria, the CDPHE shall state the changes that DOE must make to receive approval."

Once the CAMU designation is complete, design and construction of the RWSF will be dependent on the need for a contingency to the TYP. Construciton of the facility, including design, is estimated to take a little more than two years. Placement of remediation waste in the facility is dependent on the progress of D&D and remediation activities. The schedule for eventual shipment of the waste offsite has not been determined. The TYP assumes that all low-level mixed waste would be disposed offsite by the year 2007.

The schedule for implementation of this Decision Document is provided as a Gantt Chart in Figure 8-1.

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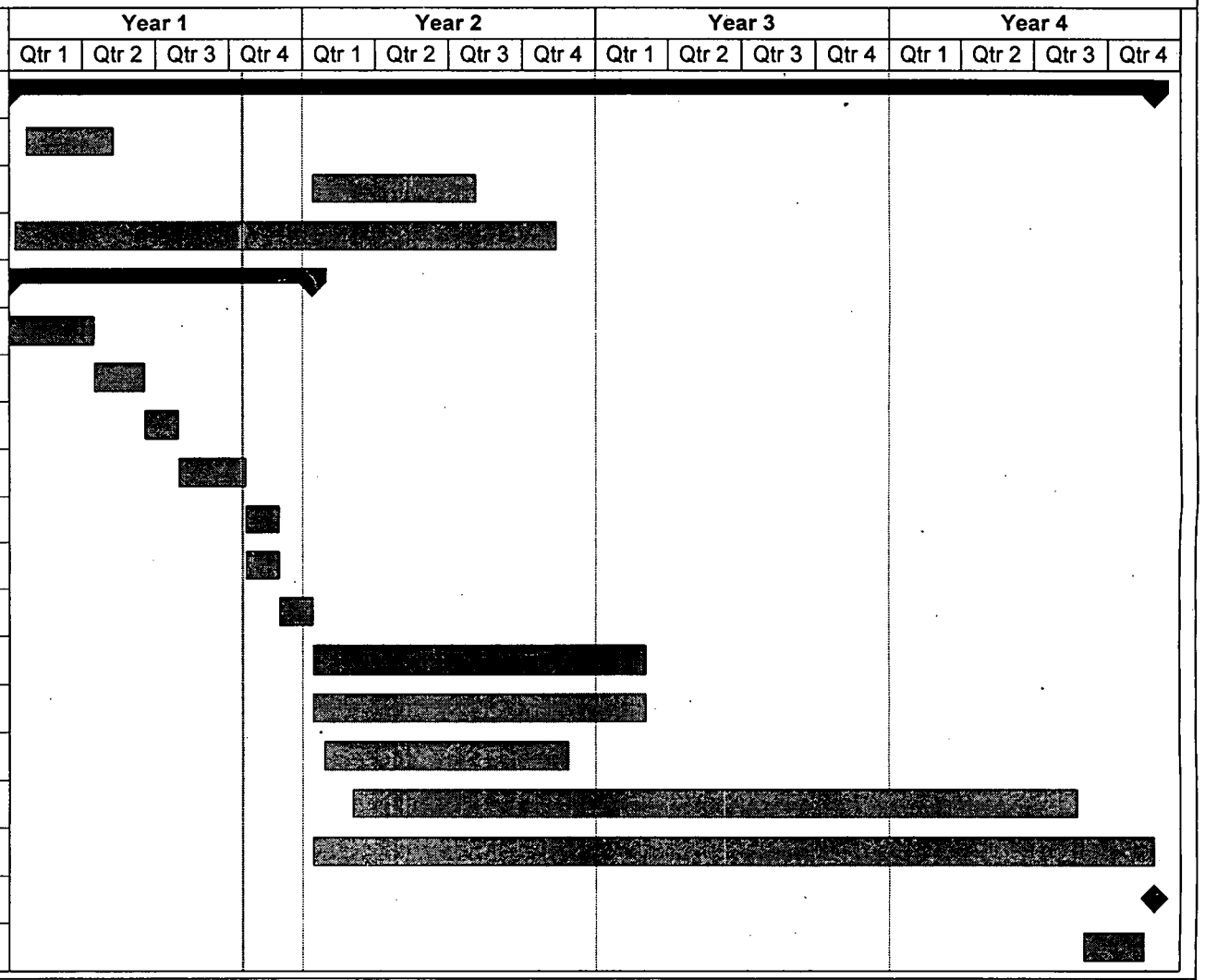
FIGURE 8-1: PROPOSED REMEDIATION WASTE STORAGE FACILITY SCHEDULE

Task Description	Dur
RWSF - DESIGN AND CONSTRUCITON	1021d
GEOTECHNICAL INVESTIGATION	78d
DEVELOP WASTE ACCEPTANCE CRITERIA	145d
PREPARE CONCEPTUAL DESIGN	482d
DECISION DOCUMENT	271d
PREPARE DECISION DOCUMENT (DD)	76d
CDPHE REVIEW DD	45d
MODIFY DD BASED ON CDPHE COMMENTS	30d
PUBLIC COMMENT PERIOD ON THE DD	60d
MODIFY DD BASED ON PUBLIC COMMENT	30d
PREPARE RESPONSIVENESS SUMMARY	30d
FINAL APPROVAL OF DD	30d
PREPARE DETAILED DESIGN	297d
PRECONSTRUCION PLAN PREPERATION	297d
PREPARE SITE FOR CONSTRUCTION	218d
CONSTRUCTION OF PREFERED ALTERNATIVE	645d
OPERATIONAL PROCEDURES & TESTING	750d
BEGIN OPERATIONS	0d
PROJECT CLOSE-OUT	55d



PROPOSED REMEDIATION WASTE STORAGE FACILITY SCHEDULE

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

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9.0 REFERENCES

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Appendix A

(This Appendix has been deleted)

Appendix B

Draft Evaluation of Onsite Versus Offsite Remediation Waste Management Options

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Foreword:

This document was developed in March 1996 to compare various onsite and offsite disposal options. The focus of the low level, low level mixed, and hazardous remediation waste program at that time was to determine which option was most favorable and to recommend that option for implementation. The final recommendation reached was to use an onsite waste disposal facility with appropriate monitoring and retrievable features. The negotiation process in achieving the Rocky Flats Cleanup Agreement (RFCA) and the responses and comments from various Stakeholders has caused a reevaluation of the original recommendation for onsite disposal.

In keeping with RFCA and the Draft DOE Ten Year Plan, there is a renewed focus on maximizing the amount of remediation waste which will be treated and disposed of offsite. With the possibility of lower volumes of remediation waste requiring treatment and disposal, because of less restrictive cleanup levels, the cost competitiveness of offsite treatment and disposal shows more promise. Thus, the conclusions from this document for onsite disposal are not as clearly distinct as the volume of remediation waste decreases. The use of the storage facilities described in the main document accompanying this appendix is evidence of the shift to more flexible options.

The data presented in this appendix remain valid in demonstrating that a thorough cost analysis was conducted to evaluate offsite disposal and that significant up front cost savings can be achieved through the use of onsite storage. The use of storage facilities will help the RFETS achieve safe and effective cleanup consistent with RFCA and the draft Ten Year Plan.

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ABBREVIATIONS, ACRONYMS, AND INITIALISMS

ASAP	Accelerated Site Action Project
CAMU	Corrective Action Management Unit
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CY	calendar year
cy	cubic yard
DOE	Department of Energy
DOT	Department of Transportation
EPA	Environmental Protection Agency
ER	Environmental Restoration
FY	fiscal year
HW	hazardous waste
IA	Industrial Area
IDM	Investigation-Derived Material
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
LDR	Land Disposal Restrictions
LLMW	low-level mixed waste
LLW	low-level waste
nCi/g	nanocuries per gram
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Act
OU	Operable Unit
PCB	polychlorinated biphenyls
PPRG	programmatic preliminary remediation goal
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RSR	Radioactive Waste Shipment and Disposal Record
Site	Rocky Flats Environmental Technology Site
Site Vision	Rocky Flats Conceptual Vision
TSCA	Toxic Substance Control Act
VOC	volatile organic compounds
WAC	waste acceptance criteria
WMF	waste management facility

EXECUTIVE SUMMARY

The purpose of this evaluation is to select the best waste management option for remediation waste at the Rocky Flats Environmental Technology Site (Site). It is part of the decision-making process for an Interim Measure/Interim Remedial Action (IM/IRA) to address remediation waste, and the intent is to reflect the current waste and environmental strategies and to be consistent with input from stakeholders. Onsite waste management was selected as the best of three options: onsite disposal, offsite disposal, and no action. The selection of onsite waste management was based on the following:

- Projected costs for onsite waste management were lower than for offsite disposal.
- Accomplishment of more risk reduction activities in support of the Rocky Flats Conceptual Vision (Site Vision). These activities could be accomplished in less time, and at a lower cost.
- Less public exposure during transportation, along with less involuntary risk.
- Less risk of spills in handling and transportation.
- Greater capacity for onsite waste management compared to offsite disposal. An onsite facility would be more accessible and more available when needed.
- Fewer schedule restrictions for an onsite facility.
- Fewer analytical requirements for an onsite facility because there is less redundancy in sampling requirements.

Ultimately, the most important difference between the onsite and offsite options is total cost and the effect of cost for reducing risk at the Site. In essence, the more it costs to dispose of a cubic yard (cy) of contaminated material, the fewer cubic yards of material the Environmental Restoration (ER) program will be able to clean up in a given timeframe. This prolongs the cleanup efforts at the Site and allows contaminated materials to remain uncontrolled in the environment for much longer periods of time. In turn, this increases the overall risk at the Site to human health including the offsite population, the onsite workers, and the environment.

In the past, environmental restoration activities at government facilities have been regarded as having unlimited budgets. Funding was expected to increase with each fiscal year and all restorations were expected to be funded. Hard choices are now necessary because federal spending reform has imposed limits on funding for environmental restoration. As part of this evaluation, it was necessary to select the waste management option that could best reduce the overall risk to human health and the environment while remaining fiscally responsible. Budget restraints now directly affect the degree of risk reduction possible. Because the onsite option can more effectively reduce the overall risk to both the public and the environment at a lower cost, it is clearly the best selection. With a given budget to

perform work onsite, more cleanup actions can be performed more effectively, and therefore, the Site can be made safer with onsite waste management.

B.1 INTRODUCTION

As part of risk reduction activities at the Rocky Flats Environmental Technology Site (Site), a projected 100,000 cubic yards (cy) of remediation waste will be excavated and appropriately managed over the next several years. This remediation waste from high risk Individual Hazardous Substance Sites (IHSSs), hot spots, and the Solar Evaporation Ponds primarily consists of either excavated media with hazardous constituents or with mixed hazardous/low-level radioactive constituents. The reduction of environmental risk is directly dependent on the ability to disposition remediation waste. This document addresses the overall approach to the disposition of remediation waste, and evaluates whether this remediation waste should be managed onsite or offsite.

The following three objectives were developed to reflect risk reduction goals as well as safety:

1. **Ensure the safety of the public, onsite workers, and the environment through safe management of remediation waste in a timely manner**

2. **Develop a viable means of consolidating and managing of remediation waste to support the Rocky Flats Conceptual Vision (Site Vision), Accelerated Site Action Project (ASAP), and risk reduction goals in the near term while addressing liability and safety issues in the long term.**

3. **Provide a cost-effective solution that can support aggressive environmental remediation and be implemented under existing budgetary constraints.**

The general approach of this evaluation is as follows:

1. Define the objectives needed to support risk reduction at the Site.

2. Develop three waste management options: no action alternative, onsite waste management, and offsite disposal. The no action alternative was evaluated as an option to not implementing or not resolving the other two options.

3. Evaluate the options in terms of cost, schedule, risks, capacity, and availability. Emphasis was placed on the ability of each option to support overall risk reduction and the Site Vision.

4. Recommend an option based on the above criteria.

This document is organized as follows:

Section B.2 - Strategic Ties to the Accelerated Site Action Project and the Site Vision describes the importance of resolving remediation waste disposal to achieve the goals of the Site Vision.

Section B.3 - Planned Remedial Activities summarizes the remediation activities scheduled for fiscal year (FY) 96 through FY98 that will require disposal of remediation waste.

Section B.4 - Description of Options describes the different options evaluated for remediation waste management.

Section B.5 - Cost Analysis evaluates each of the options based on estimated cost.

Section B.6 - Schedule Analysis compares the time required for disposal of remediation wastes for each option.

Section B.7 - Risk Analysis evaluates the risks associated with each option.

Section B.8 - Capacity and Availability evaluates the storage capacity and ability for each option to accept the remediation waste as generated.

Section B.9 - Recommendations presents the recommended option and supporting rationale.

The evaluation focuses on risk reduction activities scheduled for the near term in the Environmental Restoration (ER) budget baseline. These activities target areas with the greatest risk based on currently available data from documented environmental releases. Contamination levels, contaminant-specific risks to human health and the environment, and potential exposure pathways were considered in selecting these areas. The goal of these early actions is to remediate most of these areas in the near term. To achieve this goal, a cost-effective waste management facility (WMF) needs to be operable as soon as possible. This facility must demonstrate protectiveness for human health and the environment within a limited budget. In addition, any WMF must have the capacity to accept large quantities of remediation waste in a short timeframe to support the more streamlined and aggressive cleanup program required for the Site Vision.

B.2 STRATEGIC TIES TO THE ACCELERATED SITE ACTION PROJECT AND THE SITE VISION

Under the Site Vision, the United States Department of Energy (DOE) will remediate the Site in a manner consistent with future projected land and water uses. The future land use of the buffer zone, as recommended by the future Site Use Working Group and the Site Vision, is for open space; whereas the Industrial Area (IA) is projected to be used for industrial use. Low-level radioactive and hazardous waste will be left onsite in a stable configuration. The goal of the Site Vision is to reach an operational state in which all of the plutonium at the Site will be consolidated and stabilized, and most of the risk reduction activities completed. Under the Site Vision, high risk and no further action Individual Hazardous Substance Sites (IHSSs), including the former Operable Unit (OU) 5 (IHSS 115 of the Industrial Area OU [formerly OU 5]) and OU 7 landfills outside of the IA, will undergo closure. Many of the contaminants are not amenable to treatment and will require excavation and placement in a facility.

To implement the Site Vision, an overall approach to remediation waste management is needed. Continued use of temporary storage at the Site is not feasible because of the shortage of permitted space and the logistics of storing and monitoring the anticipated large volumes of remediation waste. The volume of remediation waste and the logistics of handling it, require that a WMF (onsite or offsite) be available to accept the remediation waste as it is excavated. A decision on the approach to remediation waste management must be determined early and implemented prior to excavation to support environmental risk reduction, and the Site Vision. Without a waste management pathway, not only will specific near-term risk reduction actions not be possible, but long-term activities will also be impacted.

Plans for the disposition of the remediation waste must fit into the Site Vision. In particular, a waste management approach must be incorporated into a Site closure strategy. Likewise, all waste management options must integrate with the overall Site closure strategy and the Site Vision statement. Each option must be evaluated according to its ability to meet the schedule requirements for Site closure, to support individual closure activities, to maximize land use flexibility, to meet cleanup standards relative to the projected land use, and to mesh with building closures and the planned capping of the IA.

B.3 PLANNED REMEDIAL ACTIVITIES

A means for dispositioning remediation waste must be available to support planned activities on high risk areas in the near term. These activities include the following:

- The Solar Evaporation Ponds remediation waste, which will include materials from the solar pond liners, basecourse, sludge, miscellaneous debris, and some vadose zone soils (now on hold) will require disposition
- The excavation of East Trenches (i.e., trenches T-1, T-3, and T-4), the 903 Pad and Lip Areas, and the Mound Area. The typical excavated media from these locations will be soils, sanitary sludges, and decomposed drums
- The excavation of soil and debris from the cleanup of Industrial Area OU tanks T-2, T-3, T-9, T-10, T-14, T-16, and T-40 from IHSS 121 and tanks from IHSS 129
- The excavation of remediation waste and IHSS 119.1 in OU 1
- The excavation of remediation waste from hot spots
- The disposition of the remaining precasting volume of Investigation-Derived Materials (IDM) from drilling activities
- The decontamination and decommissioning of Site facilities

Remediation wastes include, but are not limited to, the following:

- Contaminated soils and debris collected from accelerated actions and hot-spot removal
- Pond sludge currently stored in Resource Conservation and Recovery Act (RCRA)-certified tanks
- Sediments
- Toxic Substance Control Act (TSCA) waste, such as asbestos and polychlorinated biphenyls (PCBs)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions
- IDM from characterization activities, such as wells and borings, are also defined as remediation waste

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- Debris from decontamination and decommissioning activities

Only remediation wastes are considered in this evaluation; process waste is not included. For the purposes of this document, saltcrete and pondcrete generated from the Solar Ponds are considered as process waste. The contaminants of concern in these media can be summarized as: radionuclides (e.g., plutonium and americium), heavy metals (such as cadmium and chromium), volatile and semivolatile organic compounds, asbestos, and PCBs.

Waste volume estimates and the dates when these wastes would be generated from planned risk reduction activities over the next three years are presented in Table B-1. These waste volume estimates include only near-term accelerated actions. Additional remediation waste, including remediation waste from decommissioning activities could also be disposed of in the near term. A basis of 100,000 cubic yards (cy) was used for comparing the options to ensure that planned early actions were covered as well as near-term decommissioning activities. It is assumed that soils contaminated with volatile organic compounds (VOCs) would be treated by thermal desorption, after which the residuals would be disposed of at the original excavation location if they comply with the programmatic preliminary remediation goals (PPRGs). The assumptions for this estimate are presented in Attachment 1.

Table B-1 Waste Identification and Volumes for a Waste Management Facility

Waste Source (OU/IHSSs)	Description of Media	Waste Type	Estimated Total Volume (cy)	Anticipated Volume after Thermal Desorption (cy)
Solar Ponds				
Liners	Asphaltic Material	LLMW (rads/metals)	11,800	11,800
Liners Basecourse	Soils	LLMW (rads/metals)	11,800	11,800
Sludge	Solidified Sludge	LLMW (rads/metals)	6,000	10,000
Vadose Soil	Soil	LLMW (rads/metals)	20,000	20,000
Debris	Building Materials	LLMW (rads/metals)	700	700
Subtotal for Solar Ponds			50,300	54,300
Potential Early Actions - Top IHSSs				
Trench T-1	Soil, Drums, Pyrophoric Uranium	LLMW (rads/VOC)	3,000	1,000
Trench T-3	Soil, Drums, Sanitary Sludge	LLMW (rads/VOC)	2,700	300
Trench T-4	Soil, Drums, Sanitary Sludge	LLMW (rads/VOC)	2,500	300
Trenches T-5 through T-11	Soil, Sanitary Sludge, Planking	LLMW	6,000	1,000
Mound Area	Soil and Drums	LLMW (rads/VOC)	5,000	1,500
903 Pad and Lip Area	Soil and Asphaltic Material	LLMW (rads/VOC)	13,200	13,200
Tanks 9 and 10 (includes OU 8 IHSS 118.1)	Soil, tanks, piping	LLMW (rads/VOC)	2,000	500
Tanks 2 and 3	Soil, tanks, piping	LLMW (rads/VOC)	500	500
IHSS 119.1	Soil	LLMW (rads/VOC)	1,500	50
Tanks 14 and 16	Soil, tanks, piping	LLMW (rads/VOC)	4,450	3,340
IHSS 129	Soil	HW (VOC)	2,200	0
Tank 40	Soil, tanks, piping	LLMW	1,300	130
Miscellaneous Hot-Spot Removals	Soil	LLMW	50	50
Subtotal for Potential Early Actions			44,400	21,870
Investigation-Derived Material (IDM)	Drill Cuttings/Soil	LLMW, HW, LLW	1,200	180
Subtotal			95,900	76,350
Expansion Factor; 15%			14,385	11,453
Grand Total			110,285	87,803

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B.4 DESCRIPTION OF OPTIONS

The options for onsite waste management and offsite disposal of remediation waste were evaluated for all waste management activities including transportation to the disposal/storage facility, operations at the facility, and closure. The onsite waste management option, requires the design and construction of a new WMF, because an onsite facility that can accept this type or volume of material does not exist.

B.4.1 ONSITE WASTE MANAGEMENT OPTION

In the onsite waste management option, remediation waste would be managed in an onsite WMF designed to handle remediation waste. Appendix C, Onsite Waste Management Facility Siting Study, evaluates seven onsite locations, that would be potentially suitable for a WMF. For this onsite option, it was assumed that the remediation waste must be placed as bulk into a cell; however, the cell would be segregated for differing wastes types to support retrievability. The design of the cell would meet RCRA Subtitle "C," 6 Code of Colorado Regulations (CCR) 1007-3, Subpart S, Corrective Action of 264.552, 6 CCR 1007-3, and 6-CCR 1007-2, Part 2, "Requirements For Siting of Hazardous Waste Disposal Sites." The facility would accept media with low-level radioactive (e.g., less than 100 nanocuries per gram [nCi/g]) and/or hazardous constituents. This would not preclude the shipment of remediation waste that could be more effectively and economically managed offsite. The facility would be designed and constructed to meet all of the applicable federal, state, and local regulatory requirements.

B.4.2 OFFSITE DISPOSAL OPTION

Several offsite locations were considered under this option. Low-level waste (LLW) can be sent to the Nevada Test Site (NTS); however, NTS cannot accept low-level mixed waste (LLMW) under their current waste acceptance criteria. The Waste Isolation Pilot Plant (WIPP) location does not accept LLW or LLMW as part of their waste acceptance criteria (WAC); the option therefore was not carried forward in the study. The best facilities for the disposition of remediation waste with only hazardous constituents are Subtitle "C" landfills, such as the RCRA landfill in Last Chance, Colorado. At this time, the only facility accepting mixed remediation waste is the Envirocare facility in Tooele, Utah. For near-term remedial actions, it is anticipated that 90% of the waste will be mixed and could therefore go to the Envirocare facility under this option.

The construction of a new offsite facility was considered; however, it was rejected because it would not meet the schedule requirements for the Site Vision. Depending on the location and the operator, many years would be required for a Nuclear Regulatory Commission License, an Environmental Impact Statement, a RCRA permit, land acquisition, and other requirements. Only existing facilities that could support the accelerated action schedule were considered.

B.4.3 NO ACTION ALTERNATIVE

This no action alternative is an option to the development of an ER waste management strategy. It was included in the evaluation to furnish a baseline for risk reduction at the Site that did not include the excavation and removal of remediation waste. In this option, all waste materials would be left in place with the exception of those materials that could be treated to remove organic compounds and still meet the PPRGs.

B.5 COST ANALYSIS

Based on the waste volume estimates discussed in Section B.3, Planned Remedial Activities, 100,000 cy was selected as the basis for this cost analysis. Two cost estimates were developed: one for offsite disposal and one for onsite waste management. The estimates are based on previously incurred costs, professional experience, vendor quotes, conceptual design information, current labor rates, and current adjustment factors.

The major factors that affect offsite disposal costs include handling, packaging, transportation, the waste acceptance criteria, amount of waste being shipped at one time, the time of year during placement, the treatment method used, and the amount of debris in the waste. Where possible, assumptions for offsite disposal were selected to lower the cost and improve the feasibility of this option. Based on these assumptions, a life-cycle cost of approximately $2,302/cy was estimated (see Table B-2 for the cost summary, Attachment 1 for assumptions, and Attachment 2 for the cost basis). This cost includes packaging, handling, treatment, characterization, transportation, and disposal charges. Previously published estimates included only treatment and disposal charges, not the entire life-cycle cost.

The life-cycle cost for onsite waste management will be approximately $948/cy. This estimate includes packaging, handling, transportation, treatment, characterization, cell design and construction, operations, cap design and construction, and postclosure care and monitoring (see Attachment 1 and Attachment 2). The magnitude of the cost differences between onsite waste management and offsite disposal is illustrated in Figure B-1.

It is important to note that both estimates are conceptual and are subject to variations as additional information is obtained. However, because offsite disposal is twice as expensive as onsite waste management, it has been concluded that the onsite waste management option is the only viable alternative, based on the rough order-of-magnitude estimates.

Table B-2 Onsite Vs. Offsite Disposal Costs

	Offsite Disposal		Onsite Management			
Activity	Total Cost	Cost/ cy			Total Cost	Cost/ cy
Containers	$4,643,000	$46			-0-	-0-
Packaging	$2,855,000	$29			$2,100,000	$21
Treatment/Characterization	$78,352,000	$784			$18,722,000	$187
Transportation	$18,647,000	$186			$4,309,000	$43
Disposal	$73,322,000	$733	Onsite Management			
			- Design	$1,235,000		
			- Permitting	$300,000		
			- Cell Construction	$20,777,000		
			- Operations	$11,604,000		
			- Cell Closure	$796,000		
			- Post Closure Care	$13,378,000		
			Subtotal	$48,090,000	$48,090,000	$481
Total Costs	$177,819,000	$1,778			$73,222,000	$732
Contingency	$52,332,000	$523			$21,549,000	$215
Total Cost with Contingency	$230,151,000	$2,302			$94,771,000	$948

Note: All costs are in 1996 Dollars without contingency, except as noted. All are based on a waste volume of 100,000 cy managed or disposed.
Note: LAC updated the Offsite costs from the "new" Summary Tables E1-11 on 4/16/96 Specifically the No Action Table E-11
Note: LAC updated the Onsite costs from the CLC-B Summary Table E-2 on 4/3/96

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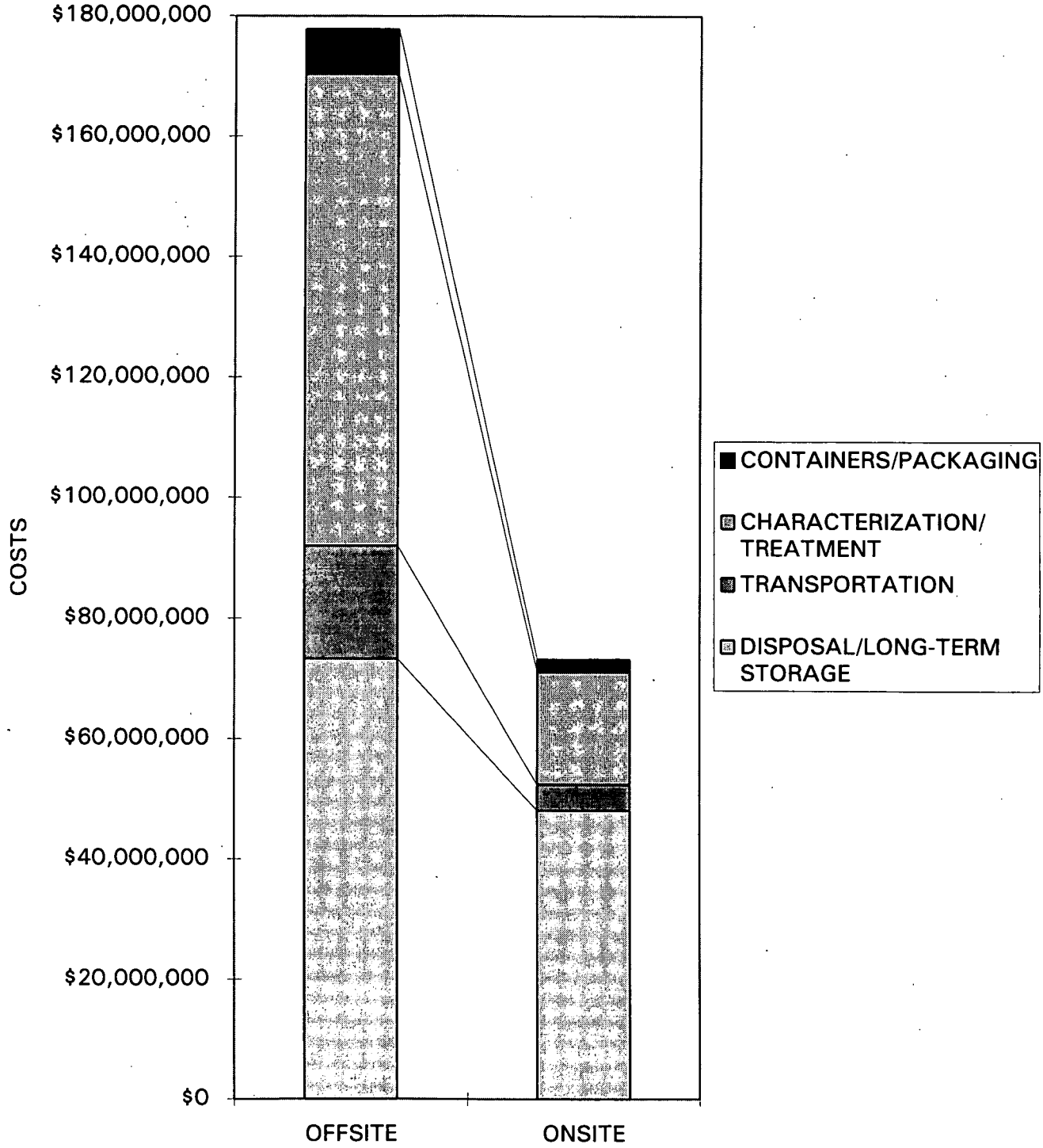
FIGURE B-1: ONSITE WASTE MANAGEMENT VS. OFFSITE DISPOSAL COST COMPARISON

(Based on a 100,000 cy scenario)



A big discrepancy in the treatment and characterization costs between the two options is shown in Table B-2 and Figure B-1. Under the Corrective Action Management Unit (CAMU) guidelines, the waste does not have to be treated to meet the Land Disposal Restrictions (LDR), however the waste must comply with onsite WAC. The treatment costs were developed from the actual costs for thermal desorption at the Site and the estimates for the Solar Pond sludge solidification process. Attachment 2 explains how the characterization costs were developed for the two options. Treatment costs were one of the major differences between the two options. This was mainly due to the expected costs of having to solidify some of the waste to meet the LDRS.

The total volume of remediation waste was another factor added to the cost difference between onsite and offsite options. If the total volume of remediation waste was sufficiently small, it would be less expensive to ship waste offsite; however, the projected total waste volume is approximately five times greater than that volume. The break-even point for managing waste onsite is 12,750 cy.

B.6 SCHEDULE ANALYSIS

One of the key factors for the comparative analysis of onsite waste management versus offsite disposal is schedule limitations. Cost and schedule are inseparable because one affects the other. Because of budget and schedule constraints, the concept of reducing overall risk to the public and the environment in less time, at a lower total cost, is more attractive than an extended waste removal process using offsite disposal. In the future, project expediency will become a significant factor in getting funding from Congress.

The no action alternative will obviously delay cleanup. The risk to the public and the environment will continue and will likely increase because of open pathways for contaminant migration. Schedule delays will not only impact the risk but will increase future costs when escalation of remedial actions is implemented.

Offsite disposal will require more time to disposition remediation waste than onsite waste management. The remediation waste at the Site is primarily LLMW and under the offsite disposal option most of the waste would go to the Envirocare facility, which currently is the only facility in the nation licensed to receive LLMW. As shown in the process flow diagram of Figure B-2, a long, arduous process is required before waste can be shipped offsite and accepted. Envirocare facility requirements that impact the schedule include:

- Documentation requirements that are more extensive for disposal at Envirocare than for onsite waste management. Most of the documentation is required prior to shipment. For any given wastestream, the documentation requirements are greatly reduced after the first shipment. An estimate of the waste volume must be submitted to Envirocare a full year prior to shipment.
- Waste acceptance contingent on the submittal of sampling and characterization data. The remediation waste must be sampled and analyzed several times prior to placement in the disposal facility. The initial analysis must be completed before submittal of Envirocare forms.
- Remediation waste meeting LDRs. Delays and additional costs will be incurred in treating the waste.
- Time-consuming logistics of handling and shipping the waste. Mixed waste must be containerized.
- Interim staging requirements for large bulk media for storing the waste while awaiting approval for shipment from Envirocare.
- The completion of manifests/travelers and compliance with U.S. Department of Transportation (DOT) criteria (which specify weight restrictions and other criteria) which creates additional delays and costs.

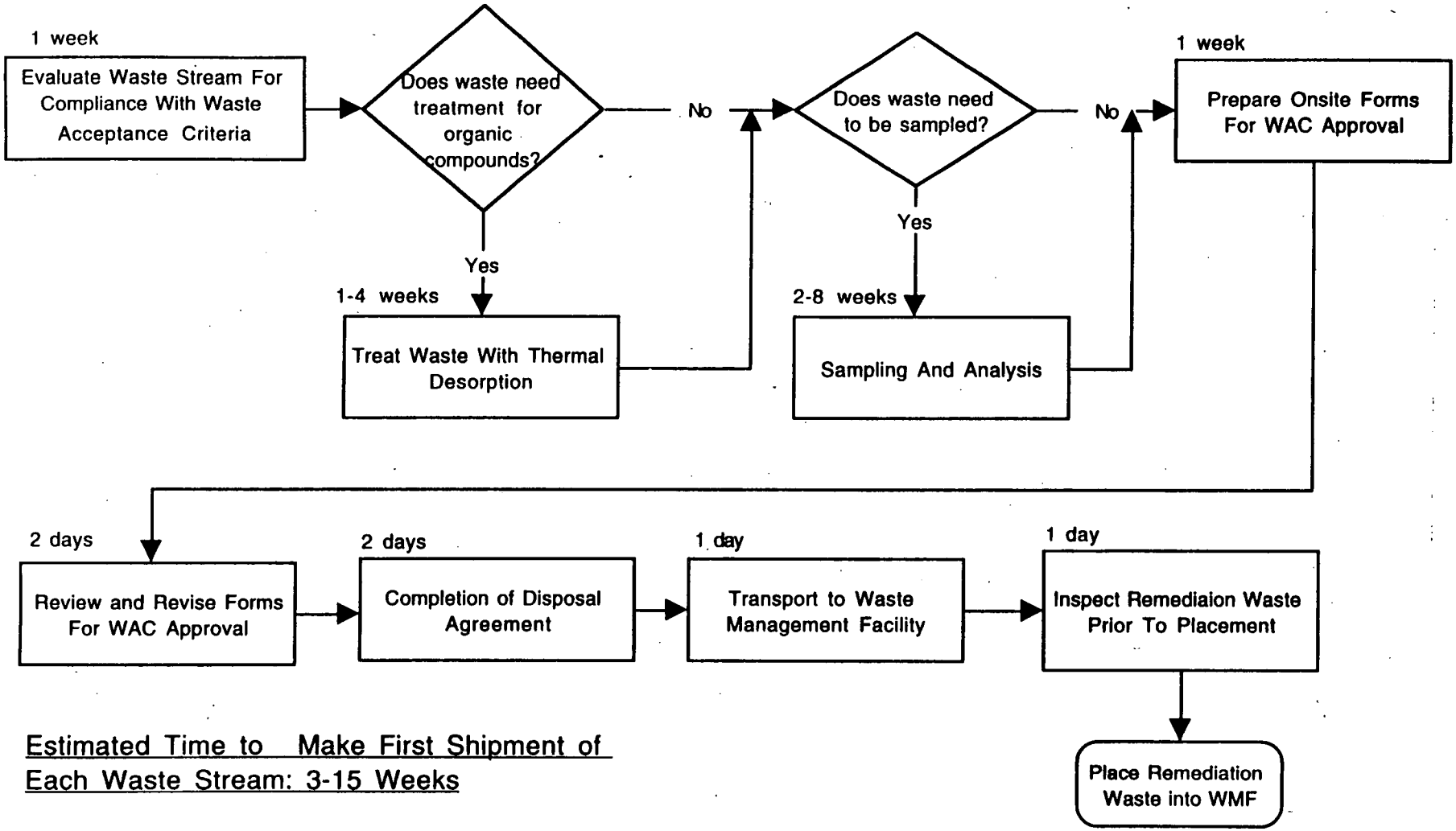
Onsite waste management has a shorter schedule than offsite disposal, once the WMF has been constructed. Like Envirocare, the onsite WMF would meet WAC; however, as shown in Figure B-3, the path from excavation to final placement would be less intensive and more expeditious. In general, only one sampling and analysis event would occur. The logistics of handling and disposal would be more straight forward because of the proximity of the disposal location. Likewise, DOT requirements would not be applicable because no state or interstate highways are traveled, and weight restrictions could be modified. Schedule problems that impact onsite disposal include:

- The placement of waste in an onsite WMF will be delayed until the facility is constructed. This is likely to cause handling problems for remediation waste excavated prior to the completion of an onsite facility.

- Additional security requirements could hamper the transport of remediation waste, although these requirements are insignificant compared to the packaging and manifesting requirements for offsite transport.

A schedule of the onsite waste management and offsite disposal options is shown in Figure B-4 for comparison.

Figure B-3 Process Flow Diagram For Onsite Waste Disposal Option



Estimated Time to Make First Shipment of Each Waste Stream: 3-15 Weeks

Estimated Time to Make Each Additional Shipment of Each Waste Stream: 3-15 Weeks

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Figure B-4: Onsite and Offsite Approval Schedules

ID	Task Name	Dur
1	**ONSITE WASTE MANAGMENT FACILITY**	**51d**
2	Evaluate Waste Stream for Compliance with WAC	5d
3	Decision Point - Does waste need treatment for organic compounds	0d
4	Treat Waste With Thermal Desorption	10d
5	Decision Point - Does waste need to be sampled	0d
6	Sampling and Analysis	25d
7	Prepare Onsite Forms for WAC Approval	5d
8	Review and Revise Forms	2d
9	Completion of Disposal Agreement	2d
10	Transport to WMF	1d
11	Inspect Remediation Waste Prior to Placement	1d
12	**OFFSITE DISPOSAL**	**195d**
13	Envirocare sends Instructions and forms to the Site	0d
14	Evaluate Waste Stream for Compliance with WAC	5d
15	Decision Point - Is treatment required to meet LDR's	0d
16	Sample waste stream	3d
17	Treat to meet LDR's	25d
18	Representative Samples are analyzed at Lab (use Utah Certified Labs)	40d

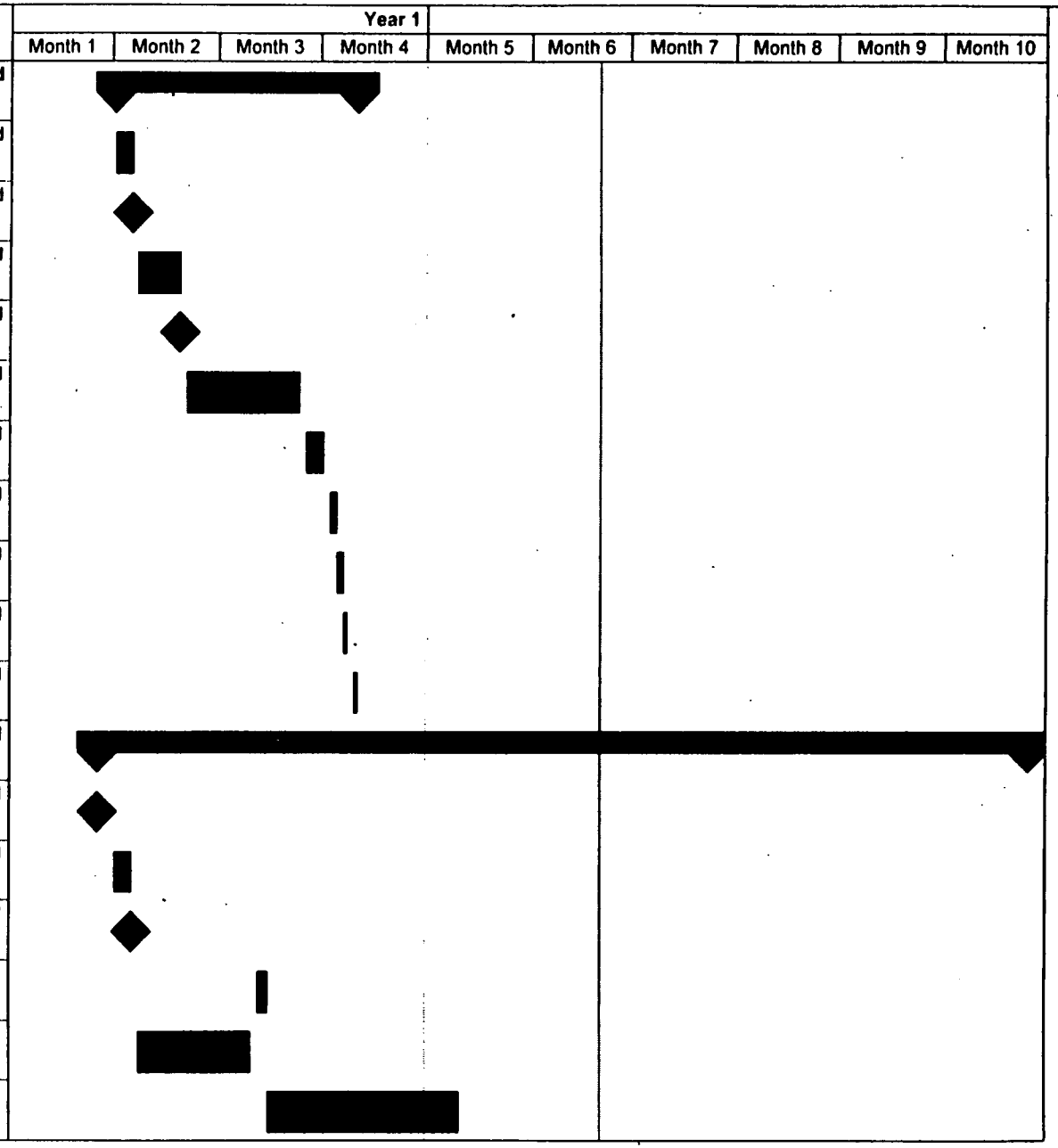

Figure B-4: Onsite and Offsite Approval Schedules

ID	Task Name	Dur
19	Decision point - Does waste meet LDR's	0d
20	Site completes Envirocare Profile Forms	5d
21	Site Reviews and Revises Forms	2d
22	Submit Lab Analysis, Forms and Pre-Shipment Samples to Envirocare	3d
23	Envirocare Evaluates Material for acceptability and approves waste profile forms	10d
24	Envirocare Analysis of Pre-Shipment Samples & establishes "Fingerprint" Acceptance Parameters	20d
25	Completion of Disposal Agreement	5d
26	Prep and Submit Radioactive Waste Shipment & Disposal Record, Manifest, and Transportation Plan	5d
27	Evirocare Approval of Disposal Record and manifest	0d
28	Envirocare Signs and Sends Notice to Transport and Pre-Shipment Sample Lab Results	5d
29	Site sends 3-day shipment notification	1d
30	Make First Shipment of a single half-crate	10d
31	Envirocare inspects incoming shipment and takes samples for fingerprinting and independent analysis	2d
32	Fingerprint parameters verified to allow unloading of waste	0d
33	Acceptable independent third-party analysis confirms shipment compliance	5d
34	Envirocare sends confirmation of disposal to the Site	0d
35	Decsion Point - Does Waste meet LDRs	0d
36	Treat to Meet LDRs	25d

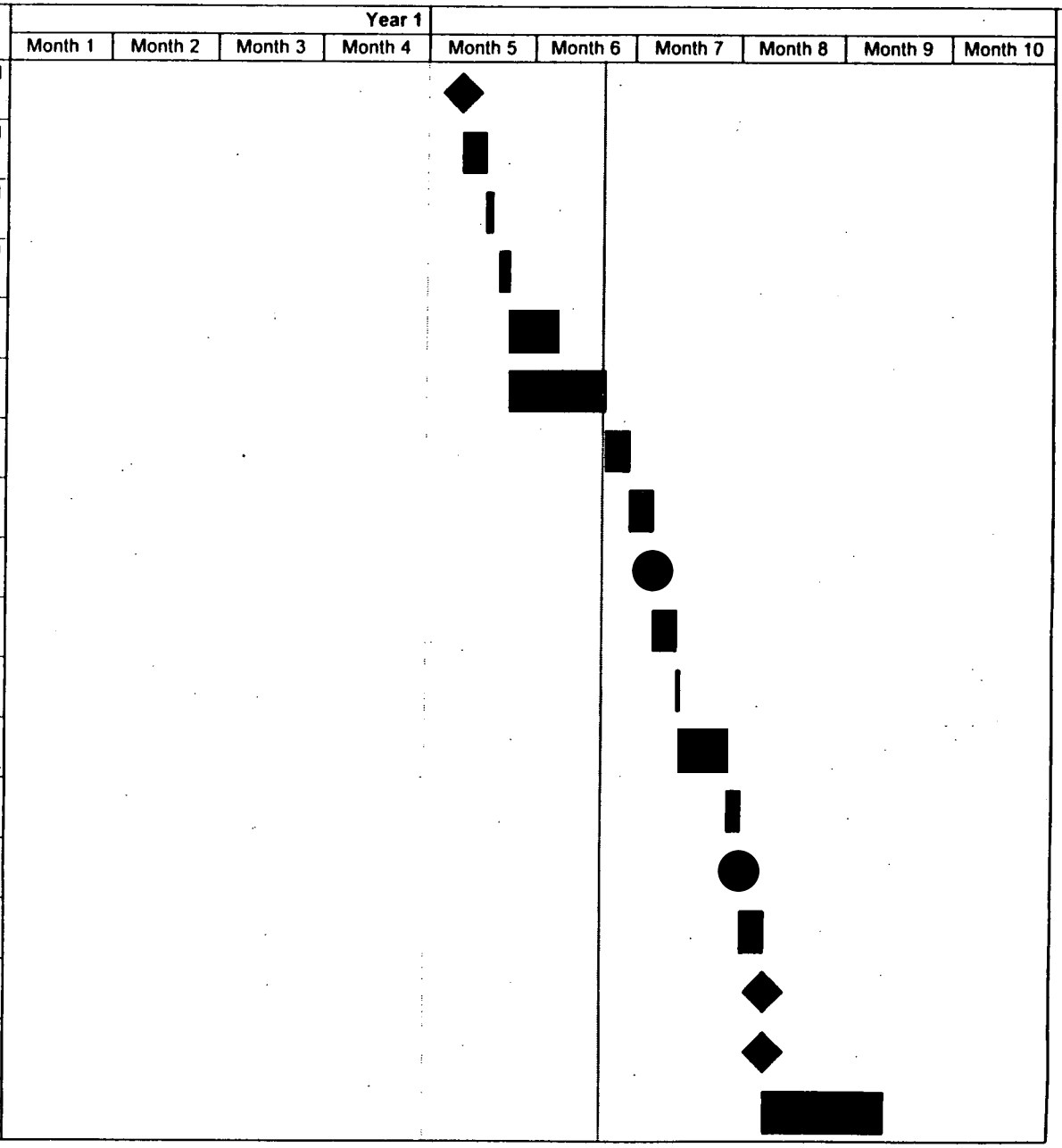

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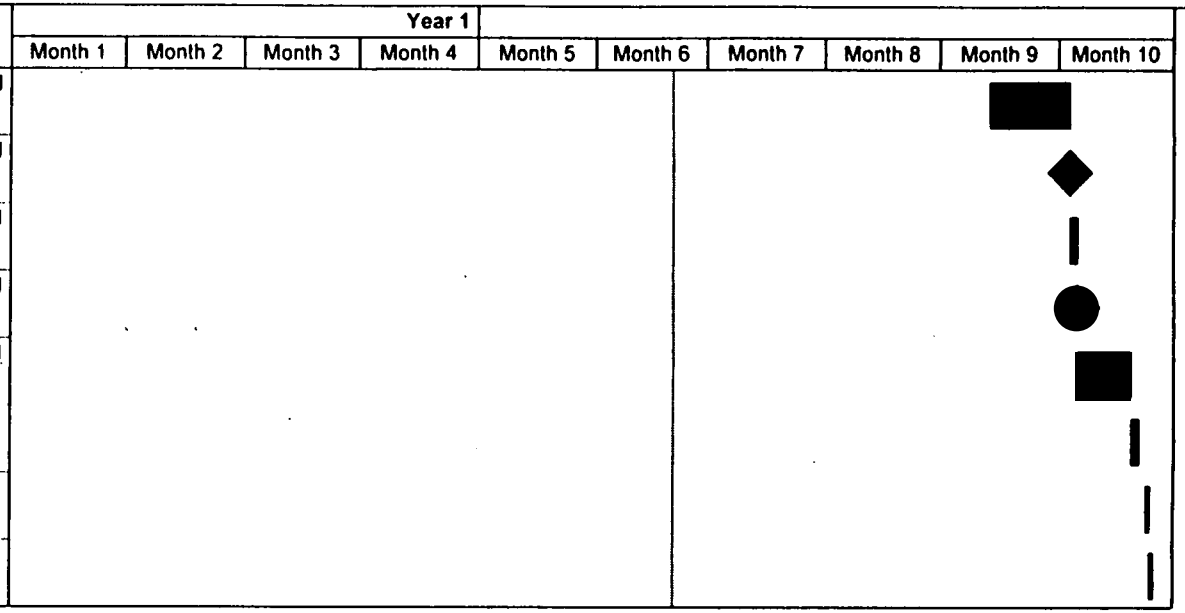
Figure B-4: Onsite and Offsite Approval Schedules

ID	Task Name	Dur
37	Take Composite Samples And Analyze	15d
38	Decision Point - Does Waste Meet LDRs	0d
39	Prepare Envirocare Forms	2d
40	Site sends 3-day Shipment Notification	0d
41	Regular Shipment of Containerized Waste	10d
42	Envirocare inspects incoming shipment and takes samples for fingerprinting and independent analysis	2d
43	Envirocare sends confirmation of disposal to the Site	1d
44	Fingerprint parameters verified to allow unloading of waste	1d



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B.7 RISK ANALYSIS

The risk analysis evaluated three types of risks: human health risk, liability risk, and risks to the environment.

B.7.1 HUMAN HEALTH RISKS TO THE SITE WORKERS AND THE PUBLIC

For the purposes of this evaluation, human health risk or hazard resulting from exposure to chemicals in the soil or water is defined as the increased chance or probability of developing cancer or other adverse health effects as a result of that exposure. Exposure may occur through ingestion of soils or waters, absorption of chemicals through the skin, or by inhalation of airborne particulates or vapors. The health effects from these exposures could vary from minor skin irritations to cancer, depending on the chemical, the concentration, the exposure pathway, the length of the exposure, and the susceptibility of the receptor.

The nature of the health risks to individuals can be classified as involuntary or voluntary, and as uncontrolled or controlled. Acceptability of a risk depends on its nature. Health risks to hazardous waste/remediation workers at the Site is minimized by compliance with the Occupational Safety and Health Act (OSHA) and DOE orders. Health risks are controlled through safety and awareness training, use of personal protective equipment, and monitoring systems. The risk is voluntary because the worker has the option to either accept or decline the task. Furthermore, the risk is clearly communicated, controlled, and accepted by the worker. Risks to the community from future land uses at the location or from remedial activities are generally involuntary and cannot be controlled to the same extent as risk to a worker. If the decision is made to take no action or to transport wastes offsite, the ability to minimize human health risks to the community is greatly diminished.

For the three options, the human health risk evaluation must consider very different ways in which people could be exposed to radiological or hazardous contaminants (exposure scenarios). Worker safety is a factor for both onsite and offsite disposal. Risks to public safety due to accidents in transportation and handling of the waste is a factor for the offsite disposal option. Public safety risks include transportation- and construction-related injuries and fatalities, in addition to accidental radiological or hazardous releases.

Of the three options, the no action alternative could present the greatest human health risk to the community in the long term and least risk in the short term. The magnitude of the risk depends upon the types of exposures to the public, the concentrations, and types of chemicals present. This is dependent on the actions taken to prevent offsite migration and on the future land use permitted at the Site.

Risk assessments have been completed on areas in the buffer zone that initially were thought to be contaminated. The human health risks for OU 1 and the former OUs 2, 5, and 6 have been

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characterized as part of the RCRA Facility Investigation/Remedial Investigation process. These assessments characterize the human health risks of the no action alternative.

Exposures to a potential office worker and to an open-space recreational user present the highest risk estimates. Cancer risks for office workers from contaminant exposure in buildings projected for the above OUs varied from 2 in 10,000 in OU 1, to 5 in 100,000 in the Walnut Creek area. This means that if 10,000 office workers worked in the highest risk area for 25 years, not more than 2 workers would be expected to develop cancer due to exposure to chemicals or radionuclides. The estimated risks to open space users were even lower, varying from 1 in 100,000 to less than 1 in 1,000,000. This means that for every person who uses the buffer zone for open-space recreation for 10 hours a month over
a 25-year period 1 in 100,000 might develop cancer due to contaminant exposure. These risks are very low when compared to the background rates of 25 to 30 people out of 100 who develop cancer during their lifetimes.

Risks have also been calculated for the exposure of offsite residents to contaminants in 903 Pad Mound and East Trenches. The risk of cancer to a resident living near the location due to offsite migration of 903 Pad Mound and East Trenches contaminants is much less than 1 in 1,000,000, varying from 1 in 10,000,000 to 1 in 100,000,000,000. These risks are considered too low to be of consequence. Data from recent accelerated actions indicate that 903 Pad Mound and East Trenches subsurface contaminant concentrations could be significantly higher than originally estimated and likewise the human health risks to construction workers could be higher if the no action alternative were implemented.

Risk assessments for the IA have not been conducted. It is expected that the human health risks will be higher than in the buffer zone because of the intense industrial activity that has taken place there for the last 50 years. Investigation data suggest that contaminant concentrations are significantly higher than levels in the buffer zone, and therefore, if no action is taken, the risks to Site workers would be higher. Without source removal, there is also a greater potential for release to the community following Site closure.

The remaining two options are onsite waste management and offsite disposal of remediation wastes. After the remediation waste has been placed in a WMF, the risks associated with these options should not be significantly different. However, the risks to both the Site workers and the public are expected to vary greatly in the handling and the movement of wastes to a facility. The differences in risks are due to uncertainties associated with transportation of the wastes.

Onsite transportation involves the movement of wastes by truck for a distance of less than 3 miles, through a controlled environment (the site). Risks associated with this movement can be tightly controlled, especially with respect to the community and worker exposure. Offsite transportation involves the movement of LLW, LLMW, and HW for distances of approximately 700 miles by rail and/or trucking. It is estimated that during the disposal effort, over 2.5 million miles would be logged

by trucks offsite. For the total waste volume, national statistics in Accident Facts from the National Safety Council published in 1994, suggest that five accidents would occur during transportation to the offsite repository. These accidents would not necessarily be fatalities but could result in personal injuries, property damage, or an accidental spill. As a result of these accidents, communities along the route from the Site to the disposal cell could be exposed to both chemical and radiological contamination. The magnitude of these risks are difficult to quantify; however, these exposures would be both involuntary and uncontrolled and, as such, may not be acceptable to potentially exposed communities (but probable low, given the nature of the waste).

Human health risks from onsite construction and transportation are much lower. Only about 6,000 miles would be logged by trucks onsite. The risk of uncontrolled releases of toxic substances will be greatly reduced. The risk to the public will be negligible and Site worker risk is controlled. Risks will also be controlled through dust suppression, personal protective equipment, training, continuous monitoring, and other safety measures.

In summation, onsite waste management is the best option in terms of human health risks for the following reasons:

- The no action alternative would provide no risk reduction.
- Additional handling and transportation to the offsite facility increases the likelihood of accidents resulting in injuries or spills.
- The offsite disposal alternative creates involuntary and uncontrolled risks to the public.
- The onsite waste management option is more amenable to risk management because risks can be tightly managed and controlled. Health risks to the workers would be better known and more risks would be voluntary.
- Finally, fewer overall risk reduction activities (including source removal) would be able to occur when using offsite disposal because less funding would be available.

The onsite waste management option offers the greatest overall risk reduction. Risk management could be conducted in a tightly controlled manner. Remediation waste would not be moved through communities where the public could be involuntarily subjected to accidental spills. Additional risk reduction could occur sooner and at a lower cost reducing exposure pathways through the air, surface waters, and groundwater.

B.7.2 LIABILITY RISKS

In evaluating liability, both near-term and long-term liability risks were analyzed. Near-term risks include the liability from spills that could occur in handling, storing, and transporting the remediation waste. Long-term liability risks include the ability to manage materials safely over time and long-term fiscal liability. These long-term risks could exist because some contaminants present in the remediation waste are resistant to natural degradation processes.

The liabilities involved with the no action alternative present the greatest risk because of the potential that contaminants could migrate offsite as airborne particulates or through surface waters to private and public lands, and bodies of water. Potential costs for cleanup of larger areas of contamination and possible payments for damage to human health and the environment are significant. The increased number of potential exposure pathways create a greater possibility for contamination of offsite lands, thus creating more liability from lawsuits for damage of property than either onsite waste management or offsite disposal of remediation waste. There could be additional exposure to the public if future land uses of the Site allow greater public access. Without some removal of contaminants, the Site cannot be released for other uses.

If remediation waste is disposed of offsite, it reduces no-action risks but there are the increased liabilities. The offsite disposal option could cause spills that could occur during transportation because of the additional mileage to offsite facilities, including damage caused by contaminated media being spread on uncontaminated roads and offsite property. The costs for offsite spills could be greater because there is a greater potential of larger and more pristine areas to become contaminated. Additionally, physical damage could occur to people, vehicles, and property.

Long-term waste management options, both onsite and offsite, were deemed to be equally effective in containing contaminants because of similar design and similar regulatory requirements. The Site and NTS are both DOE facilities. Other facilities are under private ownership. NTS cannot accept RCRA-listed waste, which severely limits the volume of waste that NTS can accept from the Site. For the offsite disposal option, most of the remediation waste would have to be managed in facilities that rely on the viability of a private firm to ensure continued operation. For the DOE, this reliance on a private firm is a risk in terms of liability, because there is no guarantee of continued effective operation. There is also no guarantee that the facility will remain effective over the hundreds or even thousands of years that the waste will pose a risk. Under CERCLA liability, waste remains the responsibility of the generator forever. A comparison of liability risks is presented in Table B-3.

Table B-3 Comparison of Liability Between Onsite Waste Management and Offsite Disposal Options

Liability	No Action Alternative	Onsite Waste Management Option	Offsite Disposal Option
Transportation Risks	Not Applicable	Reduced mileage to WMF would reduce likelihood of a spill. If a spill did occur it would be on DOE property, and therefore, would not affect private or public property.	Increased risk due to additional distance to WMF. Spill or accident could threaten public health or damage public or private property.
Handling Risks	Not Applicable	Less handling prior to shipment would reduce worker exposure and accidents.	Additional handling prior to shipment could increase liability risk from worker exposure and accidents.
Long-Term Fiscal Liability	Liability risk due to potential migration of contaminants via groundwater, surface water, and airborne particulates.	Liability due to leaks and spills.	Liability due to leaks and spills.
Fiscal Risk	Mitigation costs of offsite land and surface water.	Reduced fiscal risk-WMF remains on government property. DOE retains better control of costs in the event of a spill.	Possibility that operator might not exist in future. Liability for remediation waste could fall back to DOE based on CERCLA, or if trusts are consumed.
Long-Term Effectiveness	Not effective - Contaminated materials continue to be exposed to the environment. Cleanup costs increase because of the increase in areas of contamination.	Because of similar engineering design requirements, onsite and offsite are approximately the same.	Because of similar engineering design requirements, onsite and offsite are approximately the same.

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B.7.3 IMPACT TO THE ENVIRONMENT

Environmental impacts to air quality, surface water, groundwater, soils, and ecosystems were considered for the three options. Impacts due to construction and/or expansion of offsite facilities were not considered because it was assumed that these impacts had already occurred. Environmental impacts from source removals were assumed to be similar between the onsite and offsite options. Dust suppression, erosional control, and other efforts will be used to minimize the impact. Because of regulatory requirements, both onsite and offsite options were assumed to be adequately designed to protect the environment once the remediation waste had been placed in the WMF.

B.7.3.1 No Action Alternative

The no action alternative would have the most detrimental impacts to the environment because the least amount of effort would be put into restricting the migration of contaminants.

Impact to Air Quality

There could be local air quality impacts due to the dispersion of contaminated soils which were not remediated. Emission rates of volatiles in subsurface soils will be dependent upon future activities at the location. Potential exposures or releases could result from future events, such as construction or erosion.

Ecological Impact

Impacts to ecosystems are not expected to be significant. Minor impacts to plants and wildlife could slowly increase as contaminants migrate. Contaminants could move from sources to groundwater and from groundwater to surficial waters which, in turn, increases exposure to surficial ecosystems; however, many of these contaminants will be destroyed, volatilized, or adsorbed by the soil prior to exposure by this pathway.

Impact to Soils And Sediments

The volume of contaminated subsurface soil will increase slowly as free-phase solvents and contaminated groundwater spread out. Sediments could be impacted as airborne contaminants settle in drainages, seeps bring contaminants to the surface, and/or erosion occurs. This is not consistent with intent of Rocky Flats Cleanup Agreement (RFCA).

Impact to Water Quality

Groundwater plumes will continue to spread due to diffusion and advection. Additional contaminants will leach into groundwater and surface waters because the sources of contaminants have not been removed.

B.7.3.2 Offsite Disposal

Impact to Air Quality

Direct environmental impacts include vehicle exhaust during excavation and transportation of the excavated materials and particulates from excavation, placement of contaminated media, and transportation over dirt roads. There is a potential for a spill to occur during handling and transportation, resulting in the dispersion of contaminated dust or vapors. Dust control during the spill cleanup should reduce this impact.

Ecological Impact

No direct impact to the ecosystem is anticipated, except if a spill were to occur during handling or transportation. If excavation of a spill were required, plants and/or habitats could be destroyed and irreversible harm could occur, if the replacement of these plants and/or habitats were not successful.

Impact to Soils And Sediments

As with the other environmental impacts, if a spill occurred during handling or transportation, there could be a direct impact to soils. Excavation of the contaminated soil would be required and, based on the characterization of the spill area, a greater volume of contaminated soil could require remediation.

Impact to Water Quality

No direct environmental impact is anticipated, except if a spill occurs during handling or transportation. Contamination of the surface water is possible depending on the location of the spill.

B.7.3.3 Onsite Waste Management Option

This option assumes that the location of a WMF will be at the Site (see Appendix C, Onsite Waste Management Facility Siting Study). Environmental impacts are location-specific and this evaluation could change based on the selected location.

Impact to Air Quality

Direct environmental impacts include vehicle exhaust during excavation and transportation of the excavated materials and particulates from excavation, placement of contaminated media, and transportation over dirt roads. There is a potential for a spill to occur during handling and transportation, resulting in the dispersion of contaminated dust or vapors. Impacts would be controlled by operational control of particulate and airborne contaminants.

Ecological Impact

Impacts to plant communities, wetlands, and other habitats will be minimized at the selected location. Likewise, the impact to threatened and endangered species is also expected to be minimal.

Impact to Soils and Sediments

Minimal damage will occur to the top soil at the selected location of the WMF. A higher erosional impact could also occur particularly if the WMF is situated close to areas with high natural erosion rates, such as drainage basins and slopes; however, through siting and erosional controls this effect will be minimized. Spills or leakage through the cell liner could also occur that could impacts surficial soils.

Impact to Water Quality

Based on the siting requirements in 6 CCR 1007-2, the WMF would be designed to isolate wastes for a thousand years from natural environmental pathways that could expose the public. Therefore, no impact on water quality is anticipated for the onsite option. An onsite WMF would include a postclosure (30 years) groundwater monitoring system for early detection of contaminant migration. There is a possibility of spills during transportation and handling; however, this risk is much less than the offsite option because of the close proximity of the WMF and fewer labor-intensive handling requirements prior to placement of the remediation waste. A summary of potential environmental impacts is given in Table B-4.

Table B-4 Summary of Environmental Impacts

Option	Air Quality Impact	Ecological Impacts	Soil and Sediment Impacts	Water Quality Impacts
No Action Alternative	Airborne dispersal of contaminants in soils.	Damage to local ecology due to unchecked migration of contaminants.	Increase in contaminated areas due to unchecked migration of contaminants.	Increase in plume size and increased transport of contaminants to surface water.
Offsite Disposal Option	Possible impact due to spills, otherwise minimal.	Possible impact due to spills, otherwise minimal.	Possible impact due to spills, otherwise minimal.	Possible impact due to spills, otherwise minimal.
Onsite Waste Management Option	Possible airborne particulates/ contaminants generated during construction depending on location. Possible impact due to spills.	Dependent on location. Impacts to plants, animal habitat, and threatened and endangered species can be minimized through location selection process.	Dependent on location. Possible impact to the topsoil. Erosional impacts are also possible.	Minimal impact.

B.8 CAPACITY AND AVAILABILITY

The capacity and availability for accepting remediation waste of the three different remediation waste management options are significant factors in the decision-making process. As a permitted treatment and storage facility (e.g. existing RCRA Permit #91-09-30-01 for storage), the Site has temporarily stored waste for the short and the long term until offsite disposal could occur. The cost impacts have been enormous in providing capital investment for storage facilities, and the required routine maintenance and scheduled walkdowns of waste inventories.

As mentioned previously, the majority of ER remedial waste media is projected to be contaminated soils and designated as LLMW. The most cost-effective and efficient manner in handling this waste media is in bulk (e.g., tandem dump trucks or large roll-off containers) versus drums or crates. The Site has a permitted storage capacity of 23,700 cy for LLMW. An inventory of LLMW, as of January 1995, accounts for 19,300 cy, which leaves 4,400 cy of usable storage space (see Table B-5, Permitted and Interim Status Storage Units). The permitted capacity of several of the RCRA units is larger than the available physical capacity of the unit. The permitted capacity can never be realized because of the physical limitations of the facility. A majority of the permitted facilities are structured for the storage of drums and crates and not for roll-off containers used for bulk ER waste material. As shown in Table B-1, the ER waste generation rate would surpass the existing available onsite storage space before offsite shipment could occur. Common sense dictates that waste should not be generated unless the material can be immediately disposed of offsite or managed onsite.

For the no action alternative, there is no driving factor because no removal action will take place. The waste material would remain as is with a higher level of risk to the public and the environment; therefore, capacity and availability have no significant impact.

For the offsite disposal option, capacity and availability are significant factors. Oak Ridge National Laboratory (ORNL) is the DOE facility that has contracted collectively on behalf of all DOE facilities with Envirocare of Utah for waste disposal. The contractual maximum waste limit which in all DOE facilities collectively can ship to Envirocare is 350,000 cy over the entire contract life (e.g., 5 years). A further breakdown of this value is 70,000 cy/year by all combined facilities. However, the WAC imposed by Envirocare to waste generators requires a rigorous process of verification and assurance for compliance with the LDR. A process flow diagram that outlines the duration of these requirements is shown in Figure B-2 and illustrates that waste generated cannot be shipped offsite until approval is granted from the disposal location (Envirocare).

Table B-5 Permitted and Interim Status Storage Units (Reference: 1995 Comprehensive Waste Management Plan)

Unit	Unit Name	Waste Type	Permitted/Interim Status Storage Capacity		Physical Capacity (m3)		On-Hand Inventory (m3)		Remaining Capacity (m3)			Comment
			Liquid	Total	Liquid	Solid	Liquid	Solid	Liquid	Solid	Total	
1	Main Hazardous Waste Storage Area	LLM	466.85	466.85	313.93	313.93	12.83	0.00	301.10	301.10	301.10	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity. Administrative limit of 200 cu yd for HAZ waste.
		HAZ	466.85	466.85	152.92	152.92	79.19	49.23	24.50	24.50	24.50	
		Total	466.85	466.85	466.85		92.20	49.23	374.65	325.60	325.60	
6	Chip Drum Storage Area: Building	LLM	4.43	4.43	4.43	4.43	0.00	0.63	3.80	3.80	3.80	
		Total	4.43	4.43	4.43		0.00	0.63	3.80	3.80	3.80	
10	Drum Storage Area: Building 561	LLM	78.74	78.74	78.74	78.78	61.92	0.00	15.43	15.43	15.43	Total on-hand inventory includes nonhazardous waste stored in this unit.
		Total	78.74	78.74	78.74		63.31	0.00	15.43	15.43	15.43	
11 (Includes Units 61 & 62)	Container Storage Area Building 776, Room 134	LLM	0.00	255.88	4.78	14.34	0.00	39.36	4.78	20.08	24.86	Total on-hand inventory includes nonhazardous waste stored in this unit. Twenty five percent of LLM physical capacity reserved for repacking
		TRM	0.00	113.93	0.00	113.93	0.00	39.06	0.00	24.86	24.86	
		Total	0.00	255.88	133.05		0.00	108.19	0.00	24.86	24.86	
12	Drum Storage Area: Building 776, Room 237	LLM	37.89	37.89	35.17	35.17	0.00	29.13	0.17	0.17	0.17	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity. Total on-hand inventory includes nonhazardous waste stored in this unit.
		Total	37.89	37.89	35.17		0.61	34.39	0.17	0.17	0.17	
13	Mixed Waste Storage: Building 884	LLM	139.91	209.86	194.82	194.82	0.42	168.78	20.10	20.10	20.10	Total on-hand inventory includes nonhazardous waste stored in this unit.
		Total	139.91	209.86	194.82		0.42	174.30	20.10	20.10	20.10	
14	Centralized Waste Storage Facility: Building 906	LLM	0.00	3975.92	0.00	2857.70	0.00	0.00	0.00	2857.70	2857.70	Liquid storage not allowed. Physical capacity assumes 1:1 ratio of crates to 55 gallon drums.
		HAZ	0.00	3975.92	0.00	2857.70	0.00	0.00	0.00	2857.70	2857.70	
		Total	0.00	3975.92	2857.70		0.00	0.00	0.00	2857.70	2857.70	
15A	904 Pad and Cargo Containers	LLM	60.31	844.28	60.31	478.18	0.84	383.81	59.47	94.37	153.84	Physical capacity limited due to stacking and large container constraints.
		Total	60.31	844.06	538.49		0.84	383.81	59.47	94.37	153.84	
15B	Mixed Waste Storage Area: 904 Pad	LLM	8181.22	8181.22	8181.22	8181.22	0.00	5041.73	3139.49	3139.49	3139.49	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity.
		HAZ	8181.22	8181.22	8181.22	8181.22	0.00	0.00	3139.49	3139.49	3139.49	
		Total	8181.22	8181.22	8181.22		0.00	5041.73	3139.49	3139.49	3139.49	
17	Mixed Waste Storage: Building 777, Room 423C	LLM	0.00	1.25	0.00	0.84	0.00	0.84	0.00	0.00	0.00	Liquid storage not allowed.
		Total	0.00	1.25	0.84		0.00	0.84	0.00	0.00	0.00	
18.03	Environmental Waste Drum Storage, Tent 1	LLM	718.74	718.74	718.74	718.74	0.00	8.40	472.34	472.34	472.34	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity.
		HAZ	718.74	718.74	718.74	718.74	0.00	238.00	472.34	472.34	472.34	
		Total	718.74	718.74	718.74		0.00	8.40	710.34	710.34	710.34	
18.04	Environmental Waste Drum Storage Unit	LLM	416.30	416.30	416.30	416.30	0.00	76.27	340.03	340.03	340.03	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity.
		HAZ	416.30	416.30	416.30	416.30	0.00	0.00	340.03	340.03	340.03	
		Total	416.30	416.30	416.30		0.00	76.27	340.03	340.03	340.03	
19	Mixed Waste Storage Area: Building 374, Room 3813	LLM	180.45	180.45	135.49	135.49	0.00	49.12	0.00	0.00	0.00	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity. Total on-hand inventory includes nonhazardous waste stored in this unit.
		TRM	105.51	105.51	105.51	105.51	0.00	45.99	0.00	0.00	0.00	
		Total	180.45	180.45	135.49		0.00	135.49	0.00	0.00	0.00	
20	Shipping Storage Area: Building 664	LLM	1911.50	1911.50	601.74	601.74	0.00	80.36	70.83	70.83	70.83	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity. Total on-hand inventory includes nonhazardous waste stored in this unit.
		HAZ	1911.50	1911.50	601.74	601.74	0.00	1.05	70.83	70.83	70.83	
		TRM	448.82	448.82	448.82	448.84	0.00	183.77	70.83	70.83	70.83	
		Total	1911.50	1911.50	601.74		0.00	530.91	70.83	70.83	70.83	
24	Mixed Waste Storage: Building 964	LLM	0.00	466.36	0.00	442.93	0.00	438.69	0.00	4.24	4.24	
		Total	0.00	466.36	442.93		0.00	438.69	0.00	4.24	4.24	
25	Mixed Waste Storage	LLM	10704.40	10704.40	10704.40	10704.40	0.00	5753.80	4950.60	4950.60	4950.60	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity.
		HAZ	10704.40	10704.40	10704.40	10704.40	0.00	0.00	4950.60	4950.60	4950.60	
		Total	10704.40	10704.40	10704.40		0.00	5753.80	4950.60	4950.60	4950.60	
27	Mixed Waste Storage: Building 776	LLM	10.41	10.41	10.09	10.09	7.56	0.84	0.43	0.43	0.43	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity. Total on-hand inventory includes nonhazardous waste stored in this unit.
		Total	10.41	10.41	10.09		7.56	2.10	0.43	0.43	0.43	

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The requirement that all waste characterization be conducted by certified State of Utah laboratories further restricts the availability of resources. Additionally, the assumption of transporting the majority of waste by rail to Envirocare would have both substantial cost and time savings versus waste shipment by trucking. DOT imposes restrictions on trucking for maximum load capacities on federal and state highways, which ultimately reduces the volume of waste per shipment. However, the logistics of handling and shipping waste by rail car are presently not available at the Site. A loading facility would be required to handle the shipments by rail.

Capacity and availability appear more attractive for onsite waste management. The waste disposal cell would be designed and constructed for a net volume of 100,000 cy. No restriction on the annual volume of waste would be imposed on the generator. In fact, the operations onsite could probably accept up to 500 cy/day. It is unlikely that the rate of removal and treatment of remediation waste could exceed the acceptance rate. In other words, removal actions would not be impeded by utilization of an onsite WMF. The WAC required for the onsite WMF unit would be less complicated than the offsite option and would be the process shown on Figure B-3, not become the lengthy process shown in Figure B-2. Characterization and certification could be obtained through a quality controlled program maximizing the use of field instrumentation techniques that could significantly reduce costs and schedules. Also, DOT load capacity requirements are not as stringent because state or interstate highways are not used. As a summary of comparisons, Table B-6 summarizes the capacity and availability of each option.

Table B-6 Comparison of Capacity and Availability of Waste Management Options

Options	Maximum Capacity (Volume)	Availability	Advantages/ Restrictions
No Action Alternative	4,425 cy *	No impact	Capacity is restricted by the current Site capability to store waste.
Onsite Waste Management	100,000 cy	Readily available (once constructed) and limited by maximum capacity.	1. No restrictions on the volume accepted except total capacity. 2. The WAC is not as stringent. 3. DOT requirements are not applicable.
Offsite Disposal	70,000 cy**	5 years***	1. Approval granted by Envirocare. 2. Waste characterization done by certified State of Utah laboratories. 3. DOT requirements for trucking on highways.

Notes:

* Remainder of the space available at the Site for the storage of LLMW (based on the inventory as of January 1995).

** Maximum waste limit that can be shipped to Envirocare per year for 5 years from all DOE facilities according to the contract with the DOE. The maximum waste capacity for all DOE facilities for Envirocare during the life of the contract is 350,000 cy.

*** Based on the current contract expiration with Envirocare. Conditionally, contract may be approved for extension after 5 years.

B.9 RECOMMENDATIONS

Overall the evaluation indicates that the onsite management of remediation waste is the best option. The main advantages are:

- Cost-effectiveness
- The possibility of offsite spills is negated
- There is better support of the Site mission as embodied in the Site Vision
- Greater support for the reduction of risks to the public and the environment is provided

The main cost benefit for onsite waste management is that under a CAMU designation, remediation waste would not have to be treated to meet the LDR; it would only need to be treated to ensure that the contaminants are immobile.

This evaluation was based on the assumption that an onsite CAMU would be operated for an indefinite period of time. Should the CAMU serve only as a temporary unit, then final action costs could warrant the consideration of offsite facilities. Although an onsite facility is designed for retrievability, should the remediation waste need to be removed or it becomes economically or technologically feasible to treat the contamination, the intention is that it be managed as any other CAMU, and like other CAMUs, it is intended to be the final action for most of the waste placed into it.

To compare the effects of onsite waste management versus offsite disposal, a hypothetical model (see Table B-7) was developed that tied in costs, waste volumes, and accelerated actions. The accelerated actions and waste volumes in Table B-7 were evaluated under a fixed budget of $20M per year until all of the actions were completed. Waste minimization of remediation waste by thermal desorption treatment was incorporated into the model. These soils were assumed to be returned to their source areas and were not placed in a WMF. As shown in Figures B-5 and B-6, an equal volume of remedial waste is dispositioned in 5 years with onsite waste management versus 16 years under the offsite disposal option. A description of the hypothetical cost model is presented in Attachment 3.

The onsite waste management option not only manages the waste in a more expeditious time frame and reduces risk to the environment and the public, but total costs expenditures are reduced significantly. As mentioned earlier, funding from Congress for future environmental cleanup is being reduced and will become more difficult to justify. Onsite waste management is less expensive than offsite disposal, and would enable an expedient reduction of environmental risks at the Site because the annual budget would not be consumed by offsite disposal costs. This, in turn, would result in greater overall risk reduction and long-term protectiveness of human health and the environment.

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The primary challenge associated with an onsite WMF will be to obtain approval for an onsite CAMU, and obtaining public approval. Offsite facilities are currently permitted and are ready to accept waste for disposal despite problems with logistics and higher costs than onsite facilities.

Clearly, onsite waste management is the most cost-effective and viable option for the management of remediation waste at the Site.

Table B-7 Remediation Waste (cy) Treated By Fiscal Year

Fiscal Year	Onsite Option Waste Management (cy)	Onsite Option Thermal Desorption Treated Soil (cy)	Onsite Option Total Waste Volume (cy)	Offsite Option Waste Disposal (cy)	Offsite Option Therm Desorption Treated Soil (cy)	Offsite Option Total Waste Volume (cy)
Year 1	0	6,800	6,800	0	6,800	6,800
Year 2	12,348	0	12,348	7200	0	7,200
Year 3	6,032	4,090	10,122	7,034	144	7,179
Year 4	6,104	4,020	10,124	4,016	3,686	7,702
Year 5	11,946	0	11,946	3,519	4,280	7,799
Year 6	11,946	0	11,946	7,059	0	7,059
Year 7	11,946	0	11,946	7,059	0	7,059
Year 8	11,946	0	11,946	7,059	0	7,059
Year 9	3,352	6,170	9,522	7,059	0	7,059
Year 10	730	2,470	3,200	7,059	0	7,059
Year 11				7,059	0	7,059
Year 12				7,059	0	7,059
Year 13				3,958	3,770	7,728
Year 14				1,210	4,870	6,080
Total	76,350	23,550	99,900	76,350	23,550	99,900

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Figure B-5 Remediation Waste Disposal Versus Fiscal Year

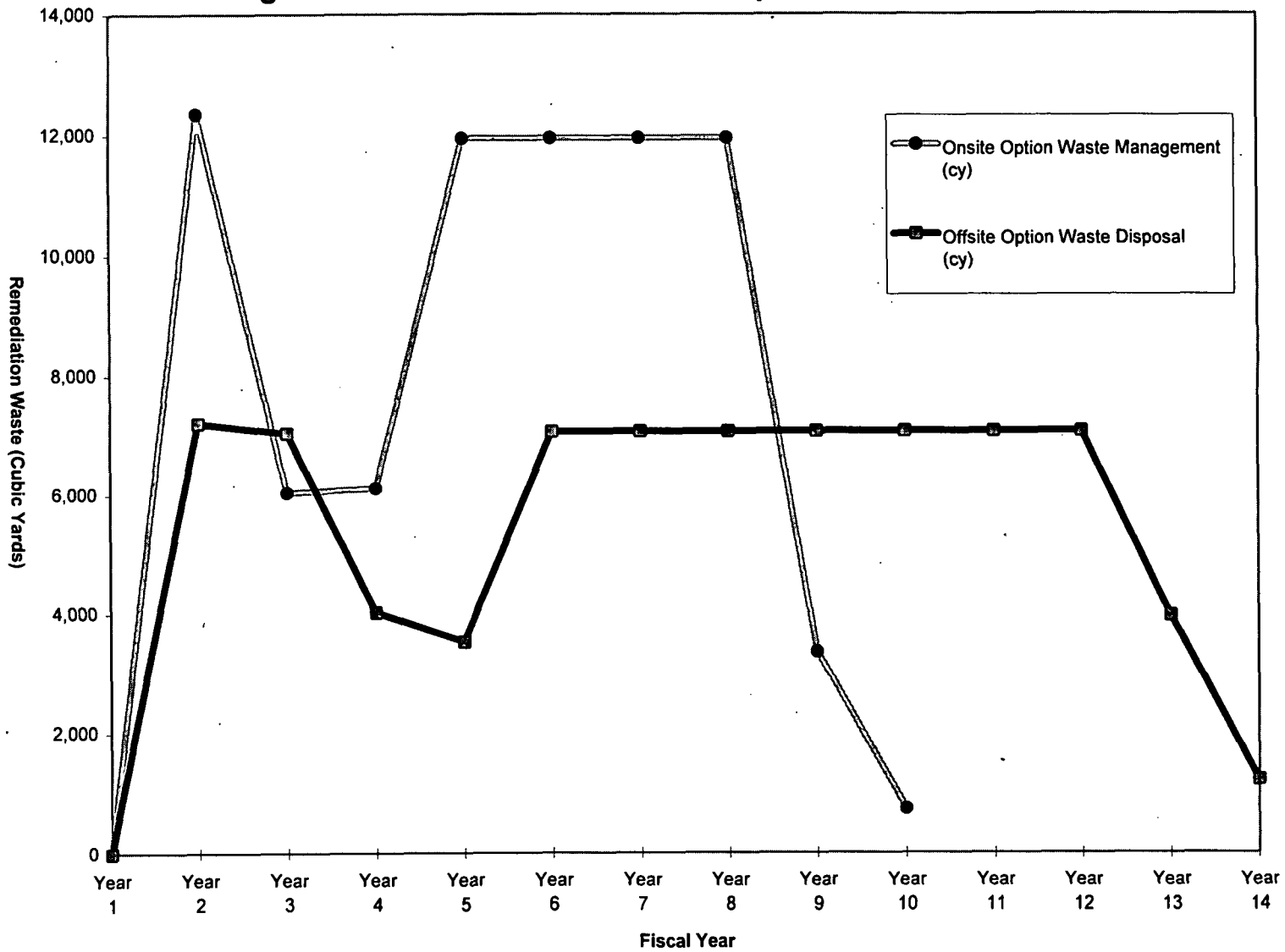

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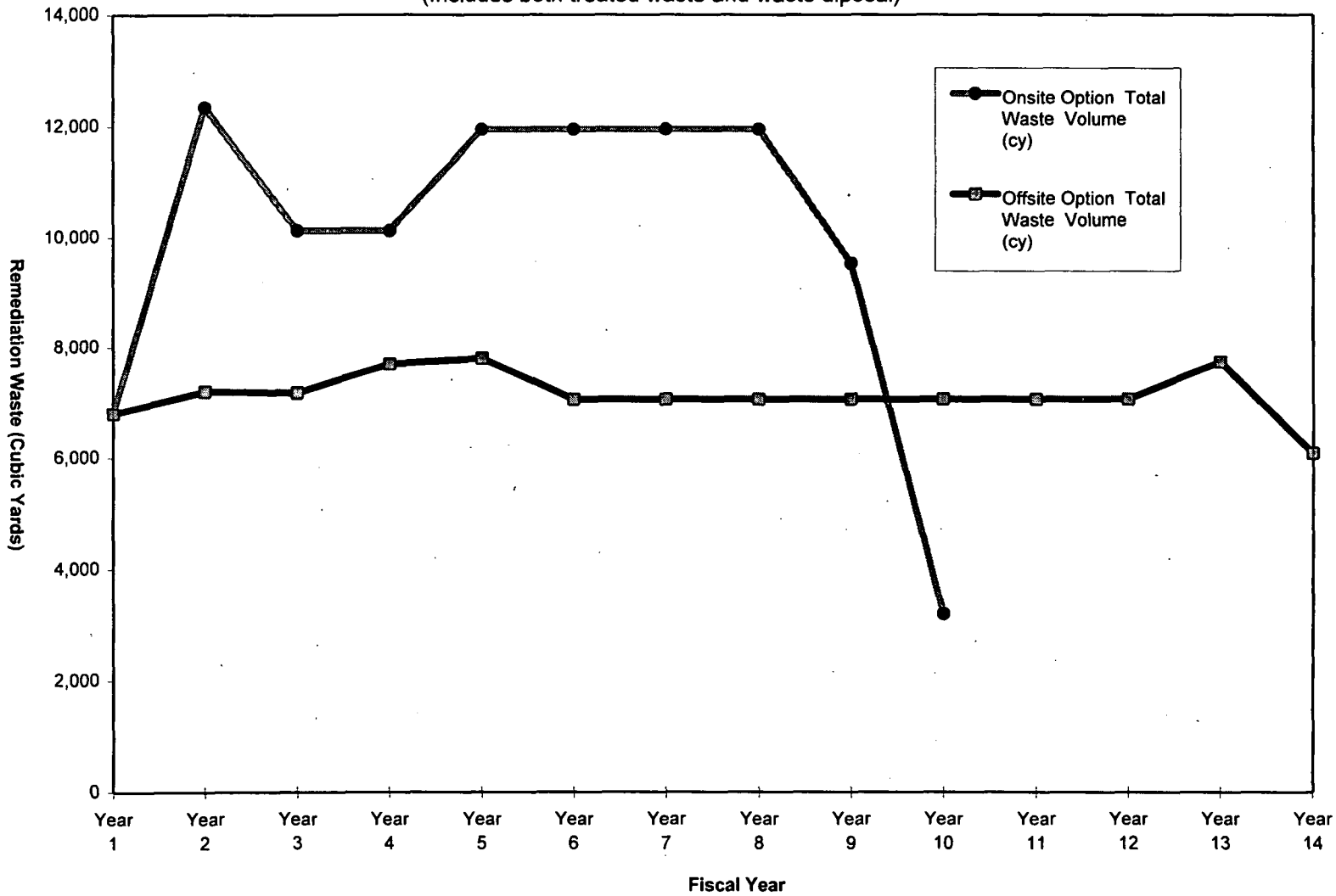
Figure B-6 Total Waste Dispositioned From Accelerated Actions Versus Time

(Includes both treated waste and waste diposal)



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Attachment 1

Assumptions

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General Assumptions

1. Assume that onsite waste management would be conducted under CAMU guidance (Subpart S, Corrective Action, Section 264.552 of 6 CCR 1007-3).

2. Assume that the onsite WMF would be designed to not pose a risk to the public or the environment for a thousand years in accordance with 6-CCR 1007-2, Part 2, Requirements For Siting of Hazardous Waste Disposal Sites.

3. Assume that high-level volatile and semivolatile organic constituents in the remediation waste would be treated using thermal desorption. Assume that contaminated soils would be treated; if PPRGs are met, the soils would be returned to their original point of excavation; if PPRGs are not met, the soils would be managed in the WMF.

4. No new interim storage facilities will be planned or budgeted for future storage of waste.

5. A limited budget in FY96 exists for the ER program. Outyear budgets have not been confirmed, however, a reduced budget for FY97 and outyears is assumed.

6. The use of railway shipment for bulk waste offsite would require upgrades or modifications to the existing system and a new loading facility.

7. No TRU waste was evaluated.

8. Under all of the options, groundwater monitoring will be integrated into the existing sitewide monitoring program. For an onsite facility, it was assumed that some additional wells would be necessary and that existing wells could also be used.

9. For all of the options, it was assumed that the level of all monitoring currently used at the Site would be continued. For the onsite option, additional monitoring would be required during construction and operation for health and safety purposes.

Assumptions of the Waste Volume Estimate (as presented in Table B-1)

1. The total volume estimated for the Solar Ponds ranges from 10,700 to 160,000 cy as referred by the *OU 4 IM/IRA Decision Document.* The value chosen assumes the vadose and surficial soils will require minimal remedial action based on the risk to human health and the environment. Pondcrete and sludge will be accepted without further treatment for free liquids. Sludge and pondcrete waste forms can be intermixed with soils to meet moisture content requirements.

2. The waste types exhibited are LLMW, HW, and LLW.

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3. Assume that approximately 60% of the IDM drums (3,000 drums) will be going to the WMF, the remaining 2,000 drums will be disposed of in the present sanitary landfill under 4-U50-REP-1006.

4. Potential Early Actions waste will be disposed of in the WMF if the treated waste cannot be returned to the source location.

5. Table B-1 does not include volumes for the remaining IHSSs in the Industrial Area. Because of budgetary constraints, insufficient sampling results are available to project potential remediation waste volumes. Remediation activities in OUs 1, 3, and Walnut Creek Area are not anticipated to generate significant waste volumes. IHSS 115 and OU 7 landfills are assumed to be capped.

6. The total estimate of 85,629 cy of remediation waste is based on a 15% fluff/expansion factor.

7. The schedule for accelerated actions is presently unknown because of potential budgetary constraints. The volumes of the accelerated action removals do not represent the total cleanup of the Site.

Cost-Analysis Assumptions

1. For offsite disposal, all LLMW and HW will go to Envirocare.

2. For offsite disposal only, small quantities of waste will be packaged in crates.

3. The remaining waste (approximately 98%), destined for offsite disposal, will be packaged in bulk in roll-offs. Roll-offs are large, rectangular containers constructed of steel which can be placed on tractor trailers or rail cars. The roll-offs were assumed to have a capacity of 20 cy.

4. All waste destined for offsite disposal will be packaged in roll-off containers.

5. No waste will be required to be packaged in crates for onsite waste management.

6. Envirocare will accept waste in roll-off containers and will allow the waste to be disposed of in bulk. They will proceed to decontaminate the roll-off containers allowing them to be used again. For this reason, no more than a two-month supply of roll-off containers will be needed. It is assumed that 500 cy (on average) will be shipped offsite every 2 months. Therefore, 34 roll-off containers will be procured (see Attachment 2 for the calculation).

7. The Site will have the capability to handle and manage the roll-offs. Currently the Site does not have the equipment or facilities to handle and manage large amounts of shipments via roll-offs.

8. Waste characterization costs will be similar to the actual costs of the OU 1 hot-spot removal.

9. The overhead costs at the Site and subcontractor costs will remain the same in the future.

10. Rail transportation will be available for LLMW shipments to Envirocare.

11. NTS does not currently have a rail spur and doesn't appear that one will be built in the near future. So all LLW being shipped to NTS will be done in roll-offs via truck (approximately 5% of the total waste volume estimate). All waste shipments are currently being shipped via truck, therefore, it is safe to assume that this practice will continue. Also, it was assumed that 25% of the total waste amounts will be shipped by truck and the remaining 75% of the total waste will be shipped by rail.

12. The NTS tipping fee will remain at $17/cubic foot.

13. The Site will be allowed to utilize the Envirocare"Above 25,000 Cubic Yard" price schedule (least expensive of three options).

14. Each of the roll-offs will be decontaminated for return to the Site by Envirocare and will not be disposed of in their cell.

15. Seventy percent of the waste will be shipped in the summer, and 30% of the waste will be shipped in the winter.

16. The Site will not ship any small waste streams (less than 4,000 cy).

17. No material will be shipped with dimensions greater than 10 inches (demolition debris is excluded from this analysis).

18. All treatment will be accomplished through thermal desorption and/or solidification.

19. Waste managed in the onsite cell will be managed under CAMU guidelines.

20. Postclosure care and monitoring will be done on a quarterly basis for the first ten years and semiannually for the remaining twenty years. This is for groundwater monitoring only. Cap maintenance will be conducted as needed.

21. Treatment and handling systems are not expected to produce emissions sufficient to require additional permitting. Air monitoring will be conducted via the existing Site monitoring system. Any additional air monitoring required for worker health and safety considerations will be conducted by the appropriate oversight organization.

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Schedule Assumptions

1. The use of laboratories in the State of Colorado which are certified by the State of Utah will not cause schedule impacts.

2. Assume 25% of the total waste (e.g., 25,000 cy) was shipped offsite in bulk via truck, using the 20 cy roll-off containers. This would become a lengthy process, (e.g., 8 years), based on shipping 500 cy every two months. This equates to 36 truckloads in a two-month period. This also assumes that there would not be delays in the waste characterization process.

Hypothetical Model for Waste Volume Cost Over Time Assumptions

1. The waste disposal and treatment options were based on an annual budget of $20M for ER activities, with the exception of a budget of $10M for FY96. This budget was used in planning for outyear activities as well.

2. The same costs for thermal desorption were used for both onsite and offsite options because it was a conservative estimate for both options.

3. The total volume does not include all of the high-risk removal actions because areas in the IA have not been totally characterized. However, it does represent the majority high-risk waste volumes outside of demolition activities.

4. No waste will be disposed of until FY97.

Attachment 2

Basis of Estimates for Onsite Waste Management and Offsite Disposal Cost

WASTE CONTAINERS

ASSUMPTIONS:

1) No waste will be packaged in drums due the higher cost per unit volume of waste.

2) Due to the small quantities of some of the waste streams and the fact that RFETS is currently packaging off-site waste in half crates, it was assumed that 2% (2,000 cy) of the projected waste volume will be packaged and transported in half-crates. Half crates are not re-usable.

3) The remainder of the remediation waste will be packaged in re-usable roll-off containers (98,000 cy) for offsite disposal.

4) Roll-offs will be cleaned/decontaminated and returned for re-use after waste disposal.
The cycle time for a rolloff is two months.
5) Rate of disposal. The cost estimate rate for off-site disposal at Envirocare is 3 years. This number averages to 5,444 cy per two months. Therefore the amount of roll-offs that need to be procured is 372. See detailed BOE below).

6)It was assumed that only 20 C.Y. roll-offs or containers would be used.

7) All waste (98,000 C.Y.) will be generated and disposed within a three year period.

COST CALCULATIONS AND BASIS OF ESTIMATE:

HALFCRATES	QTY	UNIT	BASIS OF ESTIMATE
External volume of a half crate	56 c.f.		(standard volume)
Cubic yards of waste per half crate - loss due to packaging	38 c.f.		Internal volume calculation based on Specification Drawing dimensions.
Volume of waste to be disposed in half crates (cubic yards)	2,000 c.y.		Assumption #2 above.
Volume of waste to be disposed in half crates (cubic feet)	54,000 c.f.		Assumption #2 above. 2,000 c.y. X 27 c.f./c.y.
Number of crates required	1,421	crates	(54,000 c.f.)/(38 c. f./Hcrate)
Cost per crate	$500	dollars each	Recent procurement
Total cost of Halfcrates, Offsite Options.	$ 710,500		1,421 crates X $500/crate

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ROLL-OFFS, by Rail to Offsite Disposal	QTY	UNIT	BASIS OF ESTIMATE
Capacity in Cubic yards per roll-off	20	c.y.	Basic Assumption
Usable Capacity in Tons per Rolloff	24	tons, net	Capacity of RailCar = 75 TONS. 1 Rolloff @ 0.75 Tons empty + 24 tons of waste = 25 Tons .. 3 Rolloffs at 25 tons gross wt. each = 75 Ton Capacity of railcar.
Density of soils at RFETS	1.62	tons/c.y.	Merrick Conceptual Design Document for the New Sanitary Landfill
Volume of waste allowed on each railcar	44.4	C.Y.	3 X 24 tons / 1.62 T/CY = 44.4 C.Y.
Number of Rolloffs per railcar - Maximum/not full	3.0	Rolloffs/car	44.4 C.Y. /20 C.Y. = 2.22 Rolloffs
Usable volume capacity per rolloff	14.8	C.Y.	44.4 C.Y./ 3 Rolloffs=14.8 C.Y. Rolloff
Number of roll-offs needed to achieve 5444 c.y. shipments every 2 months	372	roll-offs	(98000CY /36 months X 2 months /Roundtrip X 1 Car/44CY X 3 Rolloffs/Car = 372 rolloffs/ Roundtrip.)
Cost to procure one roll-off	$10,570	each	Actuals from Trench T-3 and T-4 Removal Project
Total cost for roll-offs, offsite disposal option.	$3,932,040		$10570 X 372 roll-offs

Containers, Rolloffs onsite storage. (Metal Buildings, Slab on Grade).

Rolloffs/ Containers, onsite storage options,	QTY	UNIT	BASIS OF ESTIMATE
Volume of Waste to be stored	100,000	C.Y.	Basic assumption
Usable capacity of container	20	C.Y.	Basic assumption
Number of containers required	5000		100,000/20 = 5,000
Cost to procure one rolloff/container	$10,570	each	Actuals from Trench T-3 and T-4 Removal Project
Total Cost to procure 5,000 container/rolloffs, onsite storage options. (100,000 C.Y.)	$52,850,000		5,000 X $10,570 each.

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CONTAINER COST SUMMARY:

Total half-crate cost (2% of Waste Volume)	$710,500
Total roll-off cost (offsite transport & Disposal)	$3,932,040
TOTAL CONTAINER COST (Offsite disposal options)	$4,642,540

TOTAL CONTAINER COST (Onsite storage options)	$52,850,000

Note 1.
End dump trucks operating and acquisition costs were placed into the Transportation BOE
Note 2.
Note these costs are UNescalated.

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PACKAGING

CRATE PACKAGING AND PREPARATION

1) For the purposes of this estimate it was assumed that the waste would not be packaged in drums because of the higher costs.

2) Due to their small quantities, the following wastes likely will be packaged in half-crates see Table 5-1):

OU-2 Trench T-2	0 cu. yd.
OU-4 Debris	700 cu. yd.
OU-9 Tank 40	130 cu. yd.
OU-6 B-1 Dam	8 cu. yd.
Hot Spot Removal	50 cu. yd.
IDM	180 cu. yd.
TOTAL	1,068 cu. yd.

3) Approximately 1421 Halfcrates will be required to contain 2,000 C.Y.Waste.

4) Packaging refers only to the cost of labor and labor supplies necessary to prepare, fill, label, and certify containers of waste for transportation. Packaging costs here exclude cost of containers , transportation, and characterization.

CRATE PACKAGING	QTY	UNITS	BASIS OF ESTIMATE
Crates packaged per hour, including documentation	0.2	crates/hr	Experience on 750 Pad.
Number of crates	1,421	crates	(From "Waste Containers" BOE)
Total hours to fill, seal, glue and nail lids, provide and attach documentation on Loaded Crates	7,105	hours	(1421 crates)/(0.2 crates/hr)
Cost per labor hour	$85	/hr	Assumed base rate including labor burden. From FY 96 Budget Call Book.
Total cost to Package Halfcrates	$603,925		$85/hr X 7,105 hours

ROLL-OFF PACKAGING AND PREPARATION

6) Assume that all waste stored or disposed of on-site not "in bulk" will be packaged in roll-offs.
   6a) Assume that all waste destined for "immediate" offsite disposal will be packaged in rolloffs.
   6b) Assume that all waste stored or disposed on site, "in bulk" will be packaged and transported in End Dump Trucks.

7) Assume that the packaging time for end dump trucks and rolloffs are equal, regardless of destination.

8) Personal Protective Equipment (PPE) is assumed to be no greater than level D (gray coveralls) for estimating purposes. Costs of Level D PPE is considered minimal. Actual PPE will be prescribed by site HS &R personnel.

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ROLL-OFF PACKAGING		QTY	UNIT	BASIS OF ESTIMATE
Person-hours to package one container		4	hours	Actuals from Trench T-3 and T-4 Removal Project
Cost per labor hour		$85	/hour	Approximate average labor rate
Labor cost per container	$	340		4 Hours X $85
Amount of waste in roll offs (off-site)		98,000	c.y.	100,000 cy - 2,000 cy (in crates)
Amount of waste in roll-offs (on-site)		100,000	c.y.	Ground Rule from Section 7.0 of this document
Volume of waste allowed in one rolloff. (offsite)		14.8	c.y.	From "Waste Container" BOE
Volume of waste allowed in one rolloff. (onsite)		20.0	c.y.	From "Waste Container" BOE
Number of times the roll-offs need to be packaged (off-site rail transportation)		6,622	times	98,000CY / 14.8 CY/Rolloff = 6622
Number of times the roll-offs need to be packaged (on-site storage options)		5,000	times	100,000Cy / 20 CY = 5000
Total cost for roll-off packaging (off-site)	$2,251,480			6622 X $340
Total cost for roll-off packaging (on-site)	$1,700,000			5,000 X $340

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DUMP TRUCK PACKAGING	QTY	UNIT	BASIS OF ESTIMATE
Person-hours to package/load one dump truck, including loading, documentation, placarding, and smear testing. (excludes excavation, crushing, grinding or treatment time and costs.) (Assumes clock time = 2 hours)	4	hours	Assumed based on actuals from Trench T-3 and T-4 Removal Project
Amount of waste in dump trucks (on-site)	100,000	c.y.	From 'Waste Container' BOE
Volume of waste allowed in one dump truck	16.0	c.y.	From 'Transportation' BOE
Number of times the dump trucks need to be packaged (on-site)	6,250	times	(100,000C.Y.) / (16 C.Y. per truck)
Total hours to place waste in dump trucks. Includes documentation, placarding, smear testing.	25,000	hours	4 Hours to package one dump truck X 6250 times
Cost per labor hour	$85	/hour	Base labor rate from FY96 Budget Call
Cost to package dump trucks w/o contingency	$2,125,000		Total hours X labor rate
Total cost for dump truck packaging	$2,125,000		Total cost w/o contingency

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PACKAGING COST SUMMARY:

OFFSITE PACKAGING COSTS	
(2,000 CY) Total half-crate packaging cost	$603,925
(98,000 CY) Total roll-off packaging cost	$2,251,480
TOTAL **OFFSITE** PACKAGING COST W/O CONTINGENCY (100,000CY)	$2,855,405

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ONSITE PACKAGING COSTS , Bulk storage	
Total half-crate packaging cost	$0
(100,000CY) Total dump truck packaging costs	$2,125,000

ONSITE PACKAGING COSTS, Container storage	
Total half-crate packaging cost	$0
(100,000 C.Y.) Total roll-off packaging costs	$1,700,000

Note: All costs on packaging BOE are UNescalated

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TRANSPORTATION

ASSUMPTIONS:

1) No Drum Transportation is included in this estimate

2) Approximately 1421 Halfcrates are included in this transportation estimate for offsite disposal. All Halfcrates will be transported by truck to offsite disposal.

3) Approximately 4900 roll-off containers of waste will be transported off-site (98,000 C.Y. / 20 CY each).

4) For onsite disposal /placement in bulk calculations all waste will be transported in 16 C.Y end-dump trucks. The trucks will be weight rated to transport full loads.

5) For onsite storage and transportation in containers the volume per container is 20 C.Y., only one container per truckload.

6) All rolloffs for offsite disposal will be transported by rail.

7) Rail Transportation of rolloffs, maximum of 4 Roll-offs per railcar, (80 C.Y. volume capacity / railcar), for return transportation of used, clean, empty, rolloffs to site for reuse.

8) Rail Transportation, Maximum number of rolloffs per loaded car is 3 due to weight limit of 75 tons. (See Weight & Volume Calculation in this BOE).

9) The existing rail siding at RFETS is currently active, certified and considered adequate to support

10) Railcar loading equipment must be provided and included in this estimate.

11) Contingency will not be added to individual BOE's.

COST CALCULATIONS AND BASIS OF ESTIMATES:

Half-Crate transportation - OFFSITE DISPOSAL	QUANTITY	UNIT	BASIS OF ESTIMATE
Waste to be transported	1,421	Halfcrate	"Waste Containers" BOE
Weight Capacity of truckload	22.5	Tons	State/DOT Regs, Est. Vehicle net load
Weight per Halfcrate	2.45	Tons	38 Cu.Ft / 27 Cu Ft/YD X 1.62 Ton / Yd = 2.279 Tons soil/Hcrate +0.175 ton tare/crate = 2.45 tons /HCrate
Max Halfcrates per truckload	9	Halfcrate:	22.5 Tons/Truck / 2.45 Tons / Halfcrate = 9.18 Halfcrates / Truck
Truckloads required.	158	Trucks	1421 HCrates/ 9 halfcrates / truck = 157.89
Cost per truckload	4,800	Dollars	Existing contract.
Direct Cost of Transportation	758,000	Dollars	4800 X 158 =$758,400
Total Cost of halfcrate transportation offsite	$758,000		

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Note: Two offsite transportation BOE's were prepared, one to determine the weight limit and one to determine the volume limit. The weight is the governing factor. The volume calculation is included here for reference only.

ROLL-OFF TRANSPORTATION - OFFSITE DISPOSAL	QTY	UNIT	BASIS OF ESTIMATE
Rail car transportation only, based on **weight**			
Amount of waste in roll offs (off-site)	98,000	c.y.	From 'Waste Container' BOE
Volume of waste allowed in one roll-off (max) (due to Weight limit)	14.8	c.y.	From 'Waste Container' BOE
Number of Rolloffs to be transported (recycled)	6,667		98,000 C.Y. / 14.8 C.Y. Rolloff
Number of loaded Rolloffs per railcar	3	Rolloffs	Assumption #8 (Above).
Number of Railcar trips required, loaded	2,223	Railcars	6667 rolloffs / 3 per car = 2223 railcar trips, loaded
Number of Railcar trips required, return empty	1,667		6667 Rolloffs / 4 per car =1667 railcar return "empties" trips.
Total Railcar trips required	3890		2223 + 1667 = 3890
Cost per railcar trip	$4,150	Dollars	RMRS Transportation Mgr. Pers Comm.
Total cost for rail transportation of rolloffs (98,000 C.Y.))	$16,143,500		$4150 X 3890 trips = $16,143,500

ROLL-OFF TRANSPORTATION - OFFSITE DISPOSAL	QTY	UNIT	BASIS OF ESTIMATE
Rail car transportation only, based on **volume**			
Amount of waste in roll offs (off-site)	98,000	c.y.	From 'Waste Container' BOE
Volume of waste allowed in one roll-off (max)	20.0	c.y.	From 'Waste Container' BOE
Number of Rolloffs to be transported (recycled)	4,900		98,000 C.Y. / 20 C.Y. Rolloff
Number of loaded Rolloffs per railcar	4	Rolloffs	Assumption #7 (Above).
Number of Railcar trips required, loaded	1,225	Railcars	4900 rolloffs /4 per car = 1225 railcar trips, loaded. *NOTE* : Four fully loaded Rolloffs exceed weight capacity of railcar by 25 Tons, per "Waste Container" BOE.
Number of Railcar trips required, return empty	1,225		4900 Rolloffs / 4 per car =1225 railcar return trips
Total Railcar trips required	2,450		1225 + 1225 = 2450
Cost per railcar trip	$4,150	Dollars	RMRS Transportation Mgr. Comm.
Total cost for rail transportation of fully loaded rolloffs, (4 rolloffs per railcar)	Not Achievable, **weight** restriction		$4150 X 2450 trips = $10,167,500

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Waste Transportation to onsite storage or onsite disposal in bulk

TRANSPORTATION -ONSITE DISPOSAL/STORAGE		QTY	UNIT	BASIS OF ESTIMATE
Amount of waste in dump trucks		100,000	c.y.	Basic assumption
Volume of waste allowed in one truck		16.0	c.y.	Assumption #4 (above)
Number of Truckloads Required		6,250	Rtrips	100,000 C.Y. / 16 C.Y. Truck
Roundtrip Distance per Truckload		3	Miles	Base assumption
Miles traveled by Trucks		18,750	Miles	6250 Rtrips X 3 Miles/Trip
Roundtrip Truckloads/day		8.3	Round-trips	6250 Rtrips/3 years X 1 year/50 weeks X 1 week/5 days X 1 day / 6 hrs working = 8.3 RTrips/day
Loads per truck per day (6 Hours operating)		2	trips	Base assumption 3 hours/RoundTrip, load 1 hour, travel 1 hour, unload 1 hour. (See Packaging BOE)
Trucks required each day		5	Trucks	8.3 RTrips/day X 1 day / 2 Rtrips/ truck = 4.15 Trucks, use 5 trucks, incl spares.
Labor, Drivers required to drive trucks		5	Drivers	Base assumption, 1 driver per truck per day
Labor Cost to drive trucks (Pay at 8 hrs/day, work at 6 hours/day)	$	2,550,000	Dollars	$85/hr X 8 hr/day X 5 drivers/day X 5 days/week X 50 weeks/yr X 3 years. Cost Basis - FY 96 Work Package Guidance)
Fuel Cost for trucks	$	9,375	dollars	18750 miles X 50 cents/mile Assumption
Procurement cost of 5 16 yd end-dump trucks	$	1,250,000	dollars	5 Trucks X $250K each, Rough Estimate, based on prior purchases
Maintenance of Trucks	$	500,000	Dollars	Rough Estimate
Total cost for onsite "Bulk" transportation	$	4,309,375		SUM of Labor, Fuel, Procurement, Maintenance

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Onsite Transportation of Rolloffs/Sealand Containers

TRANSPORTATION -ONSITE DISPOSAL/STORAGE IN CONTAINERS		QTY	UNIT	BASIS OF ESTIMATE
Amount of waste in containers		100,000	c.y.	Basic assumption
Volume of waste allowed in one truck/container		20.0	c.y.	Assumption #5 (above)
Number of Truckloads Required		5,000	Rtrips	100,000 C.Y. / 20 C.Y. Truck
Roundtrip Distance per Truckload		3	Miles	Base assumption
Miles traveled by Trucks		15,000	Miles	5000 Rtrips X 3 Miles/Trip
Roundtrip Truckloads/day		7.0	Round-trips	5000 Rtrips/3 years X 1 year/50 weeks X 1 week/5 days X 1 day / 6 hrs working =7 RTrips/day
Loads per truck per day (6 Hours operating)		2	trips	Base assumption 3 hours/RoundTrip, load 1 hour, travel 1 hour, unload 1 hour. (See Packaging BOE)
Trucks required each day		4	Trucks	7 RTrips/day X 1 day / 2 Rtrips/ truck = 3.5 Trucks, use 4 trucks, incl spares.
Labor, Drivers required to drive trucks		4	Drivers	Base assumption, 1 driver per truck per day
Labor Cost to drive trucks (Pay at 8 hrs/day, work at 6 hours/day)	$	2,040,000	Dollars	$85/hr X 8 hr/day X 4 drivers/day X 5 days/week X 50 weeks/yr X 3 years. Cost Basis - FY 96 Work Package Guidance)
Fuel Cost for trucks	$	7,500	dollars	15000 miles X 50 cents/mile Assumption
Procurement cost of 4 container-hauling trucks	$	1,000,000	dollars	4 Trucks X $250K each, Rough Estimate, based on prior purchases
Maintenance of Trucks	$	500,000	Dollars	Rough Estimate
Total cost for onsite "container" transportation	$	3,547,500		SUM of Labor, Fuel, Procurement, Maintenance

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Railcar Loading Equipment for Rolloffs.

Forklift 25 ton Capacity 20 foot lift	$250,000		Cap Cost. Quote FOB RFETS
Forklift operating cost @ $50/hr =	$225,000		3 years X 50 Weeks/year X 5 days/week X 6 hours/day =
Forklift operator and spotter- labor	$1,020,000	Dollars	3 years X 50 weeks year X 40 hrs week X $85 Hour X 2 people
Site-prep and maintenance of loading area	$250,000	Dollars	Rough Estimate
Upgrade of rails (not required)	-0-		Assumptions #8 and 9 Above.
Total of rail car loading facility equipment and maintenance of site.	$1,745,000	dollars	Sum of above costs

SUMMARY OF TRANSPORTATION COSTS

Onsite Transportation, bulk storage, via dump trucks	$	4,309,375

Onsite Transportation of Containers to Storage Facility	$	3,547,500

Off site transportation.		
Rail loading facility equipment and operation	$	1,745,000
Rolloff Transportation with recycling	$	16,143,500
Trucking of halfcrates	$	758,000
TOTAL	$	18,646,500

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Characterization Costs For Onsite Management and Offsite Disposal

Assumptions

1) Although there is a wide variation in potential sampling costs for various facilities, by making the costs identical, the playing field was leveled in terms of sampling and analysis. This allows the cost analysis to focus on other factors. Most of the variation between facilities can be attributed to the number of different analyses required and analytical methods used. In reality, the sampling and analysis costs would be expected to be higher for offsite facilities and lower for an onsite facility. This is generally true for any offsite facility and is driven by various permit requirements, waste acceptance criteria, RCRA, and other factors.

2) Laboratory analysis were estimated based on past laboratory costs. The costs are estimates and as such differ from any proprietary information that might be in current analytical contracts. For required sample methods that currently was not available through the Rocky Flats Sample Management Office, it was assumed that the required sampling methods (8000 series) would be available and the cost would be similar to similar existing methods currently in use.

3) It was assumed that all of the samples would be analyzed at laboratories. For onsite management, it might be possible to use field methods which could further reduce the costs.

4) Assume that on the average, one sample would be taken for every 75 cubic yards to meet the waste acceptance criteria. This sampling amount was increased by 100% to cover the following:

1) Quality Assurance Samples - 25%
2) Post-treatment Sampling - 75%

Assume that for a baseline each sample would be analyzed using the paint filter test, gamma spectroscopy, and TCLP for metals and volatiles. Additional miscellaneous analysis could include additional samples for Hydrogen Cyanide, Hydrogen Sulfide, Uranium Isotopic Analysis, Thorium Isotopic Analysis, Plutonium 239/240, Gross Alpha/Beta, Proctor Testing, and others.

5) Assume that the cost for sample containers were included in the analytical costs.

6) Assume that sampling would be performed on-site by plant personnel. A burdened cost of $85/hour was assumed for both monitoring and sampling personnel. Assume that sampling crews would consist of two individuals with full-time radiation monitoring support.

7 Assume that most of the sampling would be done in Level D personal protective

equipment and that on occasion this would be upgraded to Level C.

8) Assume that samples would be tracked through the Rocky Flats Environmental Database System.

9) Assume that transportation costs would be minimal since most of the samples would be analyzed on plant site. Assume that some samples would go off-site due to capacity or analytical method.

Cost Calculations

Laboratory Analysis:

Paint Filter Test (estimate)	$100.00
TCLP (metals)	$550.00
TCLP (organics)	$550.00
Gamma Spectroscopy	$200.00
Total Cost	$1,400

$1,400

Possible Additional Sample Costs

Any of the analytes below could be included depending on the waste acceptance
All sample costs are estimates and have not been escalated.

Analysis	Cost
pH	$ 15.00
Hydrogen Cyanide	$ 65.00
Hydrogen Sulfide	$ 50.00
Heavy Metal Analysis* (CLP and Non-CLP)	$600.00
Hexavalent Chromium	$ 60.00
Volatiles (Method - CLP)*	$340.00
Semivolatiles (Polynuclear Aromatics)**	$310.00
TCLP (Metals)	$550.00
TCLP (Organic Volatiles)	$550.00
TCLP (Semivolatiles)	$800.00
Gamma Spectroscopy	$200.00
Uranium Isotopic Analysis	$280.00
Thorium Isotopic Analysis	$240.00
Plutonium 239/240	$280.00
Gross Alpha/Beta	$180.00
Proctor Test	$260.00
Total Organic Halides (TOX)	$150.00

Pesticides and PCBs	$260.00
Herbicides	$310.00
Petroleum Hydrocarbons	$180.00

* Substituted other methods to estimate cost
** Substituted EPA Method 610 for 8100

Labor (Cost per Sample):

Presampling Preparation and Sampling Forms	-	**0.75 Hours**	
Donning Personal Protective Equipment	-	**0.5 Hours**	
Sampling	-	**1.25 Hours**	
Safety Monitoring	-	**2 Hours**	
Data Entry and Sample Tracking	-	**0.75 Hours**	
Sample Packaging and Shipping	-	**0.75 Hours**	
Management Oversight	-	**0.25 Hours**	
Total	-	**6.25 hours**	
Labor Rate		**$85/hour**	
Labor Cost		**$530**	**$ 530**

Materials & Equipment (Not Including Sample Bottles)

Coolers and Sampling Supplies	**$ 40**	
Protective Equipment (Level C &D)	**$ 70**	
Monitoring Equipment and Supplies	**$ 70**	
Equipment Total	**$180**	**$ 180**
Transportation (on-site/off-site)	**$ 40**	**$ 40**
Total Cost Per Sample		**$2,150**

Number of samples:

(100,000/75) x 2 = 2680 samples

Total Characterization Cost

2680 samples x $2150/sample = (without contingency)	**$5,762,000**
Total Characterization Cost (Contingency not included)	**$5,762,000**

Treatment Costs for Off-Site Disposal

Assumptions:

1) Assume that only the waste that needs to be treated to meet Land Disposal Restrictions will be treated and that treatment will consist of either solidification or thermal desorption. Assume that none of the waste needs volume reduction. Assume that soils that do not need to be treated to meet Land Disposal Restrictions (LDRs), do not need any additional treatment including dewatering or drying.

2) Cost for solidification of Solar Ponds sludge was based on Solar Ponds' estimates in the "Operable Unit 4 IM/IRA Decision Document". The estimate was for Pondcrete and Sludge combined. Volumetrically, the sludge represented roughly half of the total volume so the cost estimate was approximated by taking half of the total cost or $21 million. This cost is fully burdened but does not include escalation. The volume of sludge at the Solar Ponds is 6,000 cubic yards.

3) Cost of solidification of soils was modified from on pondcrete treatment costs in the from "Pondcrete Processing Conceptual Design", Haliburton NUS Corporation, January 6, 1995. Capital Costs are based on facility designed to treat approximately 12,000 cubic yards of pondcrete. Soil solidification costs could be reduced by approximately $11.6 million if the equipment fro pondcrete processing can be utilized for soil solidification.

Capital Cost	$11,600,000
Unit Operating Cost	$5,500,000/5,600 yd^3 = $980/$yd^3$

The total volume of remediation requiring solidification is approximately 41,100 yd^3 of which 6,000 yd^3 is sludge (see attached Table B-8) so

42,300 yd^3 - 6,000 yd^3 = 36,300 yd^3 of soils

4) A cost of $1300 per cubic yard for thermal desorption was based on the estimate for the remediation of the East Trenches (Trenches T-3/T-4). The volume requiring thermal desorption treatment is approximately 3400 yd^3 (see Table B-8).

5) Unit costs were assumed to be all inclusive. This included all transportation, health and safety, documentation, oversight, etc.

6) Costs for treatment of the liners was not included in the estimate. It was assumed that contamination on the liners would be less difficult to remove and that the costs would not be high. This assumption would need to be revised if the contamination has been absorbed into the asphalt as opposed to removable surficial contamination.

Cost Calculations

Thermal Desorption:

3400 cubic yards x $1300/cubic yard	= $4,420,000	≈	**$ 4,420,000**
Solidification of Sludge:	= $21,000,000		**$ 21,000,000**

Solidification of Soils:

Capital Cost	= $11,600,000	
Operating Cost:		
36,300 cubic yards x $980/cubic yard	= $35,570,000	
	$47,170,000	**$ 47,170,000**

Total Treatment Cost **$ 72,590,000**
(Contingency not included)

Treatment Costs for Onsite Management

Assumptions:

1) Assume that all of the soils removed from the trenches, IHSS 119.1, some soils from 903 Pad and some soils removed from Original Process Waste Line Tanks T-2, T-3, T-9, T-10, T-14, T-16 and T-40 will require treatment by thermal desorption.

	Cubic Yards
Trench T-1	1000
Trench T-3	300
Trench T-4	300
Trenches T-5 through T-11	1000
Mound Area	1500
903 Pad (IHSS 112 and 140)	1400
Tanks T2 and T-3	500
Tanks 9 & 10	500
Tanks T-14 and T-16	3,340
Tank T-40	130
Total	9,970

2) Assume a unit cost of $1300 per cubic yard for thermal desorption was based on the Operable Unit 2 estimate for the remediation of the East Trenches.

Cost Calculations:

$1300 x 9,970 = **$12,960,000**

Total Treatment Cost (Contingency not included) **$12,960,000**

Attachment 3

Description of Hypothetical Cost Model for Accelerated Actions at the Rocky Flats Environmental Technology Site

The purpose of the hypothetical cost model for accelerated actions was to compare the cost and schedule impacts of the onsite waste management option versus the offsite option, given a fixed budget. Unit costs were developed based on actuals and the estimates described in Attachment 2 as follows:

Unit Cost for Onsite Waste Management (includes Excavation)	$2,128/cy
Unit Cost for Offsite Disposal (includes Excavation)	$3,482/cy
Unit Cost for Thermal Desorption	$2,970/cy

Based on the above unit costs, the cost of thermal desorption used for onsite management and offsite disposal were calculated for each accelerated action. Ten million dollars were allocated for the first year, based on the actual FY96 budget. It was assumed that the budget for each following year would increase to $25M. All of the accelerated actions were prioritized based on risk. The cost model was set up as follows:

1. Starting with Year 1, the cost of both thermal desorption and disposition for the highest priority accelerated action was allocated to that year, followed by the next highest priority accelerated action and so on until the $10M budget was consumed.

2. This was repeated again for Year 2 for a $25M budget and again for the next year until there were no more accelerated actions to allocate. Both the onsite and offsite options were allocated in this manner.

3. Based on the costs allocated for each accelerated action in each fiscal year, the volume of soils treated with thermal desorption and the volume of soil dispositioned were determined.

4. These volumes were then plotted versus fiscal year as shown in Figures B-5 and B-6.

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Appendix C

Onsite Remediation Waste Storage Facility Siting Study

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ABBREVIATIONS AND ACRONYMS

Am	americium
ARAR	applicable or relevant and appropriate requirements
CAMU	Corrective Action Management Unit
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and Environment
CHWA	Colorado Hazardous Waste Act
cm/sec	centimeters per second
cy	cubic yards
D&D	deactivation and decontamination
DOE	United States Department of Energy
ESF	East Spray Fields (IHSS 216.2 and 216.3)
FY	fiscal year
HW	hazardous waste
IA	Industrial Area
IA-East	Industrial Area-East
IA-West	Industrial Area-West
IDM	Investigation-Derived Material
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
ITS	Interceptor Trench System
NEPA	National Environmental Policy Act
NSL	New Sanitary Landfill
PA	Protected Area
PAC	potential areas of concern
PCB	polychlorinated biphenyls
Pu	plutonium
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RWSF	Remediation Waste Storage Facility
SME	Subject Matter Expert
SE Quad	Southeast Quadrant
Site	Rocky Flats Environmental Technology Site
Site Vision	Rocky Flats Conceptual Vision
SW Quad	Southwest Quadrant
TSCA	Toxic Substance Control Act
WMF	waste management facility

EXECUTIVE SUMMARY

A Remediation Waste Storage facility (RWSF) has been envisioned to store remediation waste at the Rocky Flats Environmental Technology Site (Site). The objectives of this siting study are to identify and rank criteria to be used to select a location, develop a methodology for comparative analysis of different locations, and select location(s) that would be suitable for a RWSF within the boundaries of the Site, using the identified criteria and methodology for comparative analysis.

The location would be for a RWSF that accepts remediation wastes with low-level radioactive and/or hazardous constituents, but not preclude the shipment of remediation waste that can be more effectively and economically managed offsite. The facility would be designed and constructed to meet all of the applicable federal, state, and local regulatory requirements.

Seven onsite locations were identified and carried through the location selection process. The three locations in the Industrial Area (IA) are the IA-West, IA-East, and the area adjacent and to the east of the Solar Ponds. The four locations in the buffer zone are the New Sanitary Landfill (NSL), East Spray Fields (ESF), the Southeast Quadrant (SE Quad), and the Southwest Quadrant (SW Quad).

Six categories were considered in developing the comparative analysis. These criteria include regulatory requirements and guidelines that have been discussed during various stakeholder meetings regarding a RWSF at the Site. These criteria have been placed into six general categories, and further divided into 35 specific subdivisions.

The following general criteria categories, were assigned a weighting factor (%) totaling 100%:

Category 1, Corrective Action Management Unit (CAMU) Criteria - 20%

Category 2, Public Protection (Geotechnical and Hydrological Criteria) - 20%

Category 3, Site Special Issues - 15%

Category 4, Cost Criteria - 15%

Category 5, Regulatory Support - 15%

Category 6, Other Stakeholder Concerns - 15%

The following locations were evaluated against the criteria and given an overall ranking between 0 and 100%, with 100% being the most favorable location for the siting of a RWSF.

Solar Ponds location, IA	68.3%
IA-West location, IA	67.6%
New Sanitary Landfill, buffer zone	67.4%
SE Quad location, buffer zone	66.4%
ESF location, buffer zone	66.1%
SW Quad location, buffer zone	63.4%
IA-East location, IA	62.5%

Overall, the Solar Ponds location was ranked slightly higher than the IA-West location and the NSL as a place to locate a RWSF at the Site. The results of this study are detailed and summarized herein.

Category 1, CAMU, favored the IA locations, with the designation of the location as a CAMU. The ability to reduce the areal extent of contamination without contaminating clean areas weighed heavily in favor of the IA locations.

Category 2, Public Protection, ranked three of the buffer zone locations the highest. The primary concern with the locations in the IA is the elevated groundwater table, however, this concern is somewhat mitigated by the fact that all viable design alternatives envisioned are above-grade facilities.

Category 3, Site Special Issues, ranked the SE Quad location the highest, followed by the Solar Ponds, and ESF location. The three locations in the IA all received high ranking for the ability to support the Rocky Flats Conceptual Vision (Site Vision) in terms of future land use. However, the impacts of having to address issues related to existing infrastructures lowered the overall scores in this category. Extensive underground and overhead utilities are encountered within most of the IA, along with other building and waste storage facilities that would have to be removed or rerouted.

Category 4, Cost Criteria, favored the buffer zone locations. The major factor of the locations within the IA is the cost associated with removing, rerouting, or replacing building and underground and overhead utilities in the IA. The Solar Pond location has the additional burden of having to construct a portal through the Protected Area (PA) security fence, constructing a fence surrounding the location, and having a security staff available during construction and operation of the facility.

Category 5, Regulatory Support, showed support clearly in favor of a location in the IA. The Solar Ponds location was ranked highest followed by IA-East and IA-West.

Category 6, Other Stakeholder Concerns, ranked the IA locations the highest. The general public would more likely be receptive to placing environmental waste in areas that already contain some contamination rather than siting a RWSF in an area that has no history of contamination. Also, the

Jefferson County, Colorado Board of Commissioners are on record (Resolution No. CC94-654) for desiring to maintain the buffer zone around the IA as undeveloped open space.

C.1 OBJECTIVES

For this project, the reduction of environmental risk is dependent on the ability to disposition and manage remediation waste. As part of risk reduction at the Rocky Flats Environmental Technology Site (the Site), it is currently projected that there is 123,000 cubic yards [cy] (95,000 cubic meters [m^3]) of remediation waste to be excavated and appropriately managed. Approximately 9,000 cubic yds can be treated by thermal desorption treatment and returned to where it came from, leaving 114,000 cy that will need to be stored and managed See Table 3-1 Waste Identification and Volumes for a Remediation Waste Storage Facility, in the IM/IRA Decision Document for the RWSF for a break down of volumes by source and waste type. This waste will come from soils excavated from Individual Hazardous Substance Sites (IHSSs), accelerated actions, D&D waste and investigative derived waste (IDM). This waste consists of media with hazardous constituents or with mixed hazardous/low-level radioactive constituents. The waste streams will include, but are not limited to (approximate percentage of waste is in parentheses):

- Debris from decontamination and decommissioning activities (57%)
- Contaminated soil and debris collected from accelerated actions and hot spots removals - (30%)
- Pond sludge - (9%)
- Asphaltic materials and pondcrete - (less than 1%)
- Investigation-Derived Material (IDM) from characterization (not suitable for disposal in the sanitary landfill) from intrusive investigation activities - (less than 1%)
- Toxic Substance Control Act (TSCA) waste such as asbestos and polychlorinated biphenyls (PCBs) - (less than 1%)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions - (less than 1%)

To store this remediation waste, a RWSF has been proposed to be located within the boundaries of the Site. This task was undertaken to identify the optimal location for the facility. The three objectives of this task are to:

1. Identify and rank criteria to be used for location selection.
2. Develop a methodology for comparative analysis of different locations.
3. Select a location large enough for construction of a facility that would have the capacity to accommodate 114,000 cy of environmental waste, using the identified criteria and methodology for comparative analysis.

C.2 COMPARATIVE ANALYSIS OF SITE LOCATIONS (ALTERNATIVES)

C.2.1 SCREENING CRITERIA DEFINED

The location must accommodate a facility that would accept for storage, remediation waste with low-level radioactive and/or hazardous constituents. The facility would be designed and constructed to substantively comply with all applicable federal, state, and local regulatory requirements.

A number of categories were considered in developing the location criteria matrix. The criteria included requirements and guidelines that have been discussed during various stakeholder meetings regarding RWSF at the Site. These criteria can be placed into six major categories: (1) Corrective Action Management Unit (CAMU) Criteria, adherence to the key points of this category is fundamental if the RWSF is to designated a CAMU, (2) Public Protection, this geological and geotechnical criteria is being considered and would be relevant and appropriate if at some later date, the decision is made to close the RWSF in-place, (3) Site Special Issues, these are issues that are unique to RFETS that require consideration in the selection of a location for a RWSF, (4) Cost Criteria, (5) Regulatory Support, and (6) Other Stakeholder Concerns which generally deals with community acceptance. Each of these categories is further divided into specific issues. These categories and specific issues are discussed in the following subsections.

C.2.1.1 Category 1: Corrective Action Management Unit (CAMU) Criteria

Category 1, CAMU, focuses on the designation of the RWSF as a CAMU, per 6 CCR 1007-3, 264.522 (c), and is a critical factor in locating the facility at the Site, with the following key points:

1. The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies.

2. Waste management activities associated with the CAMU shall not create unacceptable risks to humans or the environment resulting from exposures to hazardous waste or hazardous constituents.

3. The CAMU shall include uncontaminated areas of the facility only if the inclusion of such areas for the purpose of managing remediation waste is more protective than management of wastes at contaminated areas of the facility.

4. The following key point of the CAMU regulation is not applicable to this siting study because there will be no waste left in place. Areas within the CAMU where remediation wastes remain in place after closure of the CAMU shall be managed and contained to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment.

5. The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 6 CCR 1007-3, 264.552(c)(1) or (c)(2).

6. The following key point of the CAMU regulation is not applicable to this siting study because there will be no waste left in place. The CAMU shall minimize the land area of the facility upon which remediation wastes will remain in place after closure of the CAMU, unless to do so

would be inconsistent with 6 CCR 1007-3, 264.522 (c)(1) or (c)(2).

7. The CAMU shall enable the use, when appropriate, treatment technologies, including innovative technologies, to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remedial waste.

C.2.1.2 Category 2: Public Protection (Geotechnical and Hydrological Criteria)

Category 2, Public Protection, consists of geological, geotechnical and hydrological considerations to ensure the protection of the public, should the decision be made in the future to close the RWSF in-place. These considerations are summarized below:

1. The geological and hydrogeologic conditions of a location in which hazardous waste is to be stored should be such that reasonable assurance is provided that the wastes are isolated within the storage area away from pathways to the public.

2. Geomorphic conditions either will not vary significantly from the present state or will occur to a predictable degree, which can be accommodated in the facility design.

3. Structural related issues include slope and geotechnical stability.

4. The immediate area of the location should be in strata of minimal groundwater flow.

5. Geological strata combined with engineering barriers shall provide minimum permeability.

6. Siting consideration should include bedrock and surface integration including the nature and extent of bedrock material.

7. Siting consideration should include minimal relative presence of fractures or faults.

8. Consideration should be given to the relative depth to bedrock and groundwater, including seasonal fluctuations for groundwater.

9. The Site will not impact nor be impacted by surface water.

10. Relative distance to nearest discharge area shall include consideration of groundwater flow direction and travel time.

11. The terrain is such that good drainage exists for movement of precipitation away from the storage area, and such that water and wind erosion will be minimal.

C.2.1.3 Category 3: Site Special Issues

Category 3, Site Special Issues, supports the timely construction of a facility and integration with other Site programs, including the Site Vision to occur, and includes:

1. Support from the proposed CAMU of the Site Vision objectives.
2. Impacts from existing utility, sewer, process waste, or communications lines.
3. Impacts from security.
4. Impacts from plutonium (Pu) consolidation or residue stabilization activities.
5. Impacts from decommissioning activities.
6. Impacts from current RCRA units.
7. Impacts from mineral rights issues or other easements.
8. Ability to collocate additional RWSFs in the same vicinity

C.2.1.4 Category 4: Cost Criteria

Category 4, Cost Criteria, presents cost considerations assigned as two separate criteria:

1. Cost of engineering and construction of protective measures.

2. Cost of location preparation including building demolition, subsurface utility line removal and rerouting, access requirements, and power/facility requirements above the basic RWSF.

C.2.1.5 Category 5: Regulatory Support

Category 5, Regulatory Support, focuses on using the State principles for onsite waste management of contaminated materials, per the February 27, 1995 letter from Tom Looby (CDPHE) to Jack McGraw (EPA) and Mark Silverman (DOE). The following principles have been evaluated in this study to ensure consistency with EPA and CDHPE desires, but because the RWSF being proposed is for storage, not disposal, some of these criteria may not be appropriate for siting a storage facility.

1. The number of disposal locations must be minimized. "We (CDPHE) suggest one centralized location be chosen for consolidation of contaminated materials."

2. "Every effort should be made to locate a centralized disposal facility in an area of optimal geologic parameters preferably within or close to the Industrial Area (IA)."

3. "Any disposal facility must be designed and built as a state-of-the-art disposal facility that meets or exceeds all permitting and regulatory requirements. This includes (but not limited to) siting, design, long-term protection, and performance requirements."

4. "A permitted facility would provide DOE the greatest degree of future applicability and utility. The facility should be designated with the intent to permit under RCRA/CHWA."

5. "Any disposal location at RFETS should be located in areas that have limited future land use potential and will be controlled by DOE until the interred waste no longer presents a risk to human health or the environment."

C.2.1.6 Category 6: Other Stakeholder Concerns

Category 6, Other Stakeholder Concerns, lists the following stakeholder concerns that have been factored into the analysis, and include:

1. General public perception and acceptance

2. Municipal or County acceptance

3. Department of Energy (DOE) Orders

4. National Environmental Policy Act (NEPA)

C.2.2 METHODOLOGY

A weighting system (modified from Dawson, G. W. and Mercer, B.W., Hazardous Waste Management, 1986) was used to develop the ranking system.

First, a subjective weighting factor (%) was assigned to each of the six general categories of criteria, totaling 100%, as shown in Table C-1, Criteria Comparison.

Table C-1 Criteria Comparison

Category	Criteria	Weighting Factor (%)
1	Corrective Action Management Unit (CAMU) Criteria	20
2	Public Protection (Geotechnical and Hydrological Criteria)	20
3	Site Special Issues	15
4	Cost Criteria	15
5	Regulatory Support	15
6	Other Stakeholder Concerns	15
	Total	**100**

Second, each of the six general categories was divided into specific issues as shown in Table C-2, RWSF Location Criteria Detail, and each specific issue was subjectively assigned a value between 1 and 3, with 3 being more important, and 1 being less important criteria.

Third, each of the locations (e.g., Industrial Area-West [IA-West] and Industrial Area-East [IA-East]) was compared to the specific issue, as well as the relativity to one another, and a calculated value between 0 and 1 was determined; 1 would be very favorable, and a value of 0 would indicate a fatal flaw resulting in removing that location from further consideration for a RWSF, as shown in Table C-2.

This matrix form was developed showing location versus specific issues, as shown in Table C-2. This form was distributed to Subject Matter Experts (SMEs) for scoring. The scores were averaged, and average values were used to complete the ranking. If there was a major difference between SMEs, discussions were held to resolve those differences.

SITING CRITERIA				Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1
	Category 1, CAMU Criteria - Ability to designate as CAMU. Per 6 CCR 1007-3 264.552 (c)	20															
1	The CAMU shall facilitate the implementation of reliable, effective, protective, and cost effective remedies.		3	1.8	0.6	1.5	0.5	2.1	0.7	3.0	1	2.7	0.9	2.7	0.9	2.7	0.9
2	Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposures to HW or HW constituents.		3	2.4	0.8	2.4	0.8	2.4	0.8	2.1	0.7	2.1	0.7	2.1	0.7	2.1	0.7
3	The CAMU shall include uncontaminated areas of the facility, only if including such areas for the purposes of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.		2	1.4	0.7	1.4	0.7	1.6	0.8	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6
4	The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2).		3	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8
5	The CAMU shall enable the use when appropriate of treatment technologies to enhance long term effectiveness of remedial actions by reducing the toxicity, mobility or volume of remedial waste.		2	1.8	0.9	1.8	0.9	1.8	0.9	1.8	0.9	1.8	0.9	1.8	0.9	1.8	0.9
CAMU Criteria			13.0	9.8		9.5		10.3		10.5		10.2		10.2		10.2	

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	SITING CRITERIA			Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1
	Category 2, Public Protection - Geological, Geotechnical and Hydrological Criteria	20															
1	The geological and hydrological conditions of a site in which HW are to be stored should be such that there is reasonable assurance that the wastes are isolated within the storage area away from pathways to the public.		3	0.6	0.2	0.6	0.2	0.9	0.3	1.2	0.4	1.5	0.5	2.1	0.7	0.3	0.1
2	Geomorphic conditions either will not vary significantly from the present state or will occur to a predictable degree which can be accommodated in the facility design.		2	1.6	0.8	1.6	0.8	1.6	0.8	1.8	0.9	1.8	0.9	1.4	0.7	1.8	0.9
3	Structure related issues to include: Slope and geotechnical stability		3	2.7	0.9	2.7	0.9	2.7	0.9	2.7	0.9	2.7	0.9	2.4	0.8	2.7	0.9
4	The immediate area of the site is in strata of minimal groundwater flow.		3	0.9	0.3	0.9	0.3	0.9	0.3	0.9	0.3	0.6	0.2	1.5	0.5	0.9	0.3
5	Geological strata combined with engineering barriers shall provide a minimum permeability for aquifer protection.		3	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8
6	Bedrock/surface integration including the nature and extent of bedrock material.		2	1.6	0.8	1.2	0.6	1.2	0.6	1.8	0.9	1.4	0.7	2.0	1	1.8	0.9
7	Minimal relative presence of fractures or faults.		2	1.2	0.6	1.2	0.6	1.2	0.6	1.6	0.8	1.6	0.8	1.6	0.8	1.6	0.8
8	Relative depth to bedrock/groundwater including seasonal fluctuations for groundwater.		3	0.9	0.3	0.6	0.2	0.3	0.1	1.5	0.5	1.5	0.5	0.3	0.1	0.6	0.2
9	The site will not impact nor be impacted by surface water.		2	2.0	1	2.0	1	2.0	1	1.8	0.9	1.8	0.9	1.8	0.9	1.8	0.9
10	Relative distance to nearest discharge area to include consideration of groundwater flow direction and travel time.		3	0.6	0.2	0.6	0.2	0.6	0.2	0.9	0.3	0.6	0.2	1.5	0.5	0.6	0.2
11	The terrain is such that good drainage exists for movement of precipitation away from the storage area.		1	1.0	1	1.0	1	1.0	1	1.0	1	1.0	1	0.9	0.9	1.0	1
	Public Protection		27.0	15.5		14.8		14.8		17.6		16.9		17.9		15.5	

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SITING CRITERIA				Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1
	Category 3, Site Special Issues - Ability of the candidate site to provide a "footprint" that allows timely construction of a facility to occur. (schedule criteria)	15															
1	Ability of the site to support the Rocky Flats Conceptual Vision (Vision) objectives.		3	2.1	0.7	2.4	0.8	3.0	1	0.3	0.1	0.3	0.1	0.3	0.1	0.3	0.1
2	Impacts from existing utility, sewer, process waste, or communications lines.		2	1.2	0.6	0.4	0.2	0.8	0.4	1.8	0.9	1.6	0.8	2.0	1	2.0	1
3	Impacts from security.		1	0.9	0.9	0.9	0.9	0.4	0.4	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
4	Impacts from Pu consolidation or residue stabilization activities.		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
5	Impacts from D&D activities.		2	1.2	0.6	1.0	0.5	1.4	0.7	1.6	0.8	1.8	0.9	1.8	0.9	1.8	0.9
6	Impacts from current RCRA units.		2	1.8	0.9	0.4	0.2	1.4	0.7	2.0	1	2.0	1	2.0	1	2.0	1
7	Impacts from mineral rights issues or other easements.		2	1.2	0.6	1.8	0.9	1.8	0.9	0.8	0.4	1.8	0.9	2.0	1	1.2	0.6
8	Ability to co-locate additional waste management cells in the same vicinity.		2	1.6	0.8	1.2	0.6	1.6	0.8	2.0	1	2.0	1	2.0	1	1.6	0.8
	Site Special Issues		15.0	10.8		8.9		11.2		10.2		11.2		11.8		10.6	
	Category 4, Cost Criteria	15															
1	Cost of engineering and construction of protective measures.		3	2.1	0.7	1.5	0.5	1.5	0.5	2.4	0.8	2.1	0.7	2.1	0.7	2.1	0.7
2	Cost of site preparation including building demolition, subsurface line removal and re-routing, access requirements, and power/facility requirements		3	2.1	0.7	1.5	0.5	1.8	0.6	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8
	Cost Criteria		6	4.2		3.0		3.3		4.8		4.5		4.5		4.5	

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SITING CRITERIA				Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1
	Category 5, Regulatory Support State Principles for On-Site Disposal of Contaminated Materials (27-February-95 letter from Tom Looby to Jack McGraw and Mark Silverman)	15															
1	"The number of disposal sites must be *minimized. We (CDPHE) suggest one* centralized site be chosen for consolidation of contaminated materials."		2	1.6	0.8	1.4	0.7	1.8	0.9	1.4	0.7	1.2	0.6	1.2	0.6	1.2	0.6
2	"Every effort should be made to site a centralized disposal facility in an area of optimal geologic parameters preferably within, or close to the IA."		3	2.1	0.7	2.1	0.7	2.1	0.7	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6
3	"Any disposal facility must be designed and built as a state of the art disposal facility that meets or exceeds all permitting and regulatory requirements. This includes siting, design, long term protection, and performance requirements."		3	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6
4	'A permitted facility would provide DOE the greatest degree of future applicability and utility. ....the facility should be designed with the intent to permit under RCRA/CHWA"		2	1.6	0.8	1.6	0.8	1.6	0.8	1.6	0.8	1.6	0.8	1.6	0.8	1.6	0.8
5	"Any disposal site at RFETS should be located in areas that have limited future land use potential and will be controlled by DOE until the interred waste no longer presents a risk to human health or the environment."		3	1.5	0.5	2.1	0.7	2.7	0.9	1.2	0.4	1.2	0.4	0.9	0.3	0.9	0.3
Regulatory Support			13.0	8.6		9.0		10.0		7.8		7.6		7.3		7.3	

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SITING CRITERIA				Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1
	Category 6, Other Stakeholder Concerns	15															
1	General public perception/acceptance		2	1.4	0.7	1.4	0.7	1.6	0.8	0.8	0.4	0.6	0.3	0.4	0.2	0.4	0.2
2	Municipal or County acceptance.		2	1.2	0.6	1.4	0.7	1.4	0.7	0.4	0.2	0.4	0.2	0.2	0.1	0.2	0.1
3	DOE Orders		2	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6
4	NEPA		3	2.1	0.7	2.1	0.7	2.1	0.7	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6
	Other Stakeholder Concerns		9.0	5.9		6.1		6.3		4.2		4.0		3.6		3.6	

Evaluate the seven locations (e.g., IA-East, IA-West) against the specific issues (for location, see Figure 1). The evaluation of the seven locations against Category 2 was accomplished with a series of maps displaying geologic, geomorphology, and hydrogeologic conditions (see Figures 2 through 7).

1. Evaluate and assign a number between 0-1 for each location on the matrix (e.g., IA-West, IA-East) against each specific issue with 0 being a fatal flaw that would preclude the location from being selected to 1 being the most favorable circumstance for that criteria (see Table C-2 for assigned numbers).

2. Multiply the score assigned to the specific issue in step 1 above (0 to 1) by the value assigned to the specific issue (between 1 and 3).

3. Sum the above products within each of the specific issues, as shown in Table C-2. There is a total of 35 specific issues illustrated in Table C-3, Criteria Issues:

Table C-3 Criteria Issues

Category	Criteria	Issues
1	Corrective Action Management Unit (CAMU) Criteria	5
2	Public Protection (Geotechnical and Hydrological Criteria)	11
3	Site Special Issues	8
4	Cost Criteria	2
5	Regulatory Support	5
6	Other Stakeholder Concerns	4
	Total	**35**

4. Divide the above sums by the total points and multiply by the weighting factor of that category, which in all cases is either 15 or 20%. The total available points assigned are 83, and are distributed as illustrated in Table C-4, Criteria Points.

Table C-4 Criteria Points

Category	Name	Points
1	Corrective Action Unit (CAMU) Criteria	13
2	Public Protection (Geotechnical and Hydrological Criteria)	27
3	Site Special Issues	15
4	Cost Criteria	6
5	Regulatory Support	13
6	Other Stakeholder Concerns	9
	Total	**83**

5. Sum the weighting factor of the six categories for the final ranking of the location. The overall ranking is summarized in Table C-5, RWSF Location Criteria Summary.

Each location was thus given an overall ranking between 0 and a 100%, with 100% being the most favorable location for the siting of a RWSF.

C.2.3 SCREENING PROCESS

A basic assumption made was that the entire Site as shown in Figure 1 would be included in the siting study. Category 2 includes the geologic, hydrogeologic, and geomorphologic aspects of the siting study. A series of maps were produced to assist in this evaluation. Additionally a map addressing ecology issues was included because these issues are best illustrated on a map. The seven maps produced were:

- Figure 1, Site Location Map, shows the location of building, roads, and the seven locations carried through in this evaluation.
- Figure 2, Hydrogeological Conditions, includes the depth to the water table and the area encompassed by 100-year flood plain.

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Table C-5 RWSF Siting Criteria Summary

SITING CRITERIA				Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Partial %	Points Scored	Partial %	Points Scored	Partial %	Points Scored	Partial %	Points Scored	Partial %	Points Scored	Partial %	Points Scored	Partial %	Points Scored
1	CAMU CRITERIA	20	13.0	15.1	9.8	14.6	9.5	15.8	10.3	16.2	10.5	15.7	10.2	15.7	10.2	15.7	10.2
2	PUBLIC PROTECTION	20	27.0	11.5	15.5	11.0	14.8	11.0	14.8	13.0	17.6	12.5	16.9	13.3	17.9	11.5	15.5
3	SITE SPECIAL ISSUES	15	15.0	10.8	10.8	8.9	8.9	11.2	11.2	10.2	10.2	11.2	11.2	11.8	11.8	10.6	10.6
4	COST CRITERIA	15	6.0	10.5	4.2	7.5	3.0	8.3	3.3	12.0	4.8	11.3	4.5	11.3	4.5	11.3	4.5
5	REGULATORY SUPPORT	15	13.0	9.9	8.6	10.4	9.0	11.5	10.0	9.0	7.8	8.8	7.6	8.4	7.3	8.4	7.3
6	OTHER STAKEHOLDER CONCERNS	15	9.0	9.8	5.9	10.2	6.1	10.5	6.3	7.0	4.2	6.7	4.0	6.0	3.6	6.0	3.6
	TOTALS	100%	83.0	67.6%	54.8	62.5%	51.3	68.3%	55.9	67.4%	55.1	66.1%	54.4	66.4%	55.3	63.4%	51.7

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- Figure 3, Geological and Geotechnical Conditions, includes steep, color-coded slope areas for slopes 15-20%, 20-30%, and greater than 30% and inferred faults traces.

- Figure 4, Structure Base of Alluvium, drawn on the base of the alluvium (top of bedrock).

- Figure 5, Thickness of Alluvium, show the thickness of the Rocky Flats Alluvium.

- Figure 6, Ecology and NEPA, shows the location of seeps, wetlands, and Preble's Meadow Jumping Mouse probable habitat, a wildlife species that is being considered for listing as a species of concern, or a threatened and endangered species.

- Figures 2, 3, and 6 were combined into Figure 7, Adverse (for a RWSF location) Conditions, which delineates three of the major potentially limiting criteria, the 100-year floodplain, steep slopes and the location of wetlands, seeps, and the Preble's Meadow Jumping Mouse habitat. Areas highlighted on this map have been removed from future consideration in this siting study because the presence of one or more of these aspects presents a major obstacle for locating a RWSF.

This initial screening of the Site reduced the number of locations being addressed. Seven locations are being carried forward in this study, four in the buffer zone and three located within the IA of the Site, as shown in Figure 1.

The four areas in the buffer zone are:

- The New Sanitary Landfill (NSL)

- An area near the East Spray Fields (ESF)

- An area in the Southwest Quadrant (SW Quad) of the buffer zone

- An area in the Southeast Quadrant (SE Quad) of the buffer zone

The three areas in the IA are:

- An area on the west side of the Industrial Area - (IA-West)

- An area on the southeast side of the Industrial Area - (IA-East)

- An area including the Solar Ponds 207B (North, Central, and South) and the land immediately adjacent and to the east (IHSS 165 and IHSS 176)

These seven locations are then carried on through the study and evaluated against the six general criteria categories. The scored matrix of location versus criteria and the values associated with the different combinations are shown in Table C-2.

C.2.4 ANALYSIS

The summary of the criteria evaluation is presented in Table C-5.

C.2.4.1 Corrective Action Management Unit (CAMU) Criteria

"The CAMU will facilitate the implementation of a reliable, effective, protective, and cost-effective remedy."

- A reliable, effective, and protective facility can be engineered at any of the locations being considered. The cost-effective component of this criteria ranges significantly from location to location, and is partially dependent on the RWSF design alternative selected. Locating any of the design alternatives within the IA is less cost-effective because of the infrastructure currently in place that would have to be removed, rebuilt at another location, or rerouted, such as with buried and overhead utilities.

- IA-West, IA-East, and Solar Ponds, all located within the IA, would be the less cost-effective options.

- NSL, ESF, SE Quad, and SW Quad locations located in the buffer zone would be the more cost-effective options.

"Remediation waste management activities associated with CAMU cannot create unacceptable risks to human health or the environment from exposure to hazardous waste or hazardous constituents."

- A slight advantage would be to the locations within the IA in terms of transporting waste. Most of the waste that is being targeted for the RWSF is originating in the IA, and haul distances would be less to a facility in the IA then outside the IA.

The CAMU will include uncontaminated areas of the facility, only if including such areas for the purpose of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.

- NSL, SW Quad, and SE Quad locations are not in IHSSs or potential areas of concern (PAC). The designation of a CAMU to any of these locations would not be more protective than construction of the same facility within the IA on an IHSS.

- IA-West and IA-East locations are not within IHSSs or PACs, however, they are located in the IA, adjacent to either known contamination; adjacent or within areas of the location that have been subject to significant industrial uses, such as office buildings, waste storage buildings, production buildings, parking lots, paved roads, and buried and overhead utilities.

- The Solar Ponds and ESF are located within areas that have, in part, been designated IHSSs. The Solar Ponds location overlaps the Triangle Area, IHSS 165; the Contractor Storage Yard, IHSS 176; and the Solar Ponds, IHSS 207B. Managing remediation waste in this area has the advantage of managing waste in a secure area and reducing the size of the overall footprint of contamination at the Site.

- The ESF location overlaps IHSSs 216.2 and 216.3; however, these IHSSs have been identified as having no risk associated with them and have been recommended to go to no further action (NFA).

The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 6 CCR 1007-3, 264.552(c)(1) or (c)(2).

- The timing of remedial activity implementation is more dependent on the RWSF design alternative selected and the permitting process than on the location selected. This criteria is approximately the same for all locations being considered.

The CAMU shall enable the use, "as appropriate, treatment technologies (including innovative technologies) to enhance long-term effectiveness of remedial actions at the facility by reducing the toxicity, mobility, or volume of wastes that will remain in place after closure."

- The ability of the CAMU to use these treatment technologies, when appropriate, is more or less independent on the location selected, and is approximately the same for all locations in the study.

C.2.4.2 Public Protection (Geotechnical and Hydrological Criteria)

The geological and hydrogeologic conditions of a location in which hazardous waste is stored should provide reasonable assurance that the wastes are isolated within the storage area away from pathways to the public.

- Hydraulic conductivities of foundation soil materials (Rocky Flats Alluvium) typically occur in the 10^{-3} to 10^{-5} cm/sec range. Lower hydraulic conductivity values in the range of 10^{-6} to 10^{-7} cm/sec have been measured for the underlying weathered claystone bedrock. All of the locations are located in recharge areas associated with the Rocky Flats Alluvium and colluvial deposits, and many are located near discharge areas. The depth to the Fox Hills aquifer is greater than 500 feet over most of the Site and this interval consists mainly of low permeability claystones with hydraulic conductivities in the range of 10^{-6} to 10^{-7} cm/sec.

- The estimates of lateral groundwater flow travel times in the underlying surficial materials from the proposed waste locations to their nearest discharge points are well below a 1,000 years for all of the locations under consideration. The calculated travel times typically range from several years to several decades. The presence of significant groundwater discharge points (springs and seeps) in hydraulically downgradient areas of the SW Quad (Antelope Springs), NSL (Lindsey Ranch Springs), and potentially the ESF location, tend to reduce the suitability of these locations because of the potential ecological impacts associated with sensitive habitats issues. The location least affected by short groundwater travel times is the SW Quad location because groundwater is assumed to flow through bedrock materials (hydraulic conductivities 10^{-6}-10^{-7} cm/sec) rather than the more permeable alluvium.

- Water losses from location operations via leaking pipes and general housekeeping practices are currently believed to contribute an unknown but potentially significant amount of recharge to the groundwater in the Site IA. It is expected that the elimination of anthropogenic recharge sources related to cessation of location operations and building closures under the Site Vision will result in a lowering of water levels in the IA similar to that observed in many IA well hydrographs following the termination of plant production operations in 1990.

Geomorphic conditions either will not vary significantly from the present state or will occur to a predictable degree which can be accommodated in the facility design.

- This is not a major factor in the overall siting study; all locations have approximately the same geomorphic conditions with the degree of erosion occurring at a predictable rate and can be accommodated in the facility design. The SE Quad location is rated lower in this category because the protective cover of the Rocky Flats Alluvium has been removed by erosion and escarpment retreat.

Structural related issues include slope and geotechnical stability, as shown in Figures 3 and 7.

- Areas with steep slopes (slopes greater than 15%) have been eliminated from the siting study. There is a steep slope to the north of the Solar Ponds location; however, the footprint to the facility would be positioned as far south of the slope as the design would allow and is not considered to be a limiting siting factor. Geotechnical stability of foundation soils is not expected to be a problem at any of the locations. This consideration will be addressed by a field geotechnical investigation performed at the selected location during the feasibility assessment phase of the program.

The immediate area of the location should be in strata of minimal groundwater flow.

- All of the locations have minimal groundwater flow, however, the SE Quad location is situated in an area considered more suitable compared to the other locations. At the SE Quad location, the RWSF would be built on weathered bedrock materials that have a significantly lower permeability than either the surrounding thin, colluvial soil veneer or Rocky Flats Alluvium.

Geological strata combined with engineering barriers shall provide a minimum permeability.

- The design of the facility at any of the candidate locations would incorporate an engineered barrier that would provide a minimum permeability of 10^{-7} cm/sec for protection of domestic or agriculture aquifers. Additional protection of the regionally important Laramie/Fox Hills aquifer is provided by several hundred feet of intervening, low permeability claystone aquitard materials comprising the upper Laramie and Arapahoe formations. Downward migration from the unconfined aquifer is thought to be nonexistent based on existing data (EG&G, 1995a).

Siting consideration should include bedrock and surface integration including the nature and extent of bedrock material.

- The upper Laramie Formation is an extensive (maximum thickness beneath the Site is greater than 500 feet) aquitard beneath all locations under consideration and forms an effective and continuous low-permeability barrier to downward vertical groundwater flow. Local variations in shallow bedrock lithology caused by the presence of small discontinuous bodies of subcropping Arapahoe formation sandstones are observed in the IA, notably at the Solar Ponds and IA-East locations. These sandstones are capable of both vertical and lateral groundwater transport, but vertical flow to deeper sandstones and the Laramie/Fox Hills aquifer is thought to be nonexistent. Sites with thinly saturated alluvium and subcropping sandstones, such as are found at the Solar Ponds and IA-East areas, have the greatest potential for groundwater interchange between alluvial and bedrock units. However, the sandstones from the Arapahoe and Laramie formations are discontinuous and isolated, with fewer sandstone lens present in the lower part of the formation.

Siting consideration should include minimal relative presence of fractures or faults.

- Bedrock fracturing is potentially important in areas of thinly saturated alluvium (Solar Ponds, ESF, and IA-East locations), where a significant portion of alluvial groundwater may recharge the bedrock, or at the SE Quad location, where liner materials would be in direct contact with bedrock. Groundwater flow in fractured claystone bedrock is thought to be minimal because of limited fracture densities and small fracture apertures observed in core samples across the location. Fracture densities are observed to decrease with depth.

- The inferred bedrock faults at the Site, as shown in Figures 3 and 4, are not considered to pose a seismic risk (EG&G, 1995b), according to the Nuclear Regulatory Commission (10 CFR Part 100, Appendix A) definition (NRC, 1990 and 1991), because the Rocky Flats Alluvium is not deformed over the intensely fractured areas of the Laramie Formation at the Site.

  - Solar Ponds and IA-East. There is an inferred north-to-south orientated bedrock fault through the Solar Ponds that continues south through the IA-East location (EG&G 1995a). The inferred fault appears to be located hydraulically upgradient from the Solar Ponds location which would remove it as a potential groundwater pathway. The trace of this inferred fault also bisects the IA-East location from north to south.

  - IA-West. There is an inferred northeast-to-southwest trending bedrock fault through the IA-West location. This fault is located hydraulically downgradient from the IA-West location and represents a potential groundwater pathway to deeper sections of the Laramie Formation.

- ESF. There is an inferred northeast-to-southwest bedrock fault trending fault through the ESF location. The fault is located hydraulically upgradient from the location and removes it as a potential groundwater pathway.

- NSL, SE Quad, and SW Quad. There are no mapped or inferred faults in these areas.

- A preliminary evaluation of potential vertical groundwater movement along fault zones at the Site using environmental isotopes as hydrologic tracers has indicated that fault zones probably transmit little, if any, groundwater preferentially downward relative to flow in undisturbed, unweathered bedrock zones (memorandum to A. Primrose from R. Smith dated November 22, 1995).

Consideration should be given to the relative depth to bedrock/groundwater, including seasonal fluctuations for groundwater.

- Bedrock depths range from less than an estimated 5 feet at the SE Quad location to over 40 feet at the NSL, ESF, and SW Quad locations. Saturated alluvial thicknesses at the candidate locations vary as a function of distance from drainages, configuration of bedrock topography, and seasonal recharge. Generally, saturated thicknesses are greatest in the spring (April, May, and June) and may fluctuate anywhere from a few feet to as much as 20 feet depending on local hydrologic and seasonal recharge conditions.

- Precipitation for the spring of 1995 has been estimated to be the greatest in a 102-year period based on precipitation records from Boulder, Colorado. Seasonally high water tables, in some cases within a foot of ground level, were measured or estimated at many of the locations in 1995. The locations with the deepest water tables (seasonal peaks greater than 10 feet below ground level) include ESF and the NSL.

- IA-West, IA-East, and Solar Ponds. As shown in Figure 2, the average water table in the IA is +/- 10 feet from the surface (Ref.: EG&G, Hydrogeologic Characterization Report for the Rocky Flats Environmental Technology Site, April 1995). At the IA-West location, the minimum depth to groundwater (historical highs) was recorded or estimated during 1995 and ranged from 0.0 to 8.7 feet below ground level in the six monitoring wells in and around the location. In this same timeframe at the Solar Ponds location, the depth to groundwater ranged from 1.0 to 4.8 feet. Well coverage at the IA-East location is less extensive compared to the other IA locations, and it is assumed that water-level conditions were similarly shallow based on historical water-level records and location-specific hydrologic conditions.

  - NSL. The concerns related to water table depth at the NSL are less than those associated with the IA. The minimum depth to groundwater at the NSL location was measured at 26 feet (well 0190) in 1995, which makes this the most favorable location in terms of the seasonal fluctuation criteria. The water table typically occurs in the 30- to 50-foot below grade range under normal (nonpeak) hydrologic conditions.

  - ESF. Water level records of four wells at the ESF location indicate that the minimum depth to water expected in this area is about 20 feet with an average depth of between 25 to 30 feet. The alluvium at this location generally has a saturated thickness of less than 5 feet, with

significant unsaturated areas occurring during seasonal watertable lows.

- SE Quad. There is a paucity of water-level data in this area because of the lack of monitoring well coverage. The majority of the surficial deposits in this area most likely exist in a largely unsaturated condition. A shallow water table in the underlying weathered bedrock material, however, may exist and cannot be ruled out without more information.

- SW Quad. Depth to groundwater at the SW Quad location is 0 to 20 feet with a saturated thickness of between 30 and 40 feet. Groundwater in this area becomes more shallow in an eastward direction toward Antelope Springs, as indicated by monitoring well data. The minimum water-table depth in areas west of Antelope Springs is estimated to be less than 5 feet.

The site will not impact nor be impacted by surface water

- None of the locations are located in areas that will be impacted by surface water. The locations are not expected to have a significant impact on surface water, although slight reductions in flow at nearby springs and seeps may be experienced because of a loss of recharge area. This situation might exist at the SW Quad, NSL, and ESF locations where free-flowing springs contribute directly to stream flow.

Relative distance to the nearest discharge area should include consideration of groundwater flow direction and travel time.

- The relative distance to the nearest discharge areas is relatively short for most of the locations being considered.

  - IA-West and IA-East. These locations lie astride the subsurface drainage divide between the ephemeral Woman and Walnut Creeks. The nearest point of discharge are the seeps that are expressed near the base of the alluvium on the south-facing slopes of the Woman Creek Drainage. These wetlands areas are approximately 250 feet south of the IA-West location. Groundwater flow from the IA-East location south of the drainage divide would flow toward Woman Creek but is captured by the French Drain along the 881 Hillside.

  - Solar Ponds. This location lies astride the subsurface drainage divide between the North and South Walnut Creeks. The Interceptor Trench System (ITS) adjacent to, and north of, the Solar Ponds captures part of the groundwater flow to the north. The flow to the north not captured by ITS moves toward South Walnut Creek and eventually enters the groundwater system associated with this drainage. The nearest point of discharge to South Walnut Creek is approximately 250 feet south of the Solar Ponds location.

  - NSL. This location lies astride the subsurface drainage divide between the ephemeral Rock Creek to the north and North Walnut Creek to the south. Surface expressions of groundwater in the forms of seeps are evident along the base of the alluvium in the Rock Creek Drainage about 1500 feet to the northeast. On the south side of the drainage divide the nearest discharge to surface water would be about 500 feet south to the upper reaches of North Walnut Creek.

- ESF. This location lies on the subsurface drainage divide between Woman and Walnut Creeks. The part of this candidate area that lies on the Woman Creek side of the watershed is unsaturated, which would indicate that groundwater from this location in all likelihood does not flow into Woman Creek. The part of the location on the Walnut Creek side of the location discharges into a series of seeps located 200 to 1000 feet north of the location (depending on the location of the facility) at the base of the alluvium that discharges through surface flow into Walnut Creek.

- SW Quad. The direction of flow of the groundwater from this location is to the northeast and discharges into Antelope Springs, which is adjacent to the location. The location is within the Woman Creek drainage basin.

- SE Quad. This candidate location is located on the north side of the Woman Creek drainage. Subsurface data are sparse in this area but the area is not located on the Rocky Flats Alluvium. The surficial geology of this location is weathered claystones, siltstones, and sandstones of the Arapahoe and the underlying Laramie Formations (EG&G, 1995a). The location potentially has no saturated unconsolidated surficial deposits.

The terrain is such that good drainage exists for movement of precipitation away from the storage area, and such that water and wind erosion will be minimal.

- This criteria is essentially the same for all locations, either good drainage already exists or a drainage system can be engineered to accommodate the needs of this requirement. The SW Quad has a slightly poorer drainage system developed than the other locations.

C.2.4.3 Site Special Issues

The ability of the location to support the Site Vision objectives: Under the Site Vision, all nuclear materials will be removed from the Site and the DOE will remediate the Site in a manner consistent with future projected land (see Figure 8, Conceptual Site Land Uses) and water uses.

- The future land use of the buffer zone varies from unrestricted to restricted open space, whereas the IA is projected as either an industrial use area or as a capped area.

  - Solar Ponds would be an ideal candidate to support the Site Vision, because of the future land use of the IA and its location within the footprint of the capped area.

  - IA-East and IA-West could, with extensive modification to the footprint of the capped area, could support the RFCA. The IA-West location is in a noncontaminated area in the IA. The design of the capped area would have to be extensively altered.

  - The candidate locations, NSL, ESF, SW Quad, and SE Quad, do not support the Site Vision because utilization of these locations would involve placing contamination in previously uncontaminated areas.

- Impacts from existing utility, sewer, process waste, or communications line:

  - IA-West, IA-East, and Solar Ponds. The three locations within the IA all have significant amounts of utility lines, sewer lines, and other infrastructure as listed in Table C-6, In-place Infrastructure, either buried or above ground that would require removal or replacement. Impacts would also include demolition of buildings within the footprint, provide the storage of RCRA waste currently located in buildings at these locations (IA-East and the Solar Ponds), and construction of a portal and security fence for the Solar Ponds location. The order-of-magnitude costs generated for the preparation of a location are in Table C-7.

Table C-6 In-place Infrastructure

Location	Area	Infrastructure
New Sanitary Landfill	Underground	Telephone main Electrical - 208V Water Line - 3@ (abandoned)
	Overhead	Electrical Utilities - 208V
	Miscellaneous	Live Firing Range - Range Fan Area
	Buildings	None
Solar Ponds	Underground	Process Waste Lines - 3" and 8" Raw Water Lines - 4." 6" and 8" Domestic Cold Water - 4" Sewer Lines - 4", 8" and 12" Process Drains - 3", 6" and 8" Water Valves Culverts Telephone Lines
	Overhead	Electrical Utilities - 110V, 440V, 480V and Helicopter Deterrent Power Poles
	Buildings[1]	228A, 228B, 910, 928, 964, 965, 967, and 990
IA-East	Underground	Electrical Utilities - 480V and 13.8kV Water Pipelines - 3", 6", and 10" Steam - 6" and 8" Gas Lines - 3" Sewer Lines - 4" and 12" Telephone Lines Foundation Drains Tunnel Culverts Alarms and Data Systems Storm Drains Vaults
	Overhead	Electrical - 2400V and 13.8kV Alarms Steam and Condensate Natural Gas
	Buildings	T886B, T886C, T893B, 902 Tent, 906, and ER Contractor Yard
IA-West	Underground	Electrical Utilities - 15V, 110V, 120V, 120/240V, 277V, 2400V, and 13.8kV Domestic Cold Water Pipelines - 4", 6", and Raw Water Pipelines - 2", 4", and 12" Water Valves Culverts - 12", 18", and 20" Alarms - 1", 2" and 4" Sewer Lines - 4" and 8" Catch Basins Storm Drains - 15" Scanner
	Overhead	Electrical - 480V, 2400V, 13.8kV and Parking
	Buildings	T124A

(1) Only Building 964 will need to be removed if any design alternative other than the Abovegrade Landfill is the preferred alternative.

Table C-7 Order-of-Magnitude Costs for Site Preparation

Location	Construction Cost
IA-East	$14,800,000
Solar Pond	$11,900,000
IA-West	$2,200,000
NSL	$100,000

- Costs were not generated for the ESF, SW Quad, or the SE Quad locations. The preparation for these areas would fall between the costs of the IA-West and NSL.

- Impacts from security:

  - Security impacts would be approximately the same for all locations, except for the Solar Ponds where an access portal would be needed to allow for construction materials and workers to enter the PA, a perimeter fence to isolate the discharge to surface water would be about 500 feet south to the upper reaches of RWSF during both construction and postconstruction activities, and a security staff during construction activities. The cost of the portal, fence, and security staff has been calculated as part of the preparation cost.

- Impacts from Pu consolidation or residue stabilization activities:

  - Impacts from Pu consolidation or residue stabilization activities are not a factor for the siting of a RWSF.

- Impacts from deactivation and decontamination (D&D) activities:

  - IA-West. Building T124A, is located within the footprint and staging area (22 acres) of the abovegrade RWSF landfill, and would require demolition if this design option was selected. This building is currently scheduled for removal in fiscal year (FY) 2000, but that could easily be accelerated if the location were selected. The other design alternatives for this location all have smaller footprint and staging areas (approximately 10 to 12 acres) and would not require demolition of this building.

  - IA-East. There are several building and the contractor yard that would be impacted from siting the RWSF at IA-East. Building 906, the centralized waste storage facility, is the newest building at the Site and was specifically built for waste storage. The decommissioning of this facility has not been scheduled and the current working assumption is that it will remain at least for the near term. The 902 Pad facility is a tent and the possibility exists to move it to another location without losing storage capacity. The contractor yard has a number of trailers and government- and contractor-owned stored equipment. The decommissioning of this area has not yet been scheduled and the working assumption is that it would remain open beyond 2003.

- Solar Ponds. Building 964 is located within the footprint of all of the RWSF alternatives. It is a sheet metal building used as a RCRA storage facility. Demolition of the structure is straight forward and could be completed in 90 days assuming additional waste storage capacity becomes available. If the above-grade landfill alternative is selected the footprint would be larger and also require the demolition of Buildings 228A, 228B, 928, 965, 910, and 990.

- NSL, ESF, SW Quad, and SE Quad. There are no buildings associated with these candidates locations.

- Impacts from current RCRA units:

  - IA-East. Building 906, the centralized waste storage facility, is a RCRA storage facility. The decommissioning of this facility has not been scheduled and the current working assumption is that it will remain until no longer required.

  - Solar Ponds. Building 964 is a RCRA storage facility located within the footprint of the RWSF. Alternative storage capacity would have to be created before demolition of this structure.

  - IA-West, NSL, ESF, SW Quad, and SE Quad. There are no RCRA storage units located at these candidate locations.

- Impacts from mineral rights issues or other easements:

  - All mineral rights at the Site are either privately held or as with the NSL location, it is both privately and governmentally held (see Figure 9, Mineral Ownership). Alluvial thicknesses greater than 40 feet are potentially economic for the gravel resources.

  - NSL and SW Quad. Both locations have alluvial thicknesses greater than 40 feet.

  - IA-West. Alluvial thicknesses are 25 to 40 feet thick and do not constitute an economic resource.

  - ESF. Alluvial thicknesses are 10-30 feet thick and do not constitute an economic resource.

  - IA-East and Solar Ponds. Alluvial thicknesses are +/-10 feet thick and do not constitute an economic resource.

  - SE Quad. Located off the Rocky Flats Alluvium, there are no gravel deposits at this location.

- Ability to collocate additional RWSFs in the same vicinity:

  - IA-West, NSL, ESF, SW Quad, and SE Quad. All have adequate space to location

additional RWSF cells if needed.

- Solar Ponds. The footprint shown can accommodate approximately 300,000 cy.

- The area around IA-East is restricted, with the 800 complex to the west, steep slopes to the south, and the security fence surrounding the PA to the north. Room for expansion would potentially be available to the east.

C.2.4.4 Cost Criteria

- The cost of engineering and construction of protective measures:

  - The cost of engineering and construction varies with the RWSF alternative selected. The cost of construction at the Solar Ponds would be greater than at other locations, because of the additional requirements imposed by having to construct a materials and worker portal through the security fence into the PA, and the additional security that would be required.

- Cost of preparation of the location including building demolition, subsurface line removal and rerouting, access requirements and power/facility requirements above the basic RWSF:

  - The cost of preparation varies by location. The cost of preparation at the NSL location is in the area of $100,000. The preparation for the NSL location already under construction has mitigated the costs that would otherwise be associated with a RWSF at this location.

  - ESF, SW Quad, and SE Quad would require construction or upgrades to the roads leading to the locations; costs are estimated to be more than the NSL location ($100,000) but less than the costs of the IA-West location ($2.2 to $2.8 million).
  - The locations within the IA, IA-West, IA-East, and Solar Ponds have considerable costs associated with preparation including building demolitions, subsurface line removal and rerouting access requirement. Costs associated for preparation range in order of magnitude from approximately $2.2 to $2.8 million for IA-West, $6.1 to $14.5 million for the Solar Ponds, and $15.2 to $18.1 million for IA-East.

C.2.4.5 Regulatory Support

"The number of disposal sites must be minimized. We (CDPHE) suggest one centralized site be chosen for consolidation of contaminated materials." The following concepts have been evaluated in this study to ensure consistency with EPA and CDHPE desires, but because the RWSF being proposed is for storage, not disposal, some of these criteria may not be appropriate for siting a storage facility.

- Locating the RWSF at the Solar Ponds location minimizes the number of locations by locating the facility in an area that coincides with, and would ultimately be incorporated into, the larger cap, and is a component of the Site Vision. The IA-West and the IA-East locations could, with

major revisions, support the Site Vision.

- The NSL, ESF, SE Quad, and the SW Quad locations would increase the overall areal extent of contamination by their location that is further away from the IA. The IA is where the bulk of the environmental waste at the Site is located.

"Every effort should be made to site a centralized disposal facility in an area of optimal geologic parameters preferably within or close to the Industrial Area (IA)."

- Optimal geological parameters at the Site reside in the locations outside of the IA. The NSL, ESF, and the SE Quad are preferred locations from an optimal geologic standpoint relative to the IA. However, all three locations are at a distance from the IA; the NSL is 2,000 feet northwest; ESF is 4,000 feet to the east; and the SE Quad is approximately 6,000 feet to the southeast of the PA.

- Optimal geological parameters do not exist within the IA, as discussed in Section 2.4.1, IA-West, IA-East, and the Solar Ponds are all within the IA.

"Any disposal facility must be designed and built as a state-of-the-art disposal facility that meets or exceeds all permitting and regulatory requirements. This includes (but not limited to) siting, design, long-term protection, and performance requirements."

- The alternatives considered will be built as a state-of-the-art storage facility and will meet or exceed all permitting and regulatory requirements. This criteria is the same for all locations being considered.

"A permitted facility would provide DOE the greatest degree of future applicability and utility. The facility should be designated with the intent to permit under RCRA/CHWA."

- This criteria is the same for all locations being considered.

C.2.4.6 Other Stakeholder Concerns

- General public perception and acceptance:

  - For onsite management of remediation waste, the locations within the IA, IA-West, IA-East and the Solar Ponds would in all likelihood be more readily acceptable to the general public than storage in the buffer zone. The locations in the IA reduce the footprint of contamination at the Site, and other than offsite disposal, storage of the environmental waste in the IA may well be the most acceptable alternative to the general public. Also, the Interim Measure/Interim Remedial Action (IM/IRA) for closure in place of Solar Ponds has already been accepted by the public.

- Municipal or County acceptance:

  - The Jefferson County, Colorado Board of Commissioners Resolution No. CC94-654 states, "maintaining, in perpetuity, the undeveloped buffer zone of open space around

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Rocky Flats is a critically important environmental, safety, and health constraint which must be required as part of any and all alternatives actions proposed by the Department of Energy." The three locations within the IA, IA-West, IA-East and the Solar Ponds would support this resolution.

- NSL, ESF, SW Quad, and SE Quad locations are located within the buffer zone and as such, constructing a RWSF at any of these locations would be counter to the desires of Jefferson County.

- DOE Orders:
  - The same DOE orders would apply equally to all locations.
- NEPA:
  - NEPA issues would be addressed equally for all locations.

C.2.5 RESULTS FOR SELECTED LOCATIONS

The results of the above analysis are summarized in Table C-5. Overall, the Solar Ponds (68.3%) was ranked slightly higher then the IA-West (67.6%) location, and the NSL (67.4%) as a location for a RWSF at the Site.

In Category 1, CAMU, the ability to designate the location as a CAMU was in favor of the IA locations, in order: Solar Ponds; IA-East; and IA-West. The capacity to reduce the areal extent of contamination and not contaminate clean areas weighed heavily in favor of the IA locations. No fatal flaws were associated with this category at any of the seven locations carried through the evaluation.

In Category 2, Public Protection (Geotechnical and Hydrological Criteria), three of the buffer zone locations were ranked highest, in order: SE Quad; NSL; and ESF. The primary concern with the locations in the IA, (Solar Ponds, IA-West, and IA-East) is the elevated groundwater table; however, the concerns are somewhat mitigated through the use of an above-grade design. No fatal flaws were associated with this category at any of the seven locations carried through the evaluation.

In Category 3, Site Special Issues, the SE Quad was evaluated as the highest, followed by Solar Ponds, and ESF locations. The three locations in the IA, IA-West, IA-East, and the Solar Ponds all received high ranking for the ability to support the Site Vision. However, the impacts of having to address issues with the existing infrastructure lowered the overall scores for the IA locations in this category. No fatal flaws were associated with this category at any of the seven locations carried through the evaluation.

In Category 4, Cost Criteria, the locations in the buffer zone are favored. All four buffer zone locations received higher ranking than those locations in the IA. The major factors were the costs associated with removing, rerouting, or replacing buildings and underground and overhead utilities in the IA. The Solar Ponds has the additional burden of having to construct a portal through the PA security fence, constructing a fence surrounding the location, and having a security staff available

during construction and operation of the facility.

In Category 5, Regulatory Support, the support is clearly in favor of a location in the IA. The Solar Ponds location was ranked highest followed by IA-East and IA-West.

In Category 6, Other Stakeholder Concerns, the three locations within the IA, Solar Ponds, IA-East, and IA-West respectively, ranked the highest. The general public would likely be more receptive to placing remediation waste in areas that already contain some contamination rather than siting a RWSF at a location that has no history of contamination. The Jefferson County, Colorado Board of Commissioners, state their position in Resolution No. CC94-654 as "Maintaining in Perpetuity, the undeveloped buffer zone of "Open Space" around Rocky Flats is a critically important environmental safety and health constrain which must be required as part on any and all alternative action proposed by the Department of Energy."

C.2.6 REFERENCES

Dawson, G.W. and Mercer, B.W., 1986, Hazardous Waste Management, Wiley-Interscience Chapter 5 Facility Siting.

EG&G, 1995a, *Geological Characterization Report for the Rocky Flats Environmental Site*, March 1995.

EG&G, 1995b, *Evaluation of the Capability of Inferred Faults in the Vicinity of Building 371, Rocky Flats Environmental Technology Site, Colorado: Prepared by Geomatrix Consultants, Inc., for EG&G Rocky Flats, Inc.*, Draft Report, January 1995.

Environmental Guidance Regulatory Bulletin, Office of Environmental Guidance RCRA/CERCLA Division (EH-231)CAMU/TU Final Rule Issued May 12, 1993.

EPA, 1993, Federal Register, Part II, 40CFR Part 260, et. al. Corrective Action Management Units and Temporary Units; Corrective Action Provisions; Final Rule February 16.

Jefferson County Colorado Board of Commissioners, Resolution No. CC94-654.

Looby, Tom (CDPHE), 1995 to Jack McGraw (EPA), and Mark Silverman (DOE), subject matter: State principles for onsite waste management of contaminated materials, February 27.

Smith, R., 1995, Memorandum to Annette Primrose, November 22.

Appendix D

Selection Criteria Descriptions

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D.2 COMPARISON OF ALTERNATIVES CRITERIA D-5

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D-1 Screening Criteria for IM/IRA Waste Management Facility D-1

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D.1 SCREENING CRITERIA

The criteria used in the Onsite Remediation Waste Storage Facility Siting Study and the Draft Evaluation of Onsite Versus Offsite Remediation Waste Management Options is presented in Table D-1.

Table D-1 Screening Criteria for IM/IRA Remediation Waste Storage Facility

IM/IRA Selection Criteria	Siting Criteria	Design Criteria
1. CAMU CRITERIA - Ability to designate as CAMU per 6 CCR 1007-3 264.552 (c)		
(1.1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost effective remedies.	X	X
(1.2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents.	X	X
(1.3) The CAMU shall include uncontaminated areas of the facility, only if including such areas for the purposes of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.	X	
(1.4) Areas within that CAMU, where remediation wastes remain in place after closure of the CAMU, shall be managed and contained so as to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment.	X	X
(1.5) The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2).	X	X
(1.6) The CAMU shall enable the use, when appr., of trtmt. technologies (including innovative techs.) to enhance long term effectiveness of remedial actions by reducing the tox, mob., or vol. of remediation waste that will remain in place after closure.		X
(1.7) The CAMU shall minimize the land area of the facility upon which remediation wastes will remain in place after closure of the CAMU unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2).	X	
2. PUBLIC PROTECTION (GEOTECHNICAL AND HYDROLOGICAL CRITERIA) - Ability to protect public per 6 CCR 1007-2 Part 2		
(2.1) The geol. and hydro. conditions of a site in which HW are to be disposed shall be such that reasonable assurance is provided that such wastes are isolated within the designated disposal area... away from ...pathways (to public) for 1000 yrs.	X	X
(2.2) Geomorphic conditions either will not vary significantly from the present state or will occur to a predictable degree which can be accommodated in the facility design.	X	
(2.3) Structure related issues to include: Slope and geotechnical stability	X	X
(2.4) The immediate area of the site is in strata of minimal groundwater flow.	X	
(2.5) ...geological strata combined with engineering barriers shall provide a minimum permeability of 10-7 cm/sec or equivalent...domestic or agr. aquifer protection.	X	X
(2.6) Bedrock/surface integration including the nature and extent of bedrock material.	X	

Table D-1 (continued)

IM/IRA Selection Criteria	Siting Criteria	Design Criteria
(2.7) Minimal relative presence of fractures or faults.	X	
(2.8) Relative depth to bedrock/groundwater including seasonal fluctuations for groundwater.	X	
(2.9) The juxtaposition of the site and any free flowing or standing natural surface waters shall be such that disposal location will not impact nor be impacted by surface water.	X	
(2.10) Relative distance to nearest discharge area to include consideration of groundwater flow direction and travel time.	X	X
(2.11) The terrain is such that good drainage exists for movement of precipitation away from the disposal area, and such that water and wind erosion will be minimal.	X	X
(2.12) The geochemical characteristics of the geological strata are compatible with the waste categories proposed to be disposed...provide high adsorption, absorption...fixation of any wastes that may migrate...	X	X
3. SITE SPECIAL ISSUES - Ability of the candidate site to provide a "footprint" that allows timely construction of a facility to occur. (schedule criteria)		
(3.1) Ability of the site to support the Site Vision and RFCA objectives.	X	X
(3.2) Impacts from existing utility, sewer, process waste, or communications lines.	X	X
(3.3) Impacts from security.	X	X
(3.4) Impacts from Pu consolidation or residue stabilization activities.	X	
(3.5) Impacts from building deactivation activities.	X	
(3.6) Impacts from D4 activities.	X	
(3.7) Impacts from current RCRA storage or other active RCRA units.	X	X
(3.8) Impacts from mineral rights issues or other easements.	X	
(3.9) Ability to co-locate additional waste management cells in the same vicinity.	X	X
4. COST CRITERIA		
(4.1) Cost of construction, includes Construction, Preconstruction, and Design Costs	X	X
(4.2) Cost of site preparation including building demolition, subsurface line removal and re-routing, access requirements, and power/facility requirements above basic cell F&OR.	X	X
(4.3) Cost of interim closure and monitoring after interim closure		X
(4.4) Total Life Cycle Cost		X
5. REGULATORY SUPPORT - State Principles for On-Site Disposal of Contaminated Materials (27-February-95 letter from Tom Looby to Jack McGraw and Mark Silverman)		
(5.1) The number of disposal sites must be minimized. We (Colorado Department of Public Health and the Environment) suggest one centralized site be chosen for consolidation of contaminated materials.	X	

Table D-1 (continued)

(5.2) Every effort should be made to site a centralized disposal facility in an area of optimal geologic parameters preferably within, or close to the IA.	X	
(5.3) Any disposal facility must be designed and built as a state of the art disposal facility that meets or exceeds all permitting and regulatory reqmts. This includes (but not limited to) siting, design, long term protection, and performance reqmts.	X	X
(5.4) A permitted facility would provide DOE the greatest degree of future applicability and utility. ....the facility should be designed with the intent to permit under RCRA/CHWA...	X	X
(5.5) Levels of radioactive contamination in any materials disposed on-site will be limited....levels as yet undetermined...		X
(5.6) Any disposal site at the Site should be located in areas that have limited future land use potential and will be controlled by DOE until the interred waste no longer presents a risk to human health or the environment.	X	
6. OTHER STAKEHOLDER CONCERNS		
(6.1) General public perception/acceptance	X	X
(6.2) Municipal or County acceptance.	X	X
(6.3) DOE Orders	X	X
(6.4) NEPA	X	
(6.5) Air Impacts	X	X
(6.6) Compliance to ARARS	X	X
(6.7) Long Term Liability/Effectiveness		X
(6.8) Ability to Accept Waste		X
(6.9) Demo. performance/Useful Life		X
(6.10) Construction and Operation		X
(6.11) Schedule Requirements		X
(6.12) Availability of Technology		X
(6.13) Availability of Service and Materials		X

The stakeholder concerns criteria addresses impacts to parties affected by decisions at the Site and to the Site and the surrounding community, as follows:

6.1) General Public Perception/Acceptance - The public sentiment including the general public and concerned local communities is evaluated as an alternative.

6.2) Municipal and County Acceptance - The viewpoints of local government including Jefferson County and local municipal governments are reflected in this criteria.

6.3) DOE Orders - This criteria has the ability to meet the requirements of DOE orders, particularly orders that protect the safety of workers, the public, and the environment.

6.4) NEPA - This criteria contains NEPA compliance requirements including environmental impacts, socioeconomic impacts, and impacts to archeological, cultural, and historical locations.

6.5) Air Impacts - This criteria includes impacts to air quality—onsite, offsite and regionally, as well as air pollution prevention or mitigative measures.

6.6) Compliance to Performance Regulations - This criterion was used to evaluate the ability of any given alternative to meet existing and potential state and Federal performance requirements. This did not include any performance requirements specific to the cleanup of Individual Hazardous Substance Sites that are independent of any given alternative.

6.7) Long-Term Liability and Effectiveness - This criterion was employed to evaluate the ability to safely isolate, contain, and manage remediation waste with the passage of time. It also addressed the issues of long-term liability, particularly for alternatives whose ability to safely manage materials could be subject to change in the future.

6.8) Ability to Accept Waste - This criterion was utilized to evaluate the ability of an alternative to accept waste volumes and different types of waste that will result from environmental restoration activities. This included, at a minimum, the ability of various options to accept remediation waste at the same rate that it is generated and to have the overall capacity to be a viable solution for at least near-term activities.

6.9) Demonstrated Performance/Useful Life - This criterion was used to address the permanence of a selected alternative as well as whether the alternative is known through experience to be viable.

6.10) Construction and Operation - This criterion was used to evaluate a number of factors such as whether monitoring is feasible during operations and after closure, whether environmental and geological features would circumvent construction or the overall constructability, and whether transportation of remediation waste is feasible.

6.11) Schedule Requirements - This criterion was used to directly support one of the main objectives of this IM/IRA—can the alternative be ready to accept remediation waste and be fully operational when needed in the future.

6.12) Availability of Technology - This criterion was employed to evaluate whether the technologies exist and have been developed to the point where they would be available. This was primarily directed at design considerations; however, the availability of monitoring, transportation, handling, and safety technologies was also part of this consideration.

6.13) Availability of Services and Materials - This was an evaluation of the availability of construction materials, equipment, analytical support, construction labor, and support personnel over the entire life of any given alternative.

D.2 COMPARISON OF ALTERNATIVES CRITERIA

The final comparison of alternatives used the seven criteria (plus two additional criteria) that are summarized, as follows:

1) Protection of Public Health and the Environment - This criterion was used to evaluate the alternative's impacts to ground water, surface water, drainage pattern impact, soil, air, plants and animals for the life cycle of the IM/IRA. Emphasis is placed on the ability of the alternative to control migration and leachability of contaminants and impact of any construction.

Impacts on erosion rate and loss of top soil were also examined including their offsite effects of erosion and wind blown soil. Alternatives were evaluated as to whether there were temporary or short-term changes to the soil and the erosion rate or whether these changes had lasting long-term impacts. The ability of an alternative to minimize and/or mitigate these erosional effects through erosion control or replacement of the topsoil was evaluated.

Each alternative was analyzed for biological impacts, direct and indirect impacts on critical habitat, wetlands, and vegetation. Analyzing biological effects included the cumulative effects of regionally important species, endangered species, and biodiversity. It also included the irreversible effects of permanent loss of habitat and permanent loss of species. The ability to restore biological habitat and wetlands or reduce the impact by the timing of the action was also evaluated.

Impact to air quality onsite, offsite, and regionally; and pollution prevention or mitigative measures were also considered.

The impact of the alternative on the safety of the surrounding community is evaluated. This includes not only disposal and storage of remediation waste but also the impact of transportation of remediation waste. Direct effects on water quality and water consumption are an important part of this criteria as well as airborne materials that could potentially impact public health.

2) Worker Safety - The health and safety of workers is evaluated. This includes all phases of the alternative from construction to all handling and operation to closure and surveillance.

3) Transportation - This includes all forms of transport associated with an alternative from any shipment of waste to the impacts that an alternative might have on existing traffic systems. Transportation had to be examined out of state also since the all of alternatives involve offsite shipment at some time..

4) Facility Design, Containment and Monitoring - This criterion was used to evaluate the design of each alternative in terms of implementability, efficiency safety, availability, and protectiveness. The ability of each alternative to effectively contain contaminants and the ability verify that containment through monitoring was also evaluated.

5) Institutional Controls - This criterion was used to evaluate institutional controls which limit human activities at or near the facility, protect health and environment, and assure continued effectiveness of the alternative.

6) Cost - The total cost of each alternative was evaluated, as were individual costs for design, site

preparation, construction, operations, interim closure, and interim closure monitoring.

7) Community Acceptance - This criterion was used to evaluate the public sentiment concerning an alternative. It includes the general public as well as concerned local communities. This is a modifying criterion that will address public comments as part of the review

8) Short-Term Effectiveness - This is a gauge of the alternative's capability to support upcoming risk reduction efforts at the Site. These efforts are primarily early actions which could include hot-spot removal, tank removals, additional solar pond remediation, and PCB location remediation.

9) Long-Term Effectiveness and Permanence - This criterion was used to evaluate the ability to safely isolate, contain, and manage remediation waste with the passage of time. It also addressed the issues of long-term liability, particularly for alternatives whose ability to safely manage materials could be subject to change in the future.

Appendix E

Descriptions of Remediation Waste Storage Facility Design Alternatives

REMEDIATION WASTE STORAGE FACILITY (RWSF) DESIGN ALTERNATIVES

The alternative facility designs were all based on the need to accommodate 100,000 cubic yards (cy) of Low Level Mixed Waste (LLMW), Low Level (LL), or Hazardous Wastes (HW) in a storage facility. None of the designs considered were tailored to a specific location on RFETS site. In general, bulk waste placement requires the smallest land area when compared to containerized waste placement.

Attributes common to alternative designs:

- 100,000 cy waste capacity in retrievable, monitored, storage.
- Each design considered would place the waste above the present grade.
- Each design was considered to be capable of waste retrieval, although the ease (and cost) of retrievability varied significantly among the designs.
- Conceptual design sketches (Figures) and cost estimates (Tables) follow the description of each design.
- Any leachate collected would be treated at another facility, and was not costed here.
- Groundwater Monitoring wells would be installed both up gradient and down gradient of the facility and operated from start of construction through the end of post closure monitoring.
- Costs were escalated to reflect estimated actuals at the time of expenditure , based on DOE guidance documented in RFETS 1996 Budget Call Manual.
- Construction periods were assumed to be of one year duration for all alternatives.
- Operations costs were defined as those activities directly related to placement of (prepared) waste into each alternative facility.
- Treatment and handling systems are not expected to produce emissions sufficient to require additional permitting. Air monitoring will be conducted vial the existing Site monitoring system. Any additional air monitoring required for worker Health and Safety consideration will be monitored by the appropriate oversight organizations.

Above Grade Waste Cell

This RWSF is designed such that clean dirt (fill) would be used to construct the sides of the cell so that the entire facility would be above the present grade. The design is similar to a standard Subtitle "C" landfill in use throughout the United States. The whole cell is placed at a higher elevation to allow greater vertical separation between the bottom of the cell and the water table. The conceptual design cost estimate assumed that the remediation waste would be placed in the cell without containers (in bulk, compacted in place), however, some existing containerized waste could be placed. In addition, the placement of individual waste streams would be mapped and gridded to allow retrieval (by excavation) when desired.

- This waste cell design includes a double liner with leachate collection system. These features were used to develop the cost estimate and may change during detailed design (see Figures E-1 and E-2). Compliance with 6 CCR 1007-3 Part 264 Subpart N requirements is accomplished by the following provisions:

  — Interim cover system

  — Leachate collection layer consisting of one foot of drainage gravel

  — Primary liner would be composed of an 80 mil high density polyethylene (HDPE) geomembrane

  — Leak detection system includes a geocomposite, (e.g., A geonet with a geotextile on each side)

  — Secondary liner would include three feet of compacted clay, overlain by a 80 mil HDPE geomembrane

This cell design cost estimate was based on cell dimensions of 440 feet long, 360 feet wide, and 30 feet deep. Table E-1 presents the cost estimate summary. The cost estimate included a clean dirt cover installed over exposed waste at the close of daily placement operations to prevent wind dispersion of the waste.

The entire footprint including sideslopes cover approximately 9 acres.

Cell Support Facilities include a lay down area for cell construction materials.

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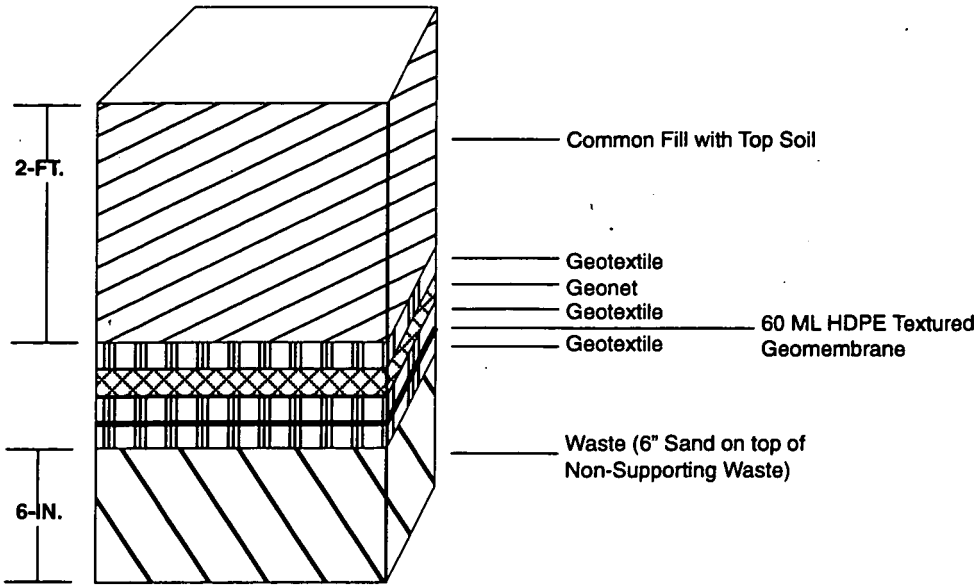
- Any leachate collected would be treated at another facility, and those costs were not included in this estimate.

- Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring.

INTERIM CELL COVER



CELL LINER

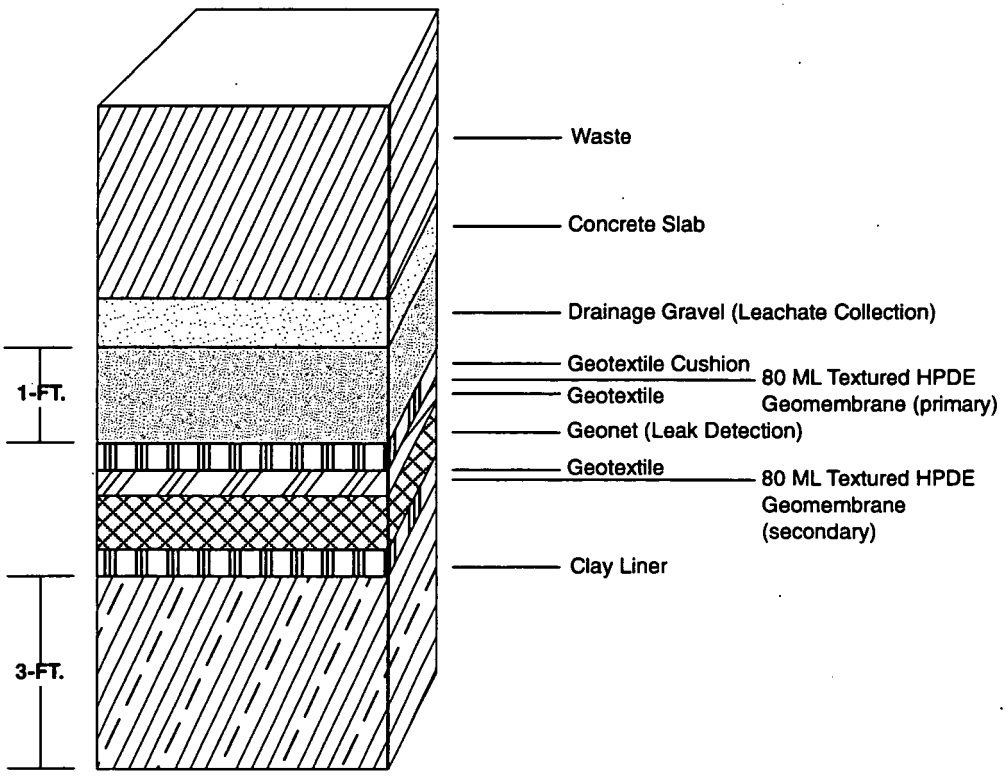


Figure E-1

ON-SITE FACILITY CROSS SECTION

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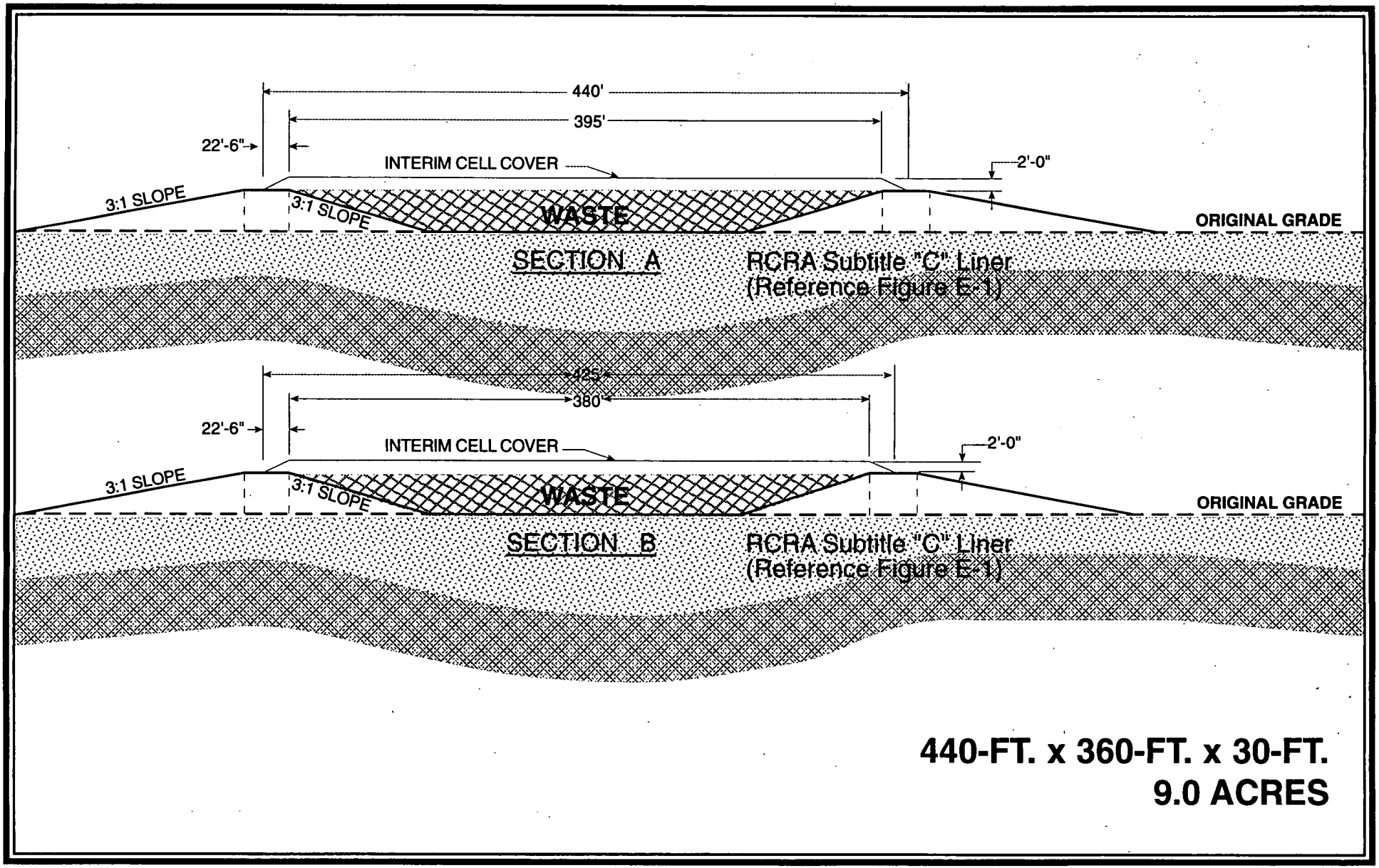

Figure E-2

CROSS-SECTION OF ABOVE-GRADE STORAGE CELL

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TABLE E-1

Above-Grade Landfill

Task Description	Estimated Cost
Containers	$0
Packaging	$2,100,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$2,200,000
Permitting	$300,000
Pre-Construction	$400,000
Site Preparation	$8,800,000
Construction	$41,700,000
Operations	$9,000,000
Interim Cap Installation	$5,300,000
Interim Closure Care and Monitoring	$13,900,000
Off-Site Disposal	N/A
Contingency	$27,000,000
Total Life Cycle Costs	***$118,800,000***

Note: Costs escalated to expected year incurred.

Concrete Lined Cell, with Bulk Placement

This alternative design consists of three adjacent open top concrete cell(s) placed over a (RCRA Subtitle 'C' landfill) double liner and leachate collection system (see Figure E-3A). When the cell(s) are filled with remediation waste an interim cover is placed over the facility. The conceptual design cost estimate assumed that the remediation waste would be placed in the cell without containers (in bulk, compacted in place), however, some of the waste could be placed in containers, in addition, the placement of individual waste streams would be mapped to allow retrieval (by excavation) when desired. The individual cells are modular and would be constructed as needed over the liner to allow flexibility in sizing the facility.

The concept for the design was modified from the BNFL Drigg Facility in the United Kingdom. The following features were used to develop the cost estimate and may change during detailed design.

- This waste cell design includes an interim cover (see Figure E-1). The surface slope of the finished cover would be approximately 4%.

- This waste cell design also includes a double liner with leachate collection system (see Figure E-1). Compliance with 6 CCR 1007-3 Part 264 Subpart N requirements is accomplished by the following provisions:

  — Interim cover system

  — Self supporting open top concrete shell with reinforced concrete walls and floor slab. The wall design incorporates integral water stops and the floor design incorporates cast-in-place drain channels and sumps

  — Leachate collection layer consisting of one foot of drainage gravel

  — Primary liner would be composed of an 80 mil HDPE geomembrane

  — Leak detection system includes a geocomposite, (e.g. A geonet with a geotextile on each side)

  — Secondary liner would include three feet of compacted clay, overlain by a 80 mil HDPE geomembrane

- The Concrete Lined Cell facility conceptual design includes the following features which were included in the cost estimate (see Table E-2 for the cost estimate summary).

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- Facility size of 500 feet long by 360 feet wide by approximately 14 feet deep
- The temporary storage facility long term footprint would be approximately four acres
- The entire footprint during construction and placement operations would be approximately 10 acres (Cell area + Lay down areas + Operations areas = 10 acres)
- No aisles or corridors
- Three open top concrete modules
- A lay down area for cell construction materials
- Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring
- Any leachate collected would be treated at another facility, and those costs were not included in the estimate

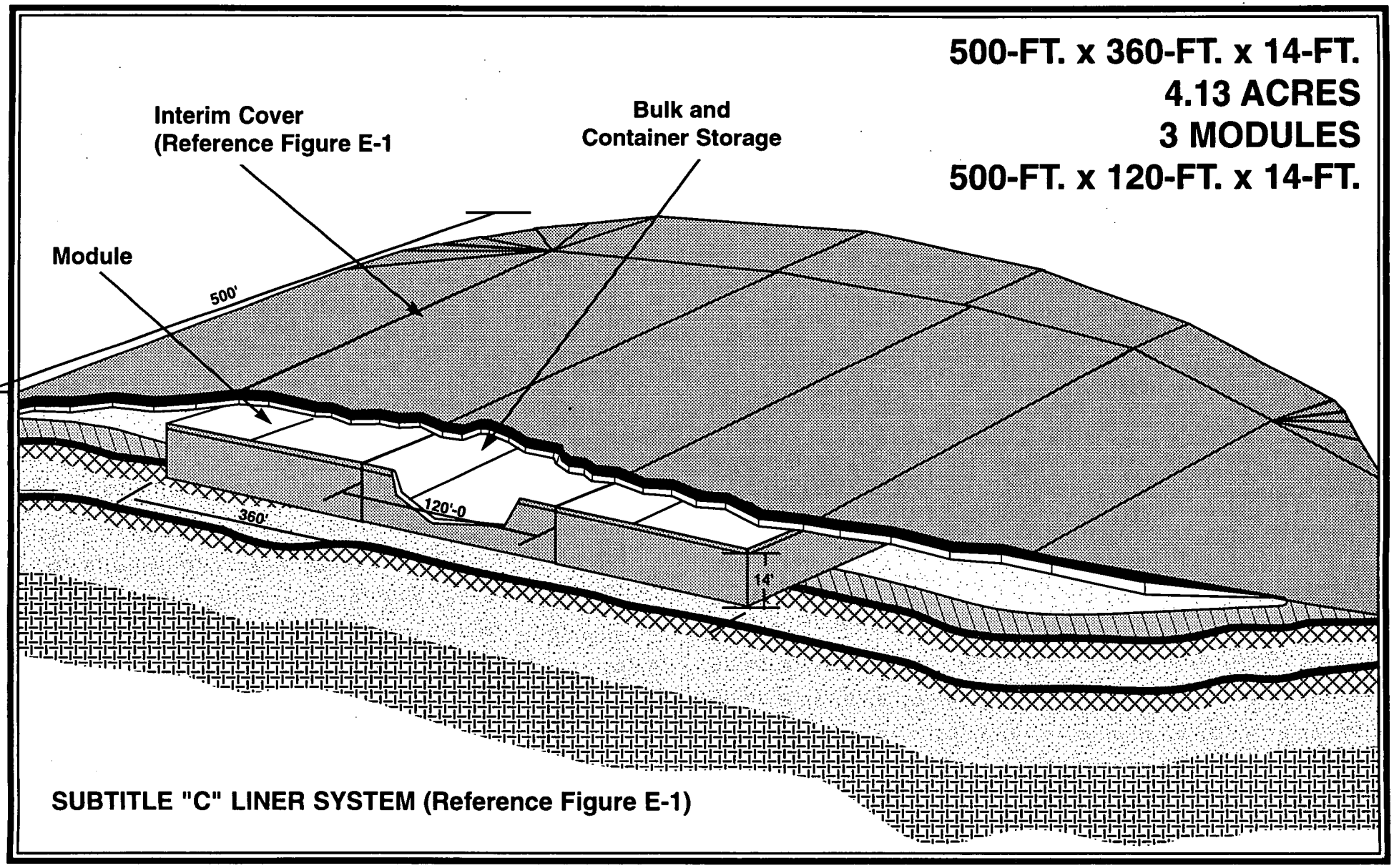

Figure E-3A

CONCRETE-LINED CELL WITH BULK WASTE PLACEMENT

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TABLE E-2

Concrete Lined Cell with Bulk Waste Placement

Task Description	Estimated Cost
Containers	$0
Packaging	$2,100,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$1,600,000
Permitting	$300,000
Pre-Construction	$150,000
Site Preparation	$1,970,000
Construction	$18,600,000
Operations	$8,600,000
Interim Cap Installation	$5,300,000
Interim Closure Care and Monitoring	$13,000,000
Off-Site Disposal	N/A
Contingency	$17,600,000
Total Life Cycle Costs	*$77,320,000*

Note: Costs escalated to expected year incurred.

Concrete Lined Cell with Container Placement

This alternative design consists of three adjacent open top concrete cell(s) placed over a (RCRA Subtitle 'C' landfill) double liner and leachate collection system (see Figure E-3B). When the cell(s) are filled with remediation waste an interim cover is placed over the facility. All of the remediation waste would be placed in containers (Cargo containers) which would then be placed into the cells. This aspect is the only significant difference from the previously described option "Concrete Lined Cell with Bulk Placement". Individual waste streams would be recorded and mapped to allow retrieval (by excavation) when required. The individual cells are modular and would be constructed as needed over the liner providing flexibility in sizing the facility. The concept for the design was modified from the Drigg Facility in the United Kingdom.

The following features were used to develop the cost estimate and may change during detailed design.

- This waste cell design includes an interim cover (see Figure E-1). The surface slope of the finished cover would be approximately 4%.

- This waste cell design also includes a double liner with leachate collection system (see Figure E-1). Compliance with 6 CCR 1007-3 Part 264 Subpart N requirements is accomplished by the following provisions:

  — Interim cover system

  — Self supporting open top concrete shell with reinforced concrete walls and floor slab. The wall design incorporates integral water stops and the floor design incorporates cast-in-place drain channels and sumps.

  — Leachate collection layer consisting of one foot of drainage gravel

  — Primary liner would be composed of 80 mil HDPE geomembrane

  — Leak detection system includes a geocomposite (e.g,. A geonet with a geotextile on each side)

  — Secondary liner would include three feet of compacted clay, overlain by a 80 mil HDPE geomembrane

- The Concrete Lined Cell facility conceptual design includes the following features which were included in the cost estimate (see Table E-3 for the cost estimate summary).

  — Facility size of 405 feet wide by 500 feet long by approximately 14 feet deep

  — The waste cell facility long term footprint would be approximately 4.6 acres

  — The entire footprint during construction and placement operations would be approximately 10 acres (Cell area + Lay down areas + Operations areas = 10 acres)

  — No aisles or corridors

  — Three open top concrete modules

  — A lay down area for cell construction materials

  — Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring

  — Any leachate collected would be treated at another facility, and those costs were not included in the estimate

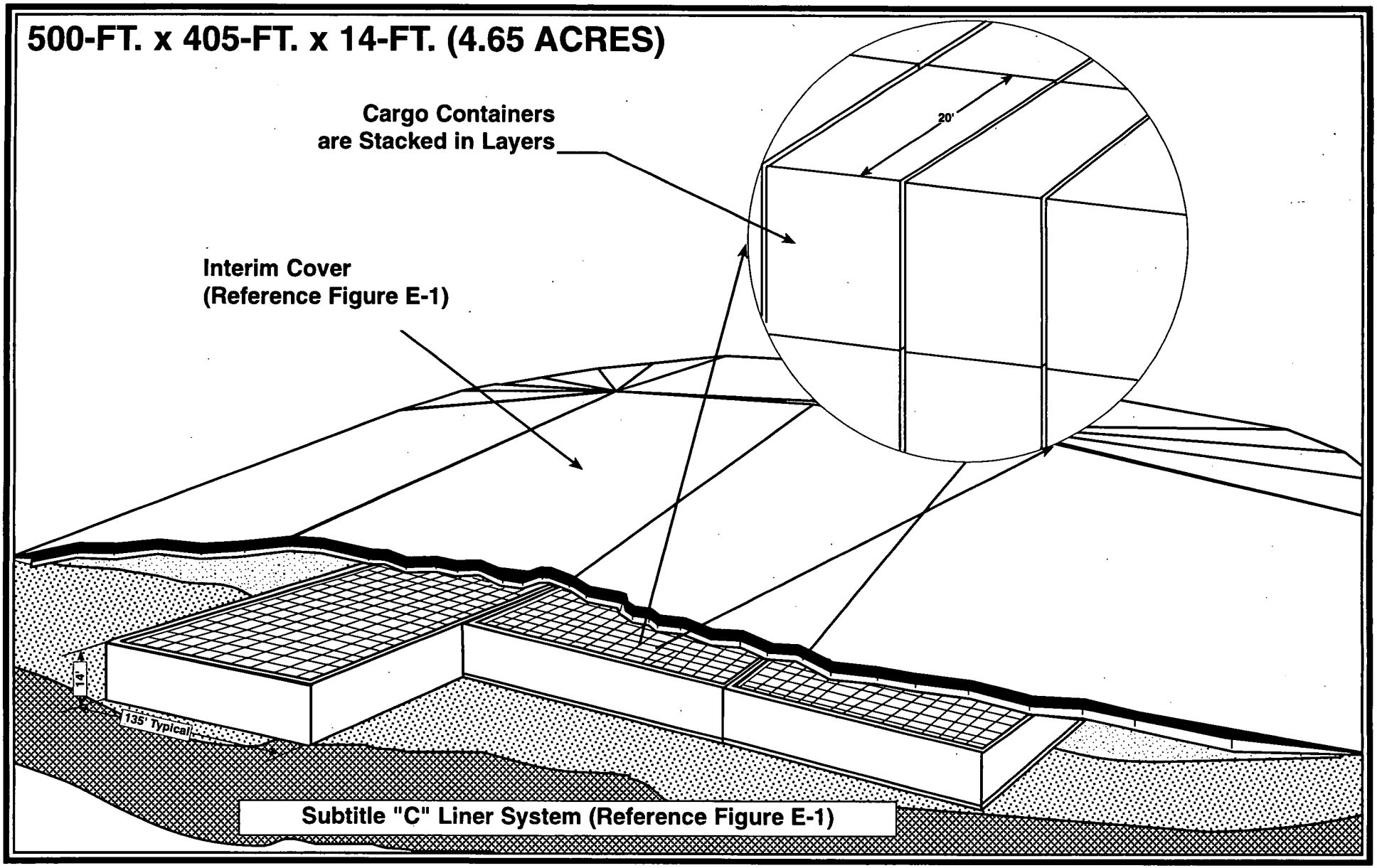

Figure E-3B

CONCRETE-LINED CELL IN CARGO CONTAINERS

TABLE E-3

Concrete Lined Cell with Cargo Containers

Task Description	Estimated Cost
Containers	$74,930,000
Packaging	$1,700,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$1,600,000
Permitting	$300,000
Pre-Construction	$150,000
Site Preparation	$1,970,000
Construction	$18,600,000
Operations	$4,900,000
Interim Cap Installation	$5,300,000
Interim Closure Care and Monitoring	$10,400,000
Off-Site Disposal	N/A
Contingency	$37,700,000
Total Life Cycle Costs	*$165,650,000*

Note:Costs escalated to expected year incurred.

HARDENED CONCRETE VAULT

This alternative design would place cargo containers, filled with remediation waste, within an above grade concrete structure (see Figure E-4). The structure would be designed as a self supporting, free standing, above grade, weatherproof structure. This structure would be constructed over a double liner and leachate collection system. The structure would consist of three modules (Vaults). Each module would contain a double row of cargo containers with an access aisle between the rows. The cargo containers would be stacked in the vault by forklifts from the access aisle. At the close of waste placement operations, each cell would be capped with a concrete roof, then the structures comprising the facility would be covered with an interim cover. This design enhances the monitoring capability during placement operations and retrievability after closure due to the open aisles and identified waste in individual containers. The concept for the design was modified from the "E"-Area Vaults from the DOE Savannah River Complex.

During the period of post closure monitoring (or later) access could be made into the vaults (by excavating through the interim cover) to inspect or retrieve the waste containers via the aisles which were left open , but isolated from the environment when the vaults were closed.

- The following features were used to develop the cost estimate (see Table E-4) and may change during detailed design.
  - Facility size would be approximately 560 feet long, 450 feet wide, and 14 feet high and consist of three modules
  - One module could be constructed each year, for three years, (subject to the rate of remediation waste generation)
  - Each module would consist of an 18 inch thick reinforced concrete slab floor, 12 inch thick reinforced concrete walls, and a 12 inch thick reinforced concrete roof
  - A 30 foot wide aisle or central corridor is planned in each module. These corridors would remain open during the life of the facility to allow routine monitoring and inspection
  - Waste would be placed into 20 cy cargo containers (5,000 containers, Total capacity 100,000 cy)
  - A double liner system and LCRS would be constructed similar to the CLC (see Figure E-1). This complies with requirements of 6 CCR 1007-3 Part 264 Subpart N.

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- The waste cell facility long term footprint would be approximately six acres
- The entire footprint during construction and placement operations would be approximately 12 acres (Cell area + Lay down areas + Operations areas = 12 acres)
- Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring
- Any leachate collected would be treated at another facility, and those costs were not included in the estimate

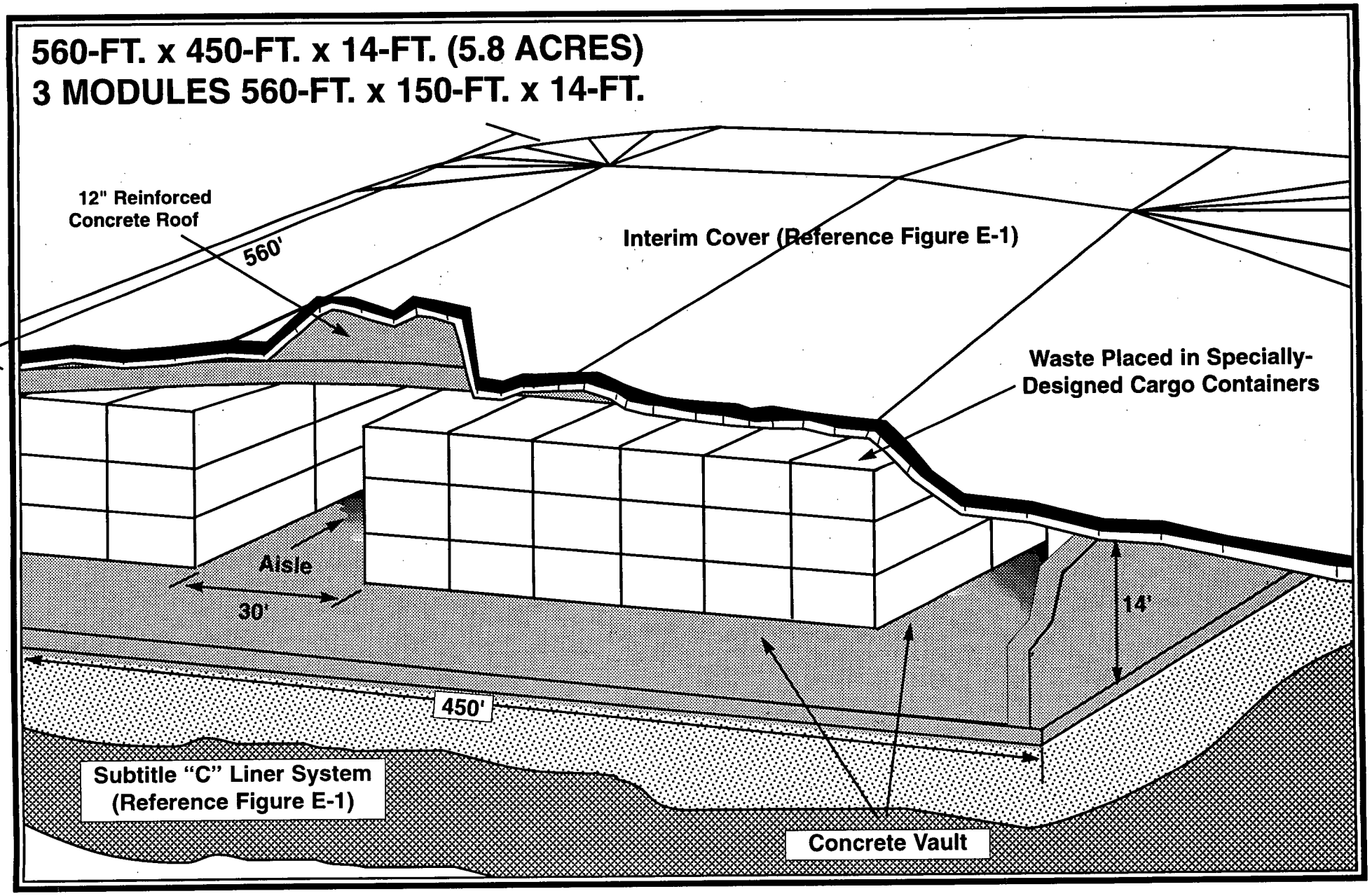

Figure E-4

HARDENED CONCRETE VAULT

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TABLE E-4

Hardened Concrete Vault

Task Description	Estimated Cost
Containers	$74,930,000
Packaging	$1,700,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$2,200,000
Permitting	$300,000
Pre-Construction	$400,000
Site Preparation	$6,100,000
Construction	$26,000,000
Operations	$4,900,000
Interim Cap Installation	$5,300,000
Interim Closure Care and Monitoring	$10,400,000
Off-Site Disposal	N/A
Contingency	$41,300,000
Total Life Cycle Costs	*$181,630,000*

Note: Costs esalated to year incurred.

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Silo Design

This alternative design consists of a series of 5,000 cy capacity open top concrete silos placed over a double liner and leachate collection system (see Figure E-5). When all of the silos are filled with remediation waste an interim cover is placed over the entire facility. Remediation waste would be placed in each silo in bulk (without containers) and compacted. When each silo is filled a structural concrete roof is constructed over the silo. Individual waste streams would be mapped and recorded to allow retrieval (by excavation) when desired. Individual silos would be constructed as needed to keep pace with remediation waste generation. This design alternative is based on a similar design described in EG&G- INEL *Interim Report: Waste Management Facilities Costs, Information for Mixed Low-Level Waste,* dated March 1994.

- The following features were used to develop the cost estimate (see Table E-5) and may change during the detailed design. This design complies with requirements of 6 CCR 1007-3 Part 264 Subpart N.

  — This waste cell design includes an interim cover (see Figure E-1)

  — The side slope of the finished cover would be approximately 12%

  — Leachate collection layer consisting of one foot of coarse sand

  — Primary liner would be composed of an 80 mil HDPE geomembrane

  — Leak detection system includes a geocomposite (e.g., A geonet with a geotextile on each side)

  — Secondary liner would include three feet of compacted clay, overlain by a 80 mil HDPE geomembrane

  — Facility size of 500 feet wide by 500 feet long by approximately 75 feet high

  — The waste cell facility long term footprint would be approximately six acres

— Self supporting open top reinforced concrete shell silos approximately 50 feet wide by 40 feet long by 70 feet high. Each silo to be constructed with 12 inch thick reinforced concrete walls and an 18 inch thick reinforced concrete slab floor. When filled with waste, a 12 inch thick structural concrete top would be constructed over each silo.

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- Space between silos would be backfilled with clean sand or fill
- The entire footprint during construction and placement operations would be approximately 12 acres (Cell area + Lay down areas + Operations areas = 12 acres)
- Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring
- Any leachate collected would be treated at another facility, and those costs were not included in the estimate

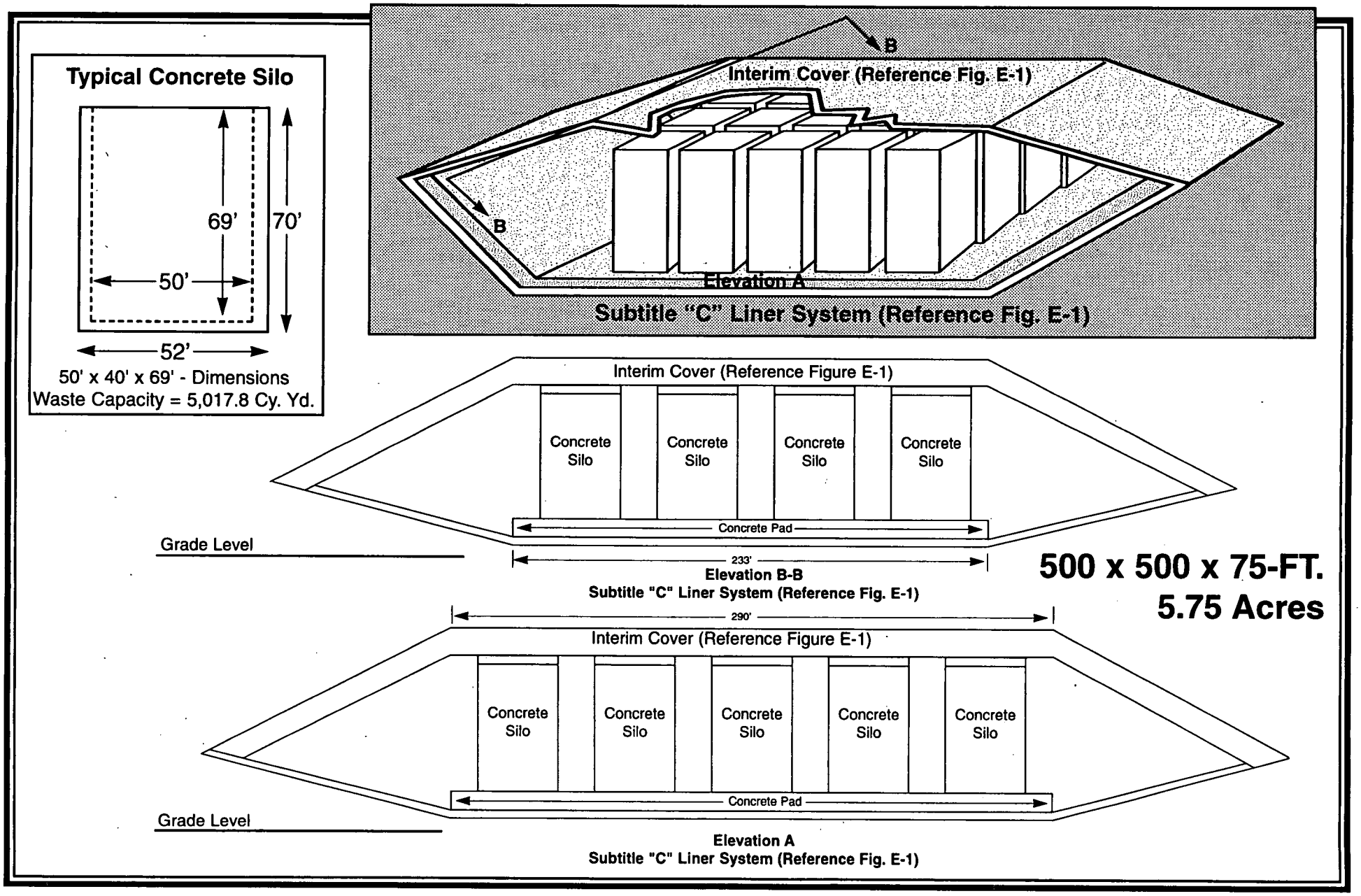

Figure E-5

SILO DESIGN

TABLE E-5

Silo Design

Task Description	Estimated Cost
Containers	$0
Packaging	$2,100,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$2,000,000
Permitting	$300,000
Pre-Construction	$400,000
Site Preparation	$6,100,000
Construction	$30,400,000
Operations	$14,300,000
Interim Cap Installation	$5,300,000
Interim Closure Care and Monitoring	$13,900,000
Off-Site Disposal	N/A
Contingency	$24,400,000
Total Life Cycle Costs	*$107,300,000*

Note: Costs escalated to year incurred.

SLAB on GRADE

This alternative design consists of 5,000, twenty cubic yard capacity, cargo containers filled with remediation waste placed outdoors on an above grade concrete slab (see Figure E-6). No liner or leachate collection system is incorporated into this design. A concrete berm around the perimeter of the slab and a sump to contain stormwater are integrated into the design. No roof or building enclosure would be placed over the cargo containers. The facility would have a design life of 30 years, at which time it was assumed that the waste would be transported to an off site facility for disposal. This concept is currently in use for storage of RCRA waste at RFETS.

- The following features were used to develop the cost estimate (see Table E-6) and could change during detailed design.
  - The waste would be placed in bulk into the 20 cy cargo containers
  - No double liner system of LCRS
  - Facility design life of 30 years
  - Requires 5,000 each 20 cy cargo containers, whose design life was assumed to be 30 years in outdoor storage
  - The footprint of the facility would be approximately 535 feet by 600 feet
  - The containers would be stacked three high and placed in double rows with a 5 foot aisle between the double rows
  - The slab with a perimeter stormwater curb would be constructed of reinforced concrete at the existing grade
  - The slab would be sloped to a central sump for storm water collection. For estimating purposes it was assumed that the storm water could be discharged without treatment.
  - Any costs associated with maintenance or replacement of the facility at the end of the design life were not included in this estimate
  - The site footprint during long term storage would be approximately 7 acres

- The entire footprint during construction and placement operations would be approximately 12 acres (Cell area + Lay down areas + Operations areas = 12 acres)

- Groundwater monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the life cycle (30 years).

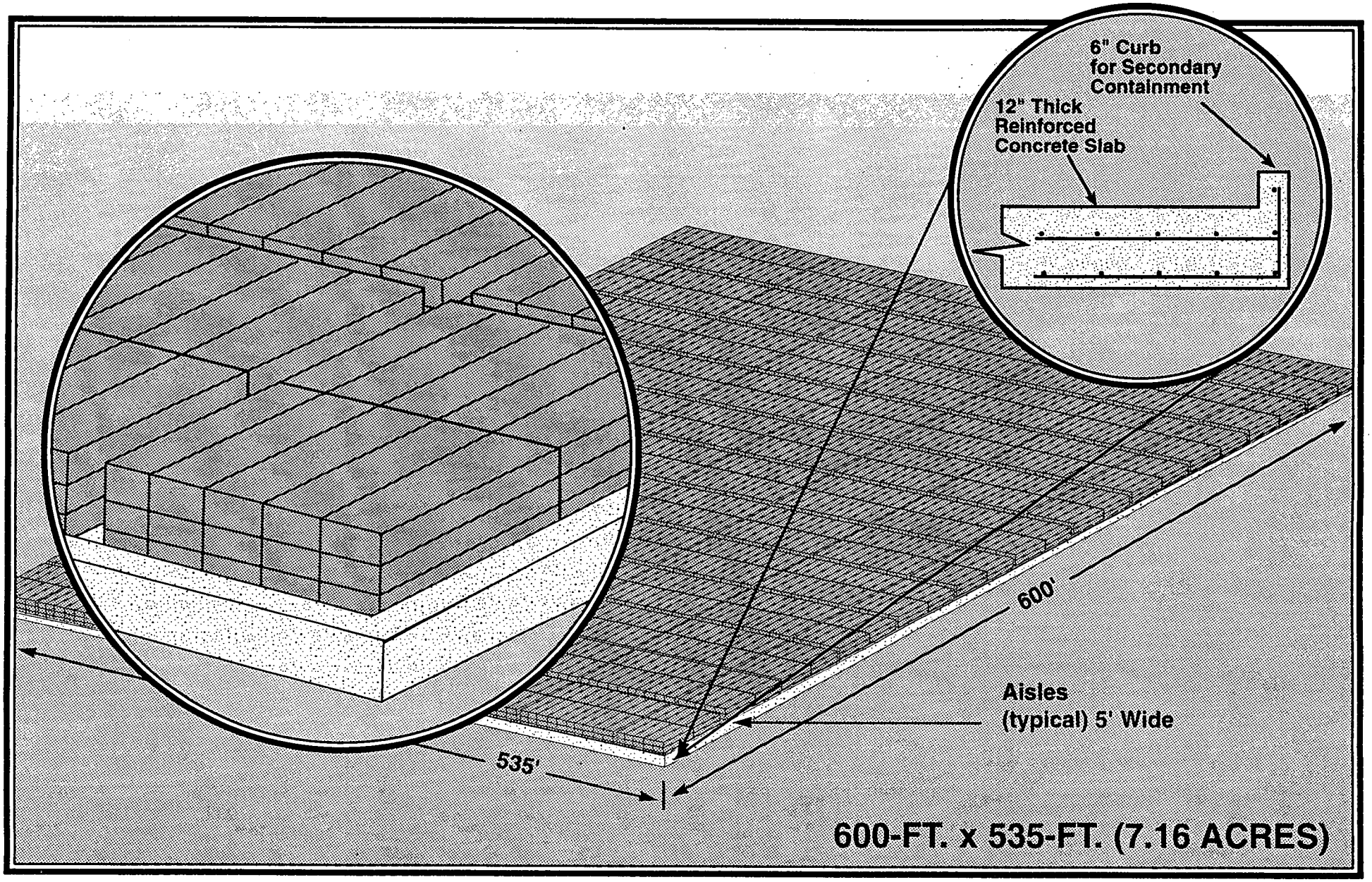

Figure E-6

SLAB ON GRADE

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TABLE E-6

Slab on Grade

Task Description	Estimated Cost
Containers	$74,900,000
Packaging	$1,700,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$300,000
Permitting	$300,000
Pre-Construction	$200,000
Site Preparation	$6,100,000
Construction	$3,800,000
Operations	$5,500,000
Interim Cap Installation	N/A
Interim Closure Care and Monitoring	$8,500,000
Off-Site Disposal	N/A
Contingency	$32,200,000
Total Life Cycle Costs	*$141,600,000*

Note: Costs escalated to year incurred.

METAL BUILDINGS

This alternative design consists of 5,000, twenty cy capacity, cargo containers filled with remediation waste placed inside engineered metal buildings (see Figure E-7). This design alternative is very similar to the Slab-on-Grade design with the exception that in this design option, the cargo containers are sheltered from the weather, and that no storm water would be collected. The buildings would be constructed on a concrete slab. No liner or leachate collection system is incorporated into this design. The facility would have a design life of 30 years, at which time it was assumed that the waste would be transported to an off site facility for disposal. This concept is currently in use for storage of RCRA waste at RFETS.

- The following features were used to develop the cost estimate (see Table E-7) and could change during detailed design.
  - Four metal buildings, each 570 feet long by 130 feet wide by 20 feet high
  - One building would be constructed per year
  - Each building would be placed on a 12 inch thick concrete slab
  - 5,000 each 20 cy capacity cargo containers
  - The containers would be stacked three high in the buildings
  - Each building would retain one centralized corridor and access aisle for routine monitoring and inspection for the design life of the facility
  - 30 year design life of the facility
  - Large forklifts to move the cargo containers
  - Transportation of the waste to an off site disposal facility at the end of the design life
  - No double liner system for LCRS
  - Cost of maintaining or replacing this Remediation Waste Storage facility after the design life were not considered in this cost estimate

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— Groundwater monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the life cycle (30 years).

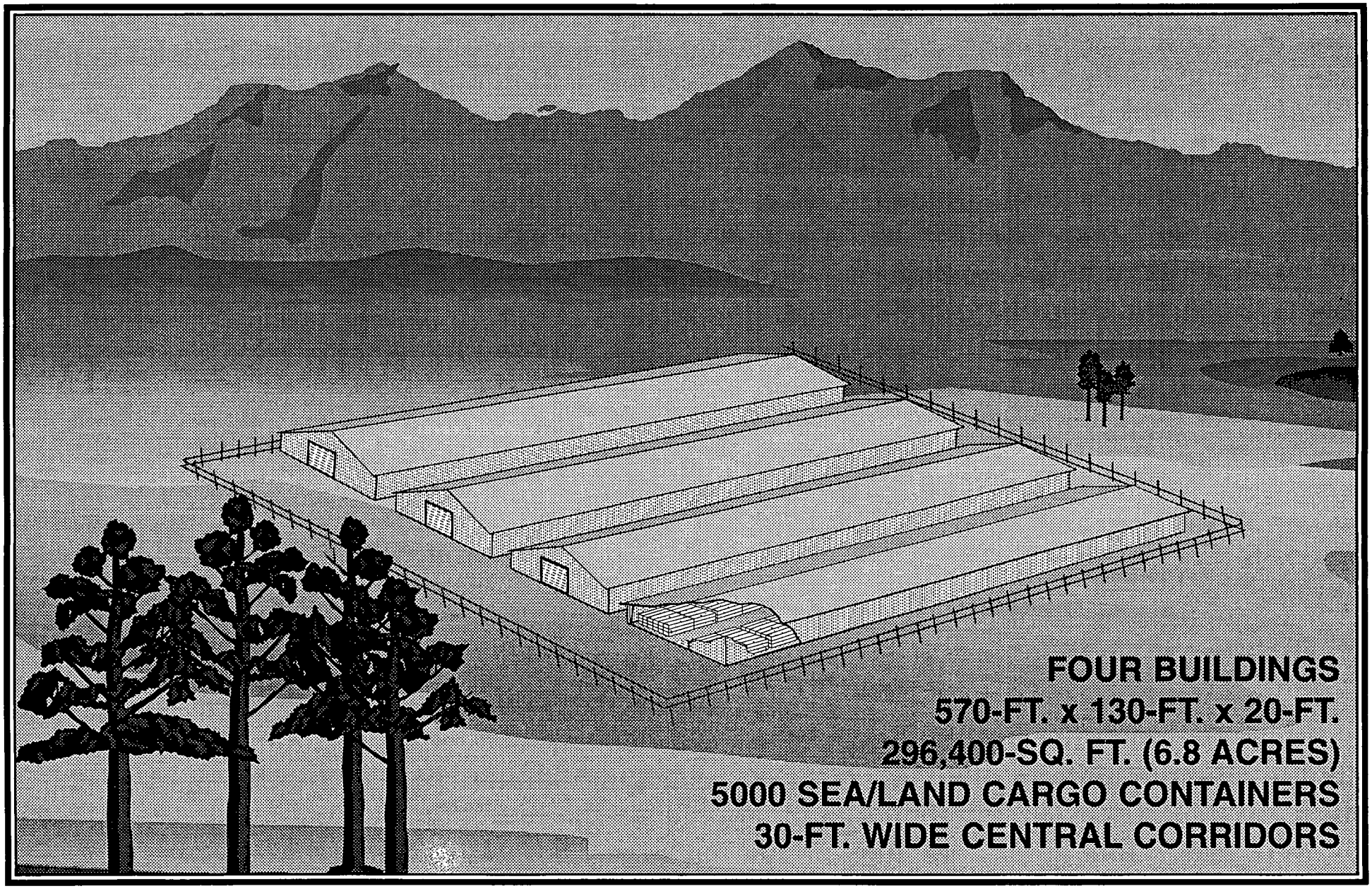

Figure E-7

METAL BUILDINGS

TABLE E-7

Metal Buildings

Task Description	Estimated Cost
Containers	$74,900,000
Packaging	$2,400,000
Characterization	$5,800,000
Transportation	$1,700,000
Design	$2,300,000
Permitting	$300,000
Pre-Construction	$1,300,000
Site Preparation	$2,800,000
Construction	$17,900,000
Operations	$4,900,000
Interim Cap Installation	N/A
Interim Closure Care and Monitoring	$10,400,000
Off-Site Disposal	N/A
Contingency	$36,700,000
Total Life Cycle Costs	***$161,400,000***

Note: Costs escalated to year incurred.

ENTOMBMENT

Essentially, in this alternative design concept, remediation waste is placed into 55 gallon steel drums. Eight steel drums are then placed into a large concrete canister (or concrete box) which is then filled with grout. The canisters are stored in a weatherproof hardened concrete vault. This design option is intended for long term retrievable storage (see Figure E-8). While meeting the definition of Monitorable Retrievable Storage , the actual waste, while highly retrievable would be less monitorable than several of the alternate designs. This design alternative is based on a similar design described in an EG&G-INEL *Interim Report: Waste Management Facilities Cost Information for Low Level Waste*, dated March 1994.

This design combines several concepts of some of the previous design alternatives, it is most similar to the hardened concrete vault design. The most significant difference is that each waste canister is entombed in concrete. The remediation waste is placed into 55 gallon steel drums. Eight drums are placed into a single larger canister (concrete box), which is then sealed by filling it with (cement) grout. The canisters are then placed into the storage facility which consists of a series of adjacent hardened concrete cells (vaults). The facility would be constructed over a double liner and leachate collection system. The facility itself would consist of rows of concrete cells having an access aisle between the rows. The canisters are placed into the open topped concrete cells, and stacked three high. When a cell is filled with canisters the void spaces in the cell (between the canisters and cell walls), are backfilled with sand and then a concrete cover is constructed on the top of the cell thereby closing the cell. When the cells have been covered with concrete, an interim cover is constructed over the entire facility.

- The following features were used to develop the cost estimate (see Table E-8) and could change during detailed design. This design option complies with 6 CCR 1007-3 Part 264 Subpart N Requirements.

  — This waste cell design includes an interim cover (see Figure E-1)

  — A leachate collection layer consisting of one foot of coarse sand

  — The primary liner would be composed of an 80 mil HDPE geomembrane

  — The leak detection system includes a geocomposite (e.g., A geonet with a geotextile on each side)

  — Secondary liner would include three feet of compacted clay, overlain by a 80 mil HDPE geomembrane

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- Each cell floor would be reinforced concrete
- The canisters would be stacked three high in the cells with each canister holding 8 drums
- Each cell would have one adjacent aisle for routine monitoring and inspection
- 1,000 year design life of the facility
- Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring
- Any leachate collected would be treated at another facility, and those costs were not included in the estimate

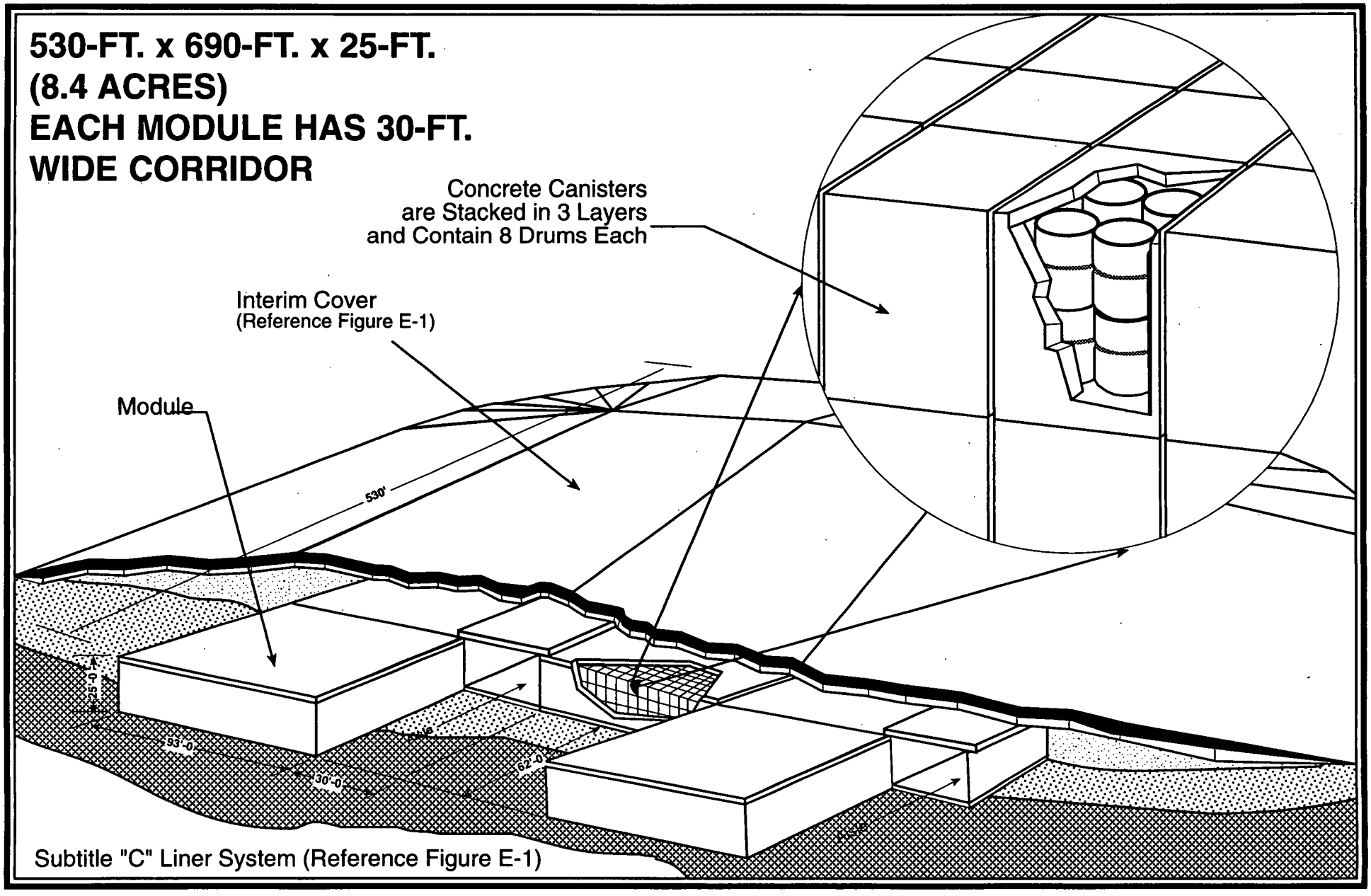

Figure E-8

ENTOMBMENT

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TABLE E-8

Entombment

Task Description	Estimated Cost
Total Cost	$525,000,000
Total Life Cycle Costs	*$525,000,000*

Note: Based on Idaho National Engineering Laboratory report, "Waste Management Fa
Cost Information for Mixed Low Level Waste", dated March 1994.

PYRAMID DESIGN

This alternative design concept is to construct a pyramid around compacted remediation waste in bulk (see Figure E-9). The base/floor of the pyramid would have a rectangular footprint and constructed to be a structurally sound base of slab-on-grade reinforced concrete and quarried stone. The structure/facility would be built in a series of compacted lifts of remediation waste with a "ring" of quarried stone blocks forming the perimeter. The length of the perimeter would decrease as the height increased. It is believed that the quarried stone blocks would not exclude all stormwater over time. Sealant would be used between the quarried stone blocks to prevent stormwater from infiltrating the compacted waste. This design alternative was described and estimated as a result of input from the Citizens Advisory Board.

It was perceived that the ease of monitoring a selected remediation waste would be among the lowest of the options considered. In addition, the structural integrity of the facility would be provided by the compacted waste itself. The quarried stone blocks, due to their large size, would be extremely expensive to procure, transport, and install. Due to the limited mass of stone relative to the mass of compacted waste, the quarried stone blocks themselves would contribute little to the overall integrity of the facility. A sealant placed between the blocks would be expected to fail when differential settling of the waste occurred, allowing stormwater to enter the waste. Because the engineering properties of the remediation waste (if any) have yet to be defined, it is not clear if the compacted waste would support the quarried stone blocks. Imposing strict physical structural requirements upon the waste to be placed into the pyramid in order to achieve the necessary structural integrity for the intended purpose could exclude significant quantities of remediation waste from this facility or that the waste be treated to a defined strength requirement at additional cost.

For these reasons the pyramid design was discarded after initial cost estimates (see Table E-9) were prepared.

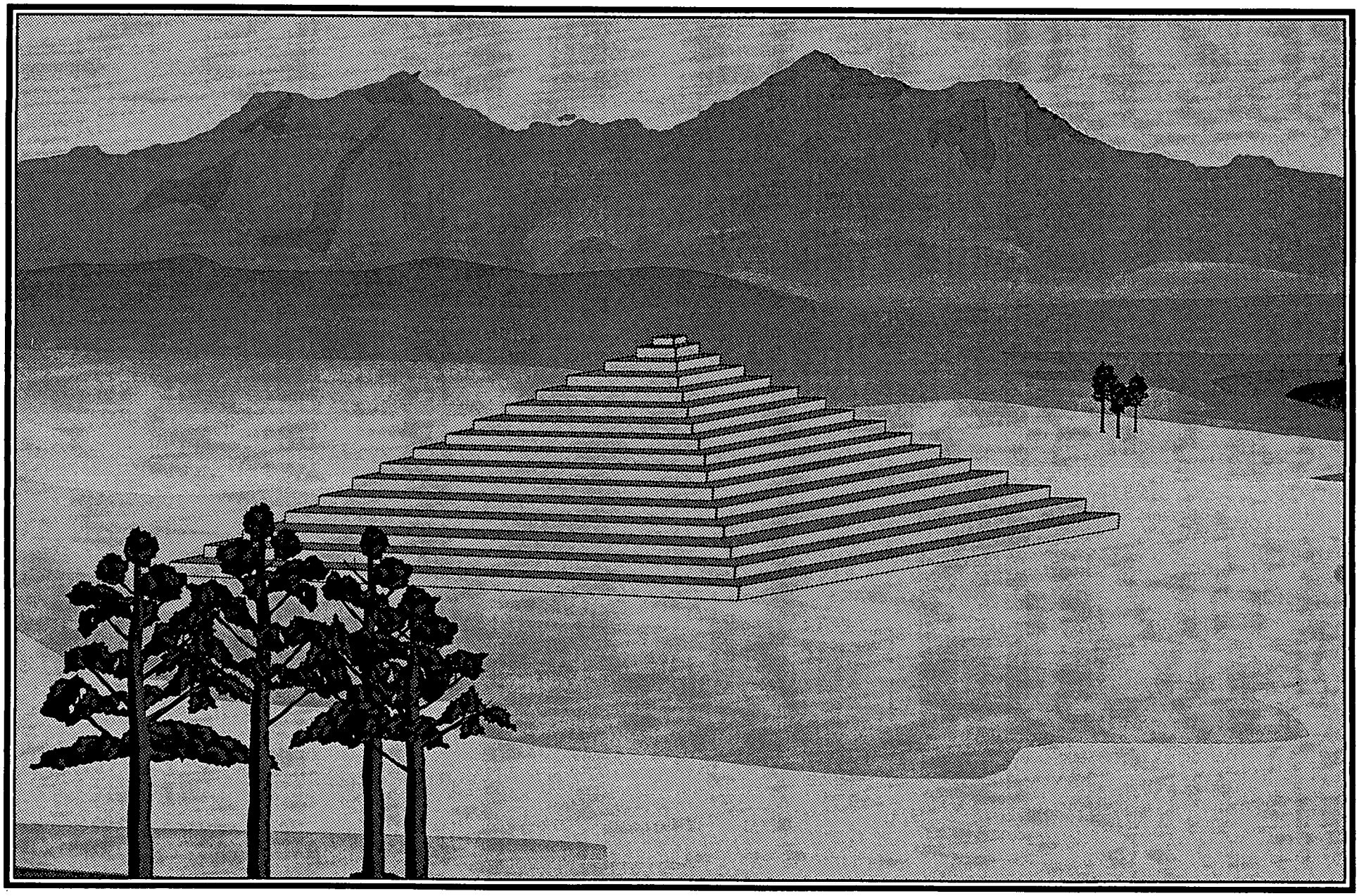

Figure E-9

PYRAMID

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TABLE E-9

Pyramid Design

Task Description	Estimated Cost
Containers	$0
Packaging	$2,100,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$2,200,000
Permitting	$300,000
Pre-Construction	$400,000
Site Preparation	$14,500,000
Construction	$57,900,000
Operations	$9,000,000
Interim Cap Installation	N/A
Interim Closure Care and Monitoring	$13,900,000
Off-Site Disposal	N/A
Contingency	$31,900,000
Total Life Cycle Costs	*$140,300,000*

Waste Pile

This alternative design concept was patterned after the Waste Pile constructed in 1988 at the Rocky Mountain Arsenal. The design was developed and implemented to isolate Basin F hazardous soils and sludges from the environment pending selection of a treatment method and a disposal site. In this concept wastes-in-bulk are compacted into a rectangular pile, covered with a geomembrane , (bottom, sides, and top) and dirt which is vegetated with native grasses (see Figure E-10). No special embankments, pits, buildings, or berms are employed. As the pile is constructed of compacted waste, the waste is covered (daily) with a plastic membrane to prevent the spread of contamination. When complete the pile is sealed within a geomembrane. The geomembrane would be covered with fill dirt and vegetated with native grasses. This alternative would provide 30 year monitored retrievable storage of remediation waste pending agreement by the public, the regulators, and the DOE as to disposition. See Table E-10 for a conceptual cost estimate.

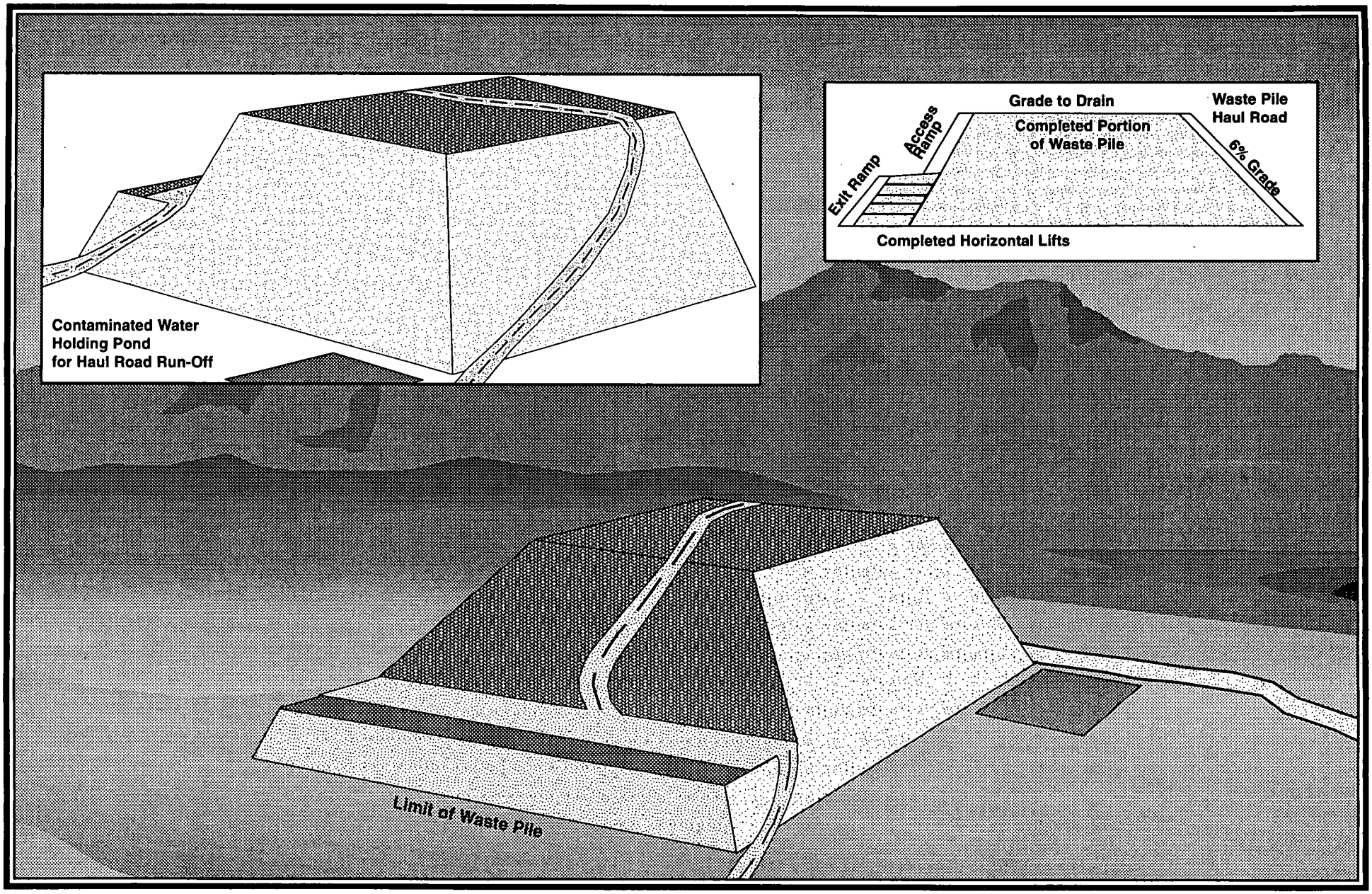

Figure E-10
WASTE PILE

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TABLE E-10

WASTE PILE

Task Description	Estimated Cost
Actual Costs (Escalated 1988 to 1996)	$36,669,000
Off-Site Disposal	N/A
Total Life Cycle Costs	*$36,669,000*

Note: Costs escalated to year incurred.

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NO ACTION

The "No Action" alternative is included in this listing of design options to fulfill the requirements of both NEPA and CERCLA regulations. Both require that the "No Action" option continues to be considered through the end of the decision making process.

The Proposed Action is an onsite facility

The proposed action is to permit and construct an onsite storage facility to contain remediation waste(s) generated as part of the cleanup and closure activities at RFETS. This facility would be designed and permitted as a CAMU, a storage facility to isolate the wastes from the environment in a retrievable fashion. This facility would be designed to meet RCRA Subtitle "C" Landfill facility requirements. Permitted storage under a CAMU permit would allow the waste to remain non-Land Disposal Requirements (LDR) compliant for the period of storage. This storage would allow an indefinite period of time for the general public, the DOE and the CDPHE to determine and agree upon the ultimate fate (disposal) of the wastes via a Record of Decision (ROD). One of the disposal options which could be considered during this time period could be the permitting of the Remediation Waste Storage Facility as a permanent CAMU storage facility.

The No Action alternative is to ship remediation waste off site as soon as it is produced

The NO ACTION option is to package and ship all remediation waste generated as part of the cleanup and closure activities to an off site disposal facility, as a permitted onsite hazardous, LLW, or LLMW disposal facility does not exist. This option requires that all waste meet Department of Transportation regulations for Interstate shipment of hazardous, radioactive, and mixed waste before it leaves the Site. This option also requires that all remediation wastes generated meet LDR's prior to disposal. See Table E-11 for the conceptual cost estimate summary.

TABLE E-11

NO ACTION

(Offsite disposal concurrent with generation)

Task Description	Estimated Cost
Containers	$4,600,000
Packaging	$2,900,000
Treatment/Characterization	$78,400,000
Transportation	$7,600,000
Design	N/A
Permitting	N/A
Pre-Construction	N/A
Site Preparation	N/A
Construction	N/A
Operations	N/A
Closure (Cap Installation)	N/A
Interim Closure Care and Monitoring	N/A
Off-Site Disposal (years 1997,8,9)	$73,300,000
*Contingency **	$49,100,000
Total Life Cycle Costs	*$215,900,000*

Note: (1) costs escalated to year incurred.

(*) Contingency not included in cost summary shown on Figure B-2 of Appendix B.

Appendix F

Backup for Facility Design Screen

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Appendix F - Backup for Facility Design Screen

This appendix provides details of the facility design screen for each of the major criteria. This appendix backs up information provided in Table 6-1. Specific criteria have been referenced in parentheses (e.g., [C #.#]). Additional information on specific criteria can be found in Section 5 and Appendix D.

F.1 ABOVEGRADE STORAGE CELL

Description:

This facility is similar in construction to a typical waste management cell except that fill would be used to build up the sides of the cell so it could be placed abovegrade. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

Many of the features of the abovegrade storage cell support a CAMU designation. The facility would have a double liner, a leachate collection system, and an impermeable cap to ensure that releases do not occur (C 1.4). The facility could well support the timing of remedial activities since it is a simple and proficient design and remediation waste can be placed in the facility without as much additional processing (C 1.5). Because waste could be placed in bulk, remediation waste could go from treatment or excavation directly into the cell. This could both expedite accelerated actions as well as reduce the cost by eliminating the need for a remediation waste staging area. Construction and of the facility could be expedient because the design is simple and the technology is readily available and well known.

Public Protection (Geotechnical and Hydrological Criteria)

The abovegrade storage cell has many of the advantages of other designs including double liners and a shallow slope around the edge of the structure to protect against erosion (C 2.1, 2.3). The double liner system and abovegrade design would isolate the facility from the substrate and ground water (C 2.3, 2.10, 2.12). The impermeable cap could have an impact on surface water drainage and groundwater infiltration since water will be diverted to the edges of the cap (C 2.11).

Site Special Issues:

The abovegrade storage cell would require a larger footprint than many other designs because of the

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additional space required to construct the embankment around the facility. To ensure slope stability, the embankment would be at a five to one slope. This would impact the ability to collocate other waste facilities next to this facility (C 3.9) and could impact some additional utilities (C 3.2). Other than space considerations, it would support the Site Vision well because the storage cell cap could be tied into the cap planned for the Industrial Area of the Site (C 3.1).

Cost Criteria:

The Cost of Construction (C 4.1) was calculated as follows:

Design	$2,200,000
Pre-Construction	$400,000
Construction	$41,700,000
Total Cost of Construction	$44,300,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$8,800,000

The Cost of Interim Closure (C 4.3) was calculated as follows:

Interim Cover	$5,300,000
Interim Care And Monitoring	$13,900,000
Total Cost of Interim Closure	$19,200,000

The above costs were combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$118,800,000

The cost of construction would be high because of the cost of fill material that would be used to build up the embankments and because of all of the earthwork that would be required to place that fill (C 4.1). The low total life cycle cost (C 4.4) would be the result of onsite management in bulk form and potentially low interim closure costs (C 4.3).

Regulatory Support:

In terms of the regulatory support criteria, this facility would not have a lot of future applicability or utility outside of its use to manage bulk waste (C 5.4). For any use, only low level waste would be put in this type of facility (C 5.5). Also, this design is more the current standard than it is state of the art (C 5.3) although the liner and the cap have the potential to be a state of the art design.

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Other Stakeholder Concerns:

This would be one of the simpler facilities to design and construct (C 6.10). The needed materials, services and technologies would be readily available (C 6.12, 6.13). In terms of schedule requirements, this facility could be both expediently constructed and expediently operated (C 6.11) because:

- The design is simple
- The materials are easy to obtain
- The waste can be placed directly into the facility in bulk
- The technology is well known

2le1

F.2 CONCRETE LINED CELL WITH BULK PLACEMENT

Description:

Bulk waste would be placed in modular concrete cells. A double liner and a leachate collection system would be under the facility. Upon filling the cells an impermeable cap would placed above them. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

The concrete walls and floors provide an additional barrier of protection to prevent leakage (C 1.4). This design supports the timing of remedial activities in a number of ways (C 1.5). Waste would be placed in bulk, so remediation waste could go from treatment or excavation directly into the cell. This could both expedite accelerated action as well as reduce the cost by eliminating the need for a remediation waste staging area. Construction of the facility would be expedient because the design is simple and the technology is readily available and well known. The modular design allows use after filling of the cells while other are under construction so the facility could start accepting waste prior to the completion of construction.

Public Protection (Geotechnical and Hydrological Criteria) :

The combination of abovegrade design and a double liner barrier will provide reasonable assurances that groundwater and subsurface soils are protected (C 2.1, 2.5, 2.10). Structurally, the concrete walls could provide additional structural stability (C 2.3). Drainage and infiltration could be impacted by the impermeable cover (C 2.11). Geomorphic effects will be minimized by maintaining a gentle slope and by forcing the design to accommodate surface features and the existing drainage patterns (C 2.2, 2.11).

Site Special Issues:

This option has a smaller footprint than some designs although it is slightly larger than the hardened concrete vault. This design well supports Site Vision objectives (C 3.1) since the facility could be part of a continuous cap planned for the Industrial Area and the smaller size of the facility means less total space for managing waste. The modular design should facilitate the placement of similar structures near this facility since walls of the unit could be shared with new modules allowing additional units to be placed right beside existing ones (C 3.9). The use of modules in this design will also enhance the ability of the facility to accept a variety of remediation waste types including Decontamination and Decommissioning waste (C 3.6).

Cost Criteria:

The Cost of Construction (C 4.1) was calculated as follows:

Design	$1,600,000
Pre-Construction	$150,000
Construction	$18,600,000
Total Cost of Construction	$20,350,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$1,970,000

The Cost of Interim Closure (C 4.3) was calculated as follows:

Interim Cover	$5,300,000
Interim Care And Monitoring	$13,000,000
Total Cost of Interim Closure	$18,300,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$77,320,000

Low construction, site preparation, and closure costs (C 4.1, 4.2, 4.3) plus cost savings resulting from bulk storage of the waste would give the lowest total life cycle costs (C 4.4).

Regulatory Support:

This facility design would offer a greater degree of applicability and utility than many of the other designs and is permitable (C 5.3, 5.4). It is a state of the art design (C 5.3) used in Europe for similar applications. Only low-level waste is currently planned for this type of facility design (C 5.5).

Other Stakeholder Concerns:

The modular concrete lined cell allows for a variety of materials to be placed into the facility while still maintaining the ability to retrieve the waste (C 6.6). This facility would offer long-term effectiveness and permanence since it has additional barriers between the waste and the environment (C 6.7, 6.9). The demonstrated performance is better known since this design adds the additional protection of concrete to a storage cell type cap and liner system (C 6.9). Because of the concrete work, this design is expect to be more work intensive in terms of construction but less intensive in terms of operation since it will be a bulk facility (C 6.10). Because the waste could be placed in bulk, it could go directly into the facility after treatment or excavation. Materials, services, and the

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technology would be readily available (C 6.12, 6.13).

F.3 CONCRETE LINED CELL IN CARGO CONTAINERS

Description:

Waste would be put into cargo containers and then placed in modular concrete cells. A double liner and a leachate collection system would be under the facility. Upon filling the cells an impermeable cap would placed above them. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

The concrete walls and floors provide an additional barrier of protection to prevent leakage (C 1.4). Construction and of the facility could be expedient because the design is simple and the technology is readily available and well known (C 1.5). The modular design allows use after filling of the cells while other are under construction so the facility could start accepting waste prior to the completion of construction.

Public Protection (Geotechnical and Hydrological Criteria):

The cargo containers themselves could provide some structural support ad well as providing an additional barrier to prevent leaking (C 2.3). Further protection of groundwater and the subsurface strata is provided by the concrete base (C 2.5, 2.11, 2.12). Drainage and erosion could be controlled by maintaining a shallow slope and by adjusting the design to account for existing drainage; however the impermeable cover would still have some impact (C 2.10).

Site Special Issues:

This option has a smaller footprint than some designs although it is slightly larger than the hardened concrete vault. This design well supports Site Vision objectives (C 3.1) since the facility could be part of a continuous cap planned for the Industrial Area and the smaller size of the facility would mean less total space for managing waste. The modular design would facilitate the placement of similar structures near the facility since walls of the unit could be shared with new modules allowing additional units to be placed right beside existing ones (C 3.9). The use of modules in this design will also enhance the ability of the facility to accept a variety of remediation waste types including Decontamination and Decommissioning waste (C 3.6).

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Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	$1,600,000
Pre-Construction	$150,000
Construction	$18,600,000
Total Cost of Construction	$20,350,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$1,970,000

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	$5,300,000
Interim Care And Monitoring	$10,400,000
Total Cost of Interim Closure	$15,700,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$165,650,000

Low construction costs (C 4.1) would offset the cost for containers to yield a relative low total life-cycle cost (C 4.4).

Regulatory Support:

This facility design would offer a greater degree of applicability and utility than many of the other designs and is permitable (C 5.3, 5.4). It is a state of the art design (C 5.3) used in Europe for similar applications. Only low-level waste is currently planned for this type of facility design (C 5.5).

Other Stakeholder Concerns:

The use of containers better supports retrievability since the waste will be segregated, accessible and easier to inspect and remove (C 6.1, 6.2). As with the concrete lined call with bulk management, it compares favorably to the other designs in terms of useful life, effectiveness, demonstrated performance, and the availability of the technology, services and materials (C 6.7, 6.9, 6.12, 6.13). It will take additional time to construct than some of the other abovegrade designs due to all of the concrete work (C 6.10, 6.11). Operations will be slightly more intensive than the concrete lined bulk facility due to the use of containers (C 6.10, 6.11).

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F.4 HARDENED CONCRETE VAULT

Description:

Remediation waste inside cargo containers would be stored in a modular, abovegrade, self-supporting concrete structure placed over a double liner and leachate collection system. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

This design has additional features that enhance its protectiveness including additional barriers provided by concrete walls and floors and the containers (C 1.1). The waste would be very accessible since aisle ways would be present and containers could be removed and visually inspected for leaks. The modular design would allow use of one module prior to completion of the facility. This would allow use of the facility to be available sooner (C 1.5).

Public Protection (Geotechnical and Hydrological Criteria):

Concrete walls and floor could provide some additional structural support. Impermeable cap could impact drainage and infiltration patterns (C 2.11).

Site Special Issues:

The footprint for the hardened concrete vault would not be as large as many of the other designs considered. It would be easier to place additional facilities next to this facility because of its smaller foot print and concrete walls (C 3.9). One drawback would be that it could take a little longer to design and build and the filling of the facility is more work intensive and would take resources always from other Site closure activities (C 3.1). It would take longer to fill each vault which could also cause scheduling problems.

Cost Criteria:

The Cost of Construction (C 4.1) was calculated as follows:

Design	$2,200,000
Pre-Construction	$400,000
Construction	$26,000,000
Total Cost of Construction	$28,600,000

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The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$6,100,000

The Cost of Interim Closure (C 4.3) was calculated as follows:

Interim Cover	$5,300,000
Interim Care And Monitoring	$10,400,000
Total Cost of Interim Closure	$15,700,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$181,630,000

In spite of high site preparation costs (C 4.2), moderately high closure costs (C 4.3) and the cost for containers, the life-cycle cost would compare favorable with the other designs considered (C 4.4).

Regulatory Support:

This design could have utilized for other applications including management of other waste types because there would be access aisles and it would be designed to hold cargo containers which could be used for other materials as well (C 5.4), although this design is only being considered for low-level waste (C 5.5). It is a state of the art design C 5.3).

Other Stakeholder Concerns:

This facility offers a high degree of monitorability and retrievability (C 6.1, 6.2) because there would be aisles for access, the waste would be in containers, and the modular design would enhance the ability to segregate and track the waste. In terms of construction and operation, this design would be more intensive (C 6.10) since additional effort would be required to construct the concrete vaults walls. During operations additional effort would be needed in containerizing the waste. The materials, services, or the technology needed to construct and operate this facility would be readily available (C 6.12, 6.13).

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F.5 SILO DESIGN

Description:

Concrete silos would be placed over a double composite liner system and leachate collection system. Remediation waste would be placed in the silos in bulk Upon completion of filling operations, the entire facility would be covered with an interim cap. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

The concrete silos, double liner and leachate collection system enhance the protectiveness of this design (C 1.1). Bulk placement in the silos would be easy to place but inspection would be limited.

Public Protection (Geotechnical and Hydrological Criteria):

Interim cap could impact drainage and infiltration patterns (C 2.11)

Site Special Issues:

The interim cap and small footprint would tie in well into the planned cap for the Industrial Area Cap as part of the Site Vision (C 3.1).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	$2,000,000
Pre-Construction	$400,000
Construction	$30,400,000
Total Cost of Construction	$32,800,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$6,100,000

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	$5,300,000
Interim Care And Monitoring	$13,900,000
Total Cost of Interim Closure	$19,200,000

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The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$107,300,000

Middle of the range construction costs (C 4.1) and low closure costs (C 4.3) combined cost savings from with bulk storage yielded a low life-cycle cost of the facility design alternatives (C 4.4).

Regulatory Support:

This design meets some of the state principles. It is a state of the art design (C 5.3) and it is design to be permitted under RCRA; however its future use would be limited since the design is geared towards the bulk management of low-level soils (C 5.4, 5.5).

Other Stakeholder Concerns:

This design is not in wide use and so the performance and useful life is not as established (C 6.7, 6.9, 6.12). The intensive nature of this design would be very demanding in terms of design and construction and would probably take longer to get into operation (F10, F11). The main activities that would affect the schedule would be the additional time setting up forms and filling the silos and additional time preparing the detailed design (C 6.11).

F.6 SLAB ON GRADE

Description:

Waste would be put in cargo containers and placed on an abovegrade slab. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

The Slab on Grade would be quick and easy to install due to its simple design, known technology, and the materials would be easily available. Since the time to complete the design work would be less also due to simplicity and the construction would mostly consist of site preparation and pouring the slab, it is anticipated that this design could be implemented in a relatively short period of time (C 1.5). The use of containers would allow for visual inspection in order to detect leaks prior to contaminants escaping to the environment (C 1.1, 1.2). Waste containers would be exposed to the elements unless a covering such as tent was placed over the slab. Contaminants that did escape from the containers could be collected in the concrete berm. Any waste material not captured by the concrete berm could escape into the environment, but since the waste is containers the possibility would be remote.

Public Protection (Geotechnical and Hydrological Criteria):

The ability to meet CAMU criteria is dependent on maintenance of the slab (C 2.5, C 2.10). A slab on grade design would be a temporary facility and the remediation waste would have to be shipped at a later date to some other facility to provide reasonable assurance that it could protect the public for a thousand years (C 2.1). A slab on grade could be engineered to provide adequate drainage (C 2.11), and a permeability of less than 10^{-7} centimeter/second (C 2.5). Slab design would also have to account for settling, expansion and contraction to avoid cracks and structural damage.

Site Special Issues:

The Slab on Grade would have minimal impact on utilities since there is little excavation involved and some overhead utilities could still run over the facility (C 3.2). As with Metal Buildings, this facility could readily support short-term Site Vision goals since it could be designed and constructed in less time, but it is temporary and could remain as an unclosed facility long after other plant facilities have been shut down (C 3.1). The collocation of other waste facilities is a problem only because the slab will have such a large footprint that it could limit the space available for other facilities (C 3.9).

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Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	$300,000
Pre-Construction	$200,000
Construction	$3,800,000
Total Cost of Construction	$4,300,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$6,100,000

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	$8,500,000
Total Cost of Interim Closure	$8,500,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$141,600,000

Site preparation costs (C 4.2) and construction costs (C 4.1) would be very low because little earth work would be involved and construction would consist mainly of pouring the pad. However, these costs would be insignificant in comparison to the costs for offsite disposal and container costs which would give a very high total life-cycle cost (C 4.4).

Regulatory Support:

Like the Metal Buildings design, this RWSF would be designed meet RCRA requirements for permitted storage including the ability to visually inspect the waste (C5.3). The lack of cover and continual exposure of the waste containers to the elements could be an issue in permitting this facility (5.3, 5.4). It would have a good degree of future applicability and utility since it is basically just a concrete pad (C 5.4). Future applications could include other storage uses, a lay down yard, a staging pad for other cleanup operations, or a tent could be constructed over it. This facility design is far from being state of the art (C 5.3) since it really offers nothing new or innovative in the way of waste management.

Other Stakeholder Concerns:

The containers would be exposed to the elements and there would a slight possibility that the run off

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could get into surface water systems (C 6.2, 6.7). Due to the simplicity of this design it should be easy to design and construct in less time than the other designs (C 6.10, 6.11, 6.12, 6.13). Monitoring and retrieval would be well supported by this facility since all sides of the facility are potentially accessible and the containers can be easily moved and inspected. It would have a very short useful life relative to the other designs (C 6.7, 6.9). The materials, services and technology for this facility would easy to obtain because it a well known technology utilizing common construction materials (C 6.12, 6.13).

F.7 METAL BUILDINGS

Description:

Waste would be put in cargo containers and placed in four engineered metal buildings constructed on a concrete slab. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

The use of cargo containers would allow visual leak detection; however, the cost for these containers is high (C 1.1). Like the slab on grade, contaminants that did escape from the containers could be collected in the concrete berm. The building roof would protect containers from precipitation and further minimize any possibility of leaching (C 1.1). The simple, proven design and less intensive construction would allow this facility to be available sooner which could quicken near term remedial activities and might avoid temporary storage of this waste at another facility or staging area (C 1.1).

Public Protection (Geotechnical and Hydrological Criteria):

The design life of this facility would be less than other alternatives considered (C 2.1). An advantage would be that most leaks could be contained prior to escaping to the environment. The metal building design would be engineered to provide adequate drainage (C 2.11). Because this design actually consists of different buildings precipitation could be allowed to infiltrate to the water table without compromising the waste with in the buildings.

Site Special Issues:

The Metal Building design would have a large footprint compared to the other designs because additional space would be needed for aisle ways and to provide spacing between the buildings (C 3.1). The facility could be used before completely constructed since only one building would need to be ready for remediation waste to be placed inside. This would better support the Site Vision objectives of accelerated site clean up; however, its large footprint would not incorporate the Site Vision objective of reducing the foot print of contaminated area (C 3.1). One advantage to the Metal Buildings design is that there would be a little more flexibility in configuring the buildings so that utilities and other features could be worked around (C 3.2). The colocation of other waste facilities would be a problem only because the Metal Buildings would have such a large footprint that it could limit the space available for other facilities (C 3.9).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	$2,300,000
Pre-Construction	$1,300,000
Construction	$17,900,000
Total Cost of Construction	$21,500,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$2,800,000

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	$10,400,000
Total Cost of Interim Closure	$10,400,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$161,400,000

Low construction costs (C 4.1) would be offset by the cost of containers to yield one of the higher total life-cycle costs (C 4.4).

Regulatory Support:

This facility design would be designed meet RCRA requirements for permitted storage including the ability to visual inspect the waste (C 5.3). The lack of cover and continual exposure of the waste containers to the elements could be an issue in permitting this facility (5.3, 5.4). It would have a good degree of future applicability and utility since it would be basically just a concrete pad (C 5.4). Future applications could include other storage uses or as a building for other closure activities. Like the Slab on Grade, this facility design is not state of the art (C 5.3) since it really offers nothing new or innovative in the way of waste management.

Other Stakeholder Concerns:

Monitoring and retrieval could be performed from the aisle ways in each buildings and the waste containers could be pulled out for even closer inspection. This is a well known technology (C 6.12) and its performance is well demonstrated (C 6.9); however, in comparison to other designs it would have a poor useful life since it is designed as a temporary facility. Even with maintenance, its

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effectiveness would eventually degrade as the buildings degrade (F7, F9). This facility would be easy to construct in a timely manner and the services and materials would very easy to acquire (C 6.10, 6.11, 6.13).

F.8 ENTOMBMENT

Description:

Remediation waste would be placed in 55 gallon drum containers and then placed in a concrete canister that are then sealed with grout. The canisters are then placed in a hardened concrete vault. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

This would have additional features that would add to the overall but protectiveness but would come at a high cost. These protective features would include an impermeable cap, a double liner, an impermeable cap, and hardened concrete walls. Inside the facility, the waste would be further contained by placement in 55 gallon drums which in turn would be entombed in concrete canisters (C 1.1). Entombment in canisters would be incorporating a treatment technology (similar to solidification) that enhances long-term effectiveness (C 1.6). Due to work intensive nature of this design compared to most facilities, additional time could be needed to design and construct this facility (C 1.5). Once in operation, this design would probably require more effort to get the waste from the field and into the facility and could require an additional staging area to seal the waste in concrete canisters.

Public Protection (Geotechnical and Hydrological Criteria)

Numerous barriers protect groundwater and surface water from any form of contaminant migration (C 2.5, 2.11, 2.12). Impermeable cap could have some impact on drainage patterns and infiltration (C 2.11).

Site Special Issues:

Entombment would require a very large footprint because the concrete box containment takes up more space than either bulk management or cargo containers. Like other designs with concrete walls, it would be easier to place additional facilities in the vicinity of an entombment facility (C 3.9). Additional staging areas would be required to grout and then place the waste containers. This could have an impact on Site activities including Site closure activities (C 3.1). Additional problems could result when the waste is to be disposed of. Because the waste would be grouted into the containers, other facilities might not be willing to accept this waste. It could require expensive and time consuming reprocessing which would also have an impact to Site closure activities (C 3.1).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	N/A
Pre-Construction	N/A
Construction	N/A
Total Cost of Construction	N/A

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	N/A

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	N/A
Total Cost of Interim Closure	N/A

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$525,000,000

* The cost for entombment was not calculated using a bottoms-up method and therefore a breakdown of costs is not available.

Entombment would be more expensive or as expensive as any of designs considered in terms of construction costs (C4.1), site preparation (C 4.2), closure (C 4.3), and total life-cycle cost (C 4.4). Factors that contribute to this high cost could include:

- Placement in concrete boxes would be labor and material intensive
- The facility itself would be very large which would increase construction costs
- The larger footprint would require more site preparation work

Regulatory Support:

This facility design could be considered state of the art (C 5.3) due its more advanced containment system. Although the materials would be sealed in place, the concrete boxes would be retrievable for inspection (C 5.3, 5.4).

Other Stakeholder Concerns:

Retrieval of the concrete boxes themselves would be simple as long as the facility was in operation. After the placement of the cap retrieval would be more difficult. Retrieval of individual drums would be further compounded by the fact that the drums would be set in grout and would have to be chiseled out. This unit would have a long useful life and would be very effective (C 6.7, C 6.9) since it would be constructed from time tested materials and would offer multiple levels of containment. Ultimately problems could occur if the entombed waste were shipped offsite since other facilities might not accept the waste in the concrete boxes. Removing the waste from the concrete boxes would be very expensive since the waste would have to be chipped out of the grout. This facility would be much more labor, material and time intensive for both construction and operation (C 6.10, 6.11). Additional time and effort would be needed to:

- Design the facility
- Develop the technology
- Build packaging facilities
- Perform additional site preparation

The operation phase would also be more intensive due to the additional efforts required to prepare the waste in concrete canisters (C 6.10, 6.11). There could also be some problems encountered with the availability of the needed technology since this type of facility is not as common (C 6.12). No problems are expected in getting the needed raw materials and services (C 6.13). There could be some limitations in accepting some waste due to the size limitations of the 55 gallon drums (C 6.8).

F.9 PYRAMID DESIGN

Description:

Bulk remediation waste would be placed inside of a giant hollow pyramid constructed of quarried stone blocks. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

This design could require more maintenance to maintain its protectiveness since settling or shifting of the outside block could cause areas of exposure requiring repair (C 1.1). A more lengthy design and construction period could be required for development of this technology and because availability of materials could be limited (C 1.5).

Public Protection (Geotechnical and Hydrological Criteria)

The Pyramid design should provide good drainage based on its geometry but could alter area drainage and infiltration patterns (C 2.11). The pyramid design would have to account for weight of the facility as well as impacts to slope stability (C 2.3).

Site Special Issues:

This alternative could need additional design and construction time which would impact cleanup efforts under the Site Vision (C 3.1). This additional time would be utilized for technology development since this is a new application. Additional time would also be spent obtaining a supplier of stone blocks, having the blocks cut, and for geotechnical work. As an innovative design, some additional time could also be required to verify the soundness of the technology. Ultimately, this could potentially impact building deactivation, decontamination, and decommissioning activities (C 3.5, 3.6). The prolonged design and construction of the facility could cause additional remediation waste to be placed in RCRA storage units consuming space needed for other waste (C 3.7). There could be some problems with locating future waste facilities near the pyramid since changes in geometry of the facility are limited and the footprint is larger than other designs (C 3.9).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	$2,200,000
Pre-Construction	$400,000
Construction	$57,900,000
Total Cost of Construction	$60,500,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$14,500,000

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	$13,900,000
Total Cost of Interim Closure	$13,900,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$140,300,000

Although this design would be one of the more expensive designs to prepare the site for and construct (C 4.1, 4.2), it would be one of the least expensive to close (C 4.3) and the total life cycle cost would place this design in the lower part of the range of those considered (C 4.4). Because the design is untested, additional costs could be incurred due technology development and additional design. These costs were not incorporated into the estimate.

Regulatory Support:

Although it is an innovative design, it is not currently state of the art (C 5.3) since the technology has never been developed for this application. Nor would the facility offer "the greatest degree of future applicability and utility" since it would be designed specifically for one use, the containment of contaminated soils.

Other Stakeholder Concerns:

Due to its innovative nature, a lot of unknowns are associated with this design. Although there is demonstrated performance with pyramids by ancient man for observatories, temples, or tombs, in general, there is no demonstrated performance for this particular design nor with the application of this design to waste management (C 6.9). If the blocks were to remain intact, the life of the structure

itself could be similar to ancient pyramids. It is not known whether differential settling would open up the seams between the blocks allowing precipitation into the interior. Depending on their size and type of stone used, the blocks for the pyramid could be difficult to acquire (C 6.11, 6.12, 6.13).

F.10 WASTE PILE

Description:

Bulk waste would be compacted into a rectangular pile, sealed in a geomembrane and covered with dirt. The facility would be underlain with a liner and leachate collection system. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

Because the necessary design and site preparation of this facility would be minimal, use of the facility could be available sooner which could expedite some near-term early actions (C 1.5).

Public Protection (Geotechnical and Hydrological Criteria)

The design life of this facility is to approximately 30 years. At the end of its useful life, the facility would have to modified, a new facility would have to be constructed or the waste would have to be sent to another facility (C 2.1).

Site Special Issues:

The impermeable cap could be tied into the cap planned for the Industrial Area as part of Site closures activities under the Site Vision (C 3.1).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	N/A
Pre-Construction	N/A
Construction	N/A
Total Cost of Construction	N/A

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	N/A

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	N/A

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Total Cost of Interim Closure	N/A

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$36,670,000

* A breakdown of specific costs are not available. Life-cycle costs are based on actuals from a similar facility.

The construction costs and site preparations costs would be very low (C 4.1, 4.2), resulting in a a low life-cycle cost (C 4.4).

Regulatory Support:

This design is geared specifically towards soil and other remediation recovered during Site clean up and therefore this facility would not have many other uses (C 5.4).

Other Stakeholder Concerns:

The useful life of this facility would be limited since the intent is to provide safe, cost-effective storage until the waste can be moved to a more permanent facility (C 6.6, 6.9). The simplicity of this facility would allow for a reduced design and construction period (C 6.11). Because waste would be placed in an easily accessed pile, operations would also be facilitated by this design. Once the waste pile is covered over, retrieval and monitoring of individual waste streams would be hampered by access problems and a lack of separation. On the other hand, retrieval of all of the waste at once could be relatively simple since the cover could be breached and the waste could be removed with a front end loader.

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F.11 NO ACTION

Description:

The no action alternative is to shipped the waste to an offsite facility as it is generated. A more detailed description of this design is given in Appendix E and Appendix B.

CAMU Criteria:

CAMU criteria are not applicable to this action since an offsite facility would not be used as a CAMU.

Public Protection (Geotechnical and Hydrological Criteria)

Public protection would be dependent on the facility. Protection to the groundwater would likely be equivalent or better than RCRA Title C Landfill requirements. Offsite facilities could have less permeable geologic strata to meet minimum permeability of 10^{-7} centimeters/second, whereas onsite facility would likely meet the same minimum permeability with engineered barriers (C 2.5).

Site Special Issues:

This option would only require a staging area for packaging and transporting the waste. Since no space would be needed for a storage facility, this option would well address the Site Vision objective of reducing the footprint of contaminated areas (C 3.1). Delays in shipping could cause valuable RCRA storage space to be utilized (C 3.7).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	N/A
Pre-Construction	N/A
Construction	N/A
Total Cost of Construction	N/A

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	N/A

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The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	N/A
Total Cost of Interim Closure	N/A

The above costs were combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$215,900,000

Because a major facility would not have to be constructed, most of the cost would be tied up in offsite disposal (C 4.4).

Regulatory Support:

These criteria are not applicable to this option, because these criteria only apply to onsite facilities.

Other Stakeholder Concerns:

Because this option would utilize an existing facility, issues associated with construction and the availability of the technology, materials, and services do not exist (C 6.10, 6.12 6.13). Some offsite facilities might not be able to accept all of the waste types that would be generated due permit or license restrictions, differing waste acceptance criteria, or restrictions based on regulation (C 6.8). In terms of schedule requirements, there would be no delays due to construction of the facility, although additional handling, packaging, and transportation facilities at the Site could be needed (C 6.11). During the operation phase, there would be delays in putting waste in the facility due to characterization, documentation, packaging, and acceptance requirements. Remediation waste would be put in temporary storage at the Site while these requirements were being addressed.

Appendix G

(This Appendix has been deleted)

Appendix H
Backup Information for Risk Evaluation

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FORWARD:

This document was developed in early spring of 1996. The intent was to define a typical waste stream based on actual analytical data in the site characterization database (Rocky Flats Environmental Data System). Since significant data gaps exist in the characterization of the Industrial Area, data from the solar ponds characterization was used to estimate a representative waste stream. No inferences should be made regarding actual waste streams which will be activity specific and subject to regulatory agency approval. The use of waste streams such as pondcrete and solar ponds vadose zone soils were for the sole purpose of estimating typical waste streams at RFETS.

Appendix H is composed of three reports. The first report "Estimation Of Contaminant Concentrations From Probable Leachate Compositions At Seep Pathways In The Vicinity Of The Waste Management Facility, Rocky Flats Environmental Technology Site, Colorado" contains the other two reports in it's Appendix A.

The body of the first report is nineteen pages long and continues from page H-5 through H-25 The body of the second report is three pages long and continues from page 26 through H-28. The third report contains tables and figures within the test and continues from page H-29 through H-53. The third report contains an appendix (Appendix A) which goes form page H-53 through H-61.

The first report has an Appendix B (Help Model Output) which goes from page H-62 through the end of Appendix H.

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April 12, 1996

1.0 INTRODUCTION

A Waste Management Facility (WMF) has been proposed to be constructed at the Rocky Flats Environmental Technology Site (RFETS). A conceptual level, semi-quantitative assessment of the maximum level of contamination that could migrate from the Waste Management Facility (WMF) to surface water was performed. This effort serves as part of the analysis of the facility design in terms of CAMU protectiveness requirements and Part 2 Siting criteria. This report presents an estimate of the concentrations that could result from groundwater exiting from seeps and/or entering surface water from the WMF, given the current design.

Based on preliminary design drawings from RMRS/Engineering, the WMF will consist of a concrete slab, 500 by 360 feet in plan (approximately 4.13 acres). The slab will be constructed as three modules (500 feet long by 120 feet wide), which will be separated from each other by vertical concrete walls (18 feet high). A 14 foot high perimeter wall will enclose the entire slab. Various waste materials will be placed in the bins, including bulk wastes (contaminated soils), pondcrete (low strength concrete in approximately one meter cubes), and structural steel.

In concept, the bottom of the slab will be poured at existing grade. However, the slab will be underlain by a composite liner system consisting of one foot of drainage gravel, a geotextile, an 80 mil textured HDPE geomembrane, a geotextile, a geonet leak detection layer, a geotextile, an 80 mil textured HDPE geomembrane, and three feet of compacted clay.

After the various bins are filled with waste, a composite cover system will be constructed. The cover will include (from the top) two feet of vegetated soil with armament, a geotextile, one foot of graded gravel, three feet of riprap (biotic barrier), a geotextile, one foot of sand, a geotextile, an 80 mil HDPE geomembrane, a geosynthetic clay membrane, and two feet of compacted clay.

Three leachate flux scenarios are addressed in this document. Scenario 1 uses a leachate flux resulting from a capped and lined WMF, representing a post-closure time period. Scenario 2 uses a leachate flux from an uncapped, but lined WMF prior to closure. The leachate flux for these scenarios are estimated using a computer model. Scenario 3 is a worst case scenario, using a leachate flux equal to an assumed RFETS recharge rate of 1 inch per year.

2.0 METHODOLOGY

A simple dilution calculation is used to obtain potential concentrations of groundwater exiting at seeps or entering surface water. In order to estimate the contamination concentrations of groundwater at locations where it intercepts surface water, (at seeps or the drainages) the following methodology was used:

1. Estimate leachate concentrations;
2. Estimate flux of leachate though the base of the WMF;
3. Estimate mass of leachate constituents in leachate exiting WMF;
4. Estimate concentrations of leachate constituents after mixing in groundwater below WMF.

In order to complete this analysis, the following assumptions were made:

- instantaneous mixing of leachate in groundwater below WMF
- annual flux out of WMF base is at equilibrium conditions (it does not change with time)
- groundwater concentrations beneath WMF do not include existing contamination
- retardation is ignored
- no thorough flow of groundwater beneath the WMF
- contamination from the WMF leachate does not "build up" over time

- concentrations are estimated for a time period after the WMF has been capped.

3.0 ESTIMATION OF LEACHATE CONCENTRATIONS

In order to estimate the concentrations of contaminants at seep locations near the WMF, it is necessary to estimate the probable leachate composition. To accomplish this, the commonly used soil/water partitioning equation (EPA, 1994) was used to estimate maximum concentrations for organic constituents and the leachate composition from Siders (1996) was used for metals and radionuclides.

The soil/water partitioning equation is a more simplified approach than numerical transport modeling. Based on the unknowns regarding the analysis parameters (amount of waste in place, contaminant concentrations in the waste, etc.) a more simplified approach is more appropriate.

The soil/water partitioning equation describes the partitioning of a contaminant between solid, liquid, and gaseous phases under equilibrium conditions. The soil/water partitioning equation is:

$$C_w = C_s/[K_d + (\theta_w + \theta_a H')/\rho_b]$$

where:

C_w is the soil water concentration (mg/l)
C_s is the waste soil contaminant concentration (mg/kg)
K_d is the distribution coefficient (ml/kg)
θ_w is the water filled porosity of the waste soils (assumed to be 1.0)
θ_a is the air-filled porosity of the waste soils (assumed to be 0.0)
H' is the Henry's Law constant
ρ_b is the representative bulk density of the waste soils (assumed to be 1.5 g/cm^3)

Leachate concentrations for volatile and semi-volatile organic compounds (VOC/SVOCs) contaminants were estimated by Roberts (1996) with greater than 15% detection frequency. These VOC/SVOC leachate concentrations were used in this analysis for the initial leachate concentrations and composition

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for VOC/SVOCs. Roberts calculated K_d values for the VOC/SVOCs using site-specific data. Roberts (1996) estimation of VOC/SVOC leachate composition and concentrations are presented in Table 1.

A similar approach (using the soil/water partitioning equation) was initially planned for estimating the leachate composition and concentrations for metals and radionuclides. Examination of K_d values for metals and radionuclides (used in the soil/water partitioning equation) revealed virtually no site specific values and that literature values ranged over several orders of magnitude. This variability makes it much more difficult to derive K_ds for metals than VOC/SVOCs. EPA (1994) indicates that the K_ds for metals (and metallic radionuclides) are affected by several factors, including numerous geochemical processes and parameters, variability in the field, and differences in experimental methods. These factors result in variabilities of up to seven orders of magnitude.

Because no meaningful literature or site-specific values for metal K_ds could be obtained, the leachate composition derived by Siders (1996) was used. Siders calculated a probable leachate compositions for metals, radionuclides, and inorganic parameters based on estimated volumes of waste to be stored in the WMF and available data for leachates, pore water, and groundwater from wastes and waste areas. Siders (1996) estimated metals and radionuclides leachate composition and concentrations are also presented in Table 1.

Roberts (1996) and Siders (1996) are contained in Appendix A as supporting documentation.

4.0 ESTIMATION OF LEACHATE FLUX

In order to estimate the amount of contaminants that could potentially reach surface water from the WMF, it was necessary to estimate the flux of fluid through the base of the WMF. This was accomplished using the results of two Hydrologic Evaluation of Landfill Performance (HELP) models and an assumed value of leachate flux. The HELP numerical code was developed for the EPA by the

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U.S. Army Corps of Engineers. HELP is used to obtain rapid and economical estimation of water flux in and out of landfills. Both site-specific and literature values were used in the preparation of this model, which was used to evaluate the effectiveness of the proposed WMF cap/liner system design. The model was run for 100 years.

The HELP model for the WMF consisted of 17 layers over a 10 acre site, representing the engineered liner and cap system. The layers are:

Layer 1 - angular pea gravel

Layer 2 - vegetative layer with gravel

Layer 3 - general backfill

Layer 4 - sand/gravel

Layer 5 - bioexclusion layer (cobbles)

Layer 6 - sand/gravel

Layer 7 - geomembrane and geosynthetic clay liner

Layer 8 - clay liner

Layer 9 - general backfill

Layer 10 - compacted waste

Layer 11 - drainage network

Layer 12 - concrete slab with drainage pipes

Layer 13 - gravel

Layer 14 - leachate collection membrane

Layer 15 - geocomposite

Layer 16 - leak detection membrane

Layer 17 - barrier soil liner (clay).

To evaluate a range of possibilities regarding leachate fluxes, three scenarios were examined. Two scenarios using HELP were examined. Scenario 1 includes both cap and liner systems (simulating post-closure), while Scenario 2 includes only the liner system with no cap(simulating pre-closure). Another scenario (Scenario 3) was also considered in which the leachate flux through the base of the WMF is equal to an assumed recharge rate at RFETS (1 inch/year). Scenario 3 would represent a worst-case scenario because in order for this scenario to take place, the cap/liner system would either have experienced complete failure or would have never been installed. It should be noted that the assumed recharge rate is probably greater than the actual value at Rocky Flats.

From the HELP model scenarios, the average annual leakage through the base of layer 17 (the bottom clay liner) is 0.084 ft^3 (2.38 liters) for Scenario 1 (cap and liner) and 0.205 ft^3 (5.81 liters) for Scenario 2 (liner). These fluxes are probably greater than what would actually result from the WMF, due to the differences in the areas for the HELP models (10 acres) and the proposed design (4.13 acres). This is a conservative result because it would introduce more leachate into the groundwater. This results are only valid for the various inputs used in the model, including industry standard parameters, literature values, and the proposed design of the WMF. Any changes in the model parameter values could change the results of the model. Of course, the model is only a predictor of ideal conditions. Actual design and construction of the WMF will affect performance. It is assumed that the amount of leachate exiting the

WMF is continuous and at equilibrium (it will not change with time). The HELP model output is contained in Appendix B.

Using the assumed value of site recharge (1 inch/year) and the same area used in the HELP model (10 acres) results in 36,300 ft^3 (1.03 million liters) of leachate exiting the WMF annually. Again, this scenario represents a worst-case scenario which could only result from either no cap/liner installation or complete failure of the cap/liner system.

5.0 ESTIMATION OF MASS/ACTIVITY OF LEACHATE CONSTITUENTS

Using the flux exiting the WMF estimated in section 4.0, the mass (or activities for the radionuclides) of the leachate constituents were calculated. This was accomplished by multiplying the amount of the annual flux for each scenario (2.38, 5.81, and 1.03 million liters for scenarios 1, 2, and 3, respectively) by the concentration of the constituents comprising the leachate. The results of this calculation are presented in Table 2. These results represents the mass/activities of contaminants available for mixing in groundwater below the WMF.

6.0 ESTIMATION OF GROUNDWATER VOLUME BELOW WMF

To calculate the resulting concentrations of the mass/activity of leachate constituents, it is necessary to estimate the volume of groundwater beneath the WMF. To obtain this volume, the average saturated thickness was estimated, based on water levels wells screened in the upper hydrostratigraphic unit (UHSU). These data are available in EG&G (1995a). Since the UHSU is comprised of both alluvial materials and weathered bedrock, the estimated saturated thickness included the thickness of the weathered bedrock. The thickness of the weathered bedrock was obtained from EG&G (1995b). Using a

saturated thickness of approximately 35 feet, a porosity of 0.3, and an assumed area of 10 acres, there is approximately 130 million liters of groundwater beneath the WMF available for mixing.

7.0 ESTIMATION OF GROUNDWATER CONCENTRATIONS BENEATH WMF FROM LEACHATE

Using the volume of groundwater beneath the WMF (estimated in section 6.0) and the mass/activity of the leachate constituents (estimated in section 5.0), the concentration of the groundwater from leachate constituents is calculated for each scenario. This is accomplished by dividing the volume of groundwater by the mass/activity of the constituents. This assumes instantaneous mixing of the leachate and the groundwater beneath the WMF and instantaneous appearance at surface water points and seeps. This is a conservative assumption, since no retardation and decay of the contaminants is considered. Concentrations of the leachate constituents which already exist (either naturally or through anthropogenic agencies) in the groundwater are not considered.

This estimation, however, does not consider the addition of contaminants over time. Table 3 presents the potential concentrations of groundwater beneath the WMF from leachate for each scenario. These concentrations represent a potential value for groundwater exiting at seeps and entering surface water for the given scenarios.

8.0 CONCLUSIONS AND RECOMMENDATIONS

These estimates represent potential concentrations for groundwater contamination from leachate. Assuming that this concentration reaches the surface water and seeps, it also represents a potential concentration that could appear at these locations. Resulting groundwater concentrations for the three scenarios were compared to draft RFCA (RFCA, 1996) action levels for surface water as a mean of evaluating the impact of the WMF. Table 4 lists the applicable RFCA surface water action levels for stream segment 5 (the section of Walnut Creek near the WMF).

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Any modifications to the existing HELP model and/or changes in the design of the WMF could result in changes to the concentrations obtained in this analysis. Actual construction of the WMF could also result in differences between the predicted concentrations and observed concentrations in the future.

8.1 Scenario 1 (Cap and Liner)

The predicted concentrations, when compared with applicable surface water action levels listed in the draft RFCA, are much less than those levels requiring action. Because the estimated concentrations are very low, it appears that the design of the cap/liner system (as used in the HELP model) is sufficient to protect surface water and seeps from contamination.

It should be noted that changing the saturated thickness from 35 feet to 5 feet (thickness of the alluvial part of the UHSU) will lessen the resulting volume by less than an order of magnitude. Thus, reduction in the saturated thickness will only increase the resulting concentrations by an order of magnitude. These values would still be well below the actions levels specified by RFCA.

8.2 Scenario 2 (Liner)

Comparison of the resulting concentrations for Scenario 2 with RFCA surface water action levels reveals that for most leachate constituents, the concentrations are less than the action levels. Because the estimated concentrations are very low, it appears that during the active life of the facility, while waste is being loaded into the WMF modules, the liner system is sufficient to protect surface water and seeps from contamination.

Changing the saturated thickness from 35 feet to 5 feet (the thickness of the alluvial part of the UHSU) will lessen the resulting volume by less than an order of magnitude, thus increasing the groundwater concentrations by an order of magnitude. This action would not increase groundwater concentration above RFCA action levels for surface water.

8.3 Scenario 3 (Flux equals Recharge)

Comparison of the resulting concentrations for Scenario 3 with RFCA surface water action levels reveals that for most leachate constituents, the concentrations are less than the action levels. Only for certain VOC/SVOCs (carbon tetrachloride, 1,1 dichloroethane, 1,2 dichloroethene, methylene chloride, tetrachloroethylene, and trichloroethene) are groundwater concentrations greater than RFCA action levels for surface water. It should be noted that this scenario is the worst-case scenario. This scenario is not likely to take place because a liner would restrict leachate percolation into the UHSU. This scenario would either represent a complete failure of the cap/liner system or no cap/liner.

It should be noted that changing the saturated thickness from 35 feet to 5 feet (thickness of the alluvial part of the UHSU) will lessen the resulting volume by less than an order of magnitude, thus increasing the groundwater concentrations by an order of magnitude. This modification would lead to a greater number of leachate constituents exceeding the draft RFCA surface water action levels. In addition to the VOC/SVOCs mentioned previously, bis (2-ethylhexyl) phthalate exceeds the draft RFCA surface water action levels, as do some metals (manganese, mercury, and silver) and radionuclides (gross alpha, gross beta, U-233/234, and U-238).

8.4 Recommendations

It is recommended that a transport model, using the fluxes obtained from the HELP model and the leachate concentrations from Roberts (1996) and Siders (1996). A numerical model could incorporate retardation and decay, as well as account for mass transfer from the groundwater system to the surface water and seeps. It may be possible to utilize the ASAP groundwater flow model, once it is calibrated. The ASAP modeling effort is anticipated to be calibrated by the end of August 1996.

It is also recommended that a three-dimensional scientific visualization be constructed of the area where the WMF is to be constructed. RMRS Environmental Restoration has the capability to perform this task,

which would show the relationships of geology and hydrogeology with the WMF. A three-dimensional model would be invaluable for integrating data and interpretations and would be useful for both technical and non-technical personnel.

9.0 REFERENCES

EG&G, 1995a, Hydrogeologic characterization report for the Rocky Flats Environmental Technology Site, Volume II of the sitewide geoscience characterization study, EG&G Rocky Flats, Golden, Colorado.

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Rocky Flats Cleanup Agreement (RFCA) (Public Comment Draft), March 14, 1996.

Siders, M., 1996, Analysis of inorganic constituents and probable leachate composition from waste stored in the new waste cell at the Rocky Flats Environmental Technology Site, Golden, Colorado, Rocky Mountain Remediation Services, March 29, 1996.

TABLES

Table 1: Estimated Leachate Concentrations

Constituent	Leachate Concentrations	Units
Volatile Organic Compounds		
Acetone	150000	µg/L
Carbon Tetrachloride	2100	µg/L
Chloroform	3000	µg/L
1,1 Dichloroethane	3100	µg/L
1,1 Dichloroethene	2800	µg/L
1,2 Dichloroethene	16000	µg/L
Diethyl Phthalate	12000	µg/L
Di-n-Butyl Phthalate	3600	µg/L
Bis (2-Ethylhexyl) Phthalate	140	µg/L
Methylene Chloride	19000	µg/L
Tetrachloroethylene	2000	µg/L
1,1,1-Trichloroethane	2500	µg/L
Trichloroethene	2500	µg/L
Metals		
Aluminum	547	µg/L
Antimony	22	µg/L
Arsenic	48	µg/L
Barium	133	µg/L
Beryllium	1.8	µg/L
Cadmium	8.5	µg/L
Calcium	111230	µg/L
Cesium	146	µg/L
Chromium	173	µg/L
Cobalt	37	µg/L
Copper	59	µg/L
Iron	970	µg/L
Lead	27	µg/L
Lithium	528	µg/L
Magnesium	17910	µg/L
Manganese	550	µg/L
Mercury	0.46	µg/L
Molybdenum	302	µg/L
Nickel	90	µg/L
Potassium	165300	µg/L
Selenium	5.5	µg/L

Table 1 (cont.)
Estimated Leachate Concentrations

Constituent	Leachate Concentrations	Units
Silver	10	µg/L
Sodium	783800	µg/L
Strontium	1640	µg/L
Thallium	8	µg/L
Tin	84	µg/L
Vanadium	17	µg/L
Zinc	60	µg/L
Radionuclides		
Americium-241	0.11	pCi/L
Cesium-134	ID	pCi/L
Cesium-137	0.33	pCi/L
Gross Alpha	375	pCi/L
Gross Beta	230	pCi/L
Plutonium-239/240	0.12	pCi/L
Radium 226	1.4	pCi/L
Radium-228	3.2	pCi/L
Tritium (total)	1310	pCi/L
Uranium-233/234	147	pCi/L
Uranium-235	6.1	pCi/L
Uranium-238	142	pCi/L

Notes:

ID = Insufficient Data
µg/L = micrograms per liter
pCi/L = picocuries per liter

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Table 2: Estimated Mass/Activity of Leachate Constituents Exiting WMF

Constituent	Scenario 1	Scenario 2	Scenario 3	Units
Volatile Organic Compounds				
Acetone	357000	871500	1.54E+11	µg
Carbon Tetrachloride	4998	12201	2.16E+09	µg
Chloroform	7140	17430	3.09E+09	µg
1,1 Dichloroethane	7378	18011	3.19E+09	µg
1,1 Dichloroethene	6664	16268	2.88E+09	µg
1,2 Dichloroethene	38080	92960	1.65E+10	µg
Diethyl Phthalate	28560	69720	1.24E+10	µg
Di-n-Butyl Phthalate	8568	20916	3.70E+09	µg
Bis (2-Ethylhexyl) Phthalate	333.2	813.4	1.44E+08	µg
Methylene Chloride	45220	110390	1.96E+10	µg
Tetrachloroethylene	4760	11620	2.06E+09	µg
1,1,1-Trichloroethane	5950	14525	2.57E+09	µg
Trichloroethene	5950	14525	2.57E+09	µg
Metals				
Aluminum	1301.86	3178.07	5.60E+08	µg
Antimony	52.36	127.82	2.26E+07	µg
Arsenic	114.24	278.88	4.94E+07	µg
Barium	316.54	772.73	1.37E+08	µg
Beryllium	4.284	10.458	1.85E+06	µg
Cadmium	20.23	49.39	8.75E+06	µg
Calcium	264727.4	646246.3	1.15E+11	µg
Cesium	347.48	848.26	1.50E+08	µg
Chromium	411.74	1005.13	1.78E+08	µg
Cobalt	88.06	214.97	3.81E+07	µg
Copper	140.42	342.79	6.05E+07	µg
Iron	2308.6	5635.7	19.95E+08	µg
Lead	64.26	156.87	2.78E+07	µg
Lithium	1256.64	3067.68	5.45E+08	µg
Magnesium	42625.8	104057.1	1.84E+10	µg
Manganese	1309	3195.5	5.65E+08	µg
Mercury	1.0948	2.6726	4.73E+05	µg
Molybdenum	718.76	1754.62	3.11E+08	µg
Nickel	214.2	522.9	9.25E+07	µg
Potassium	393414	960393	1.70E+11	µg
Selenium	13.09	31.955	5.56E+06	µg

Table 2 (cont.)
Estimated Mass/Activity of Leachate Constituents Exiting WMF

Constituent	Scenario 1	Scenario 2	Scenario 3	Units
Silver	23.8	58.1	1.03E+07	µg
Sodium	1865444	4553878	8.05E+11	µg
Strontium	3903.2	9528.4	1.69E+09	µg
Thallium	19.04	46.48	8.20E+06	µg
Tin	199.92	488.04	8.65E+07	µg
Vanadium	40.46	98.77	1.75E+07	µg
Zinc	142.8	348.6	6.15E+07	µg
Radionuclides				
Americium-241	0.2618	.6391	1.13E+05	pCi
Cesium-134	ID	ID	ID	pCi
Cesium-137	0.7854	1.9173	3.40E+05	pCi
Gross Alpha	892.5	2178.75	3.86E+08	pCi
Gross Beta	547.4	1336.3	2.37E+08	pCi
Plutonium-239/240	0.2856	.6972	1.24E+05	pCi
Radium 226	3.332	8.134	1.44E+06	pCi
Radium-228	7.616	18.592	3.29E+06	pCi
Tritium (total)	3117.8	7611.1	1.35E+09	pCi
Uranium-233/234	349.86	854.07	1.51E+08	pCi
Uranium-235	14.518	35.441	6.25E+06	pCi
Uranium-238	337.96	825.02	1.46E+08	pCi

Notes:

ID = Insufficient Data
Mass/Activity calculated from leachate concentrations in Table 1.
µg = micrograms (mass)
pCi = picocuries (activity)
Scenario 1 leachate flux = 2.38 liters.
Scenario 2 leachate flux = 5.81 liters.
Scenario 3 leachate flux = 1.03 million liters.

Table 3: Estimated Groundwater Concentrations Beneath WMF From Leachate

Constituent	Scenario 1	Scenario 2	Scenario 3	Units
Volatile Organic Compounds				
Acetone	2.76E-03	6.73E-03	1190	µg/L
Carbon Tetrachloride	3.86E-05	9.42E-05	16.65	µg/L
Chloroform	5.51E-05	1.35E-04	23.8	µg/L
1,1 Dichloroethane	5.70E-05	1.39E-04	24.6	µg/L
1,1 Dichloroethene	5.14E-05	1.26E-04	22.2	µg/L
1,2 Dichloroethene	2.94E-04	7.18E-04	127	µg/L
Diethyl Phthalate	2.20E-04	5.38E-04	95	µg/L
Di-n-Butyl Phthalate	6.61E-05	1.61E-04	28.55	µg/L
Bis (2-Ethylhexyl) Phthalate	2.57E-06	6.28E-06	1.11	µg/L
Methylene Chloride	3.49E-04	8.52E-04	151	µg/L
Tetrachloroethylene	3.67E-05	8.97E-05	15.85	µg/L
1,1,1-Trichloroethane	4.59E-05	1.12E-04	19.85	µg/L
Trichloroethene	4.59E-05	1.12E-04	11	µg/L
Metals				
Aluminum	1.01E-05	2.45E-05	4.34	µg/L
Antimony	4.04E-07	9.87E-07	0.175	µg/L
Arsenic	8.82E-07	2.15E-06	0.381	µg/L
Barium	2.44E-06	5.97E-06	1.06	µg/L
Beryllium	3.31E-08	8.07E-08	0.0143	µg/L
Cadmium	1.56E-07	3.81E-07	0.0675	µg/L
Calcium	2.04E-03	4.99E-03	885	µg/L
Cesium	2.68E-06	6.55E-06	1.16	µg/L
Chromium	3.18E-06	7.76E-06	1.375	µg/L
Cobalt	6.80E-07	1.66E-06	0.294	µg/L
Copper	1.08E-06	2.65E-06	0.469	µg/L
Iron	1.78E-05	4.35E-05	7.7	µg/L
Lead	4.96E-07	1.21E-06	0.215	µg/L
Lithium	9.70E-06	2.37E-05	4.19	µg/L
Magnesium	3.29E-04	8.03E-04	142	µg/L
Manganese	1.01E-05	2.47E-05	4.37	µg/L
Mercury	8.45E-09	2.06E-08	0.0037	µg/L
Molybdenum	5.55E-06	1.35E-05	2.395	µg/L
Nickel	1.65E-06	4.04E-06	0.72	µg/L
Potassium	3.04E-03	7.41E-03	1310	µg/L
Selenium	1.01E-07	2.47E-07	0.0437	µg/L
Silver	1.84E-07	4.49E-07	0.0795	µg/L

Table 3 (cont.)
Estimated Groundwater Concentrations Beneath WMF From Leachate

Constituent	Scenario 1	Scenario 2	Scenario 3	Units
Sodium	1.44E-02	3.52E-02	6200	µg/L
Strontium	3.01E-05	7.36E-05	13	µg/L
Thallium	1.47E-07	3.59E-07	0.0635	µg/L
Tin	1.54E-06	3.77E-06	0.665	µg/L
Vanadium	3.12E-07	7.63E-07	0.135	µg/L
Zinc	1.10E-06	2.69E-06	0.476	µg/L
Radionuclides				
Americium-241	2.02E-09	4.93E-09	0.0009	pCi/L
Cesium-134	ID	ID	ID	pCi/L
Cesium-137	6.06E-09	1.48E-08	.0026	pCi/L
Gross Alpha	6.89E-06	1.68E-05	2.98	pCi/L
Gross Beta	4.23E-06	1.03E-05	1.83	pCi/L
Plutonium-239/240	2.20E-09	5.38E-09	0.001	pCi/L
Radium 226	2.57E-08	6.28E-08	0.011 1	pCi/L
Radium-228	5.88E-08	1.44E-07	0.0254	pCi/L
Tritium (total)	2.41E-05	5.88E-05	10.4	pCi/L
Uranium-233/234	2.70E-06	6.59E-06	1.17	pCi/L
Uranium-235	1.12E-07	2.74E-07	0.0484	pCi/L
Uranium-238	2.61E-06	6.37E-06	1.13	pCi/L

Notes:

ID = Insufficient Data

Concentrations calculated from mass/activities in Table 3 and estimated groundwater volume of 130 million liters.

µg/L = micrograms per liter

pCi/L = picocuries per liter

Table 4: DRAFT RFCA Surface Water Action Levels for Stream Segment 5 (Walnut Creek)

Constituent	Concentration	Units
Volatile Organic Compounds		
Acetone	365000	µg/L
Carbon Tetrachloride	5	µg/L
Chloroform	100	µg/L
1,1 Dichloroethane	1010	µg/L
1,1 Dichloroethene	7	µg/L
1,2 Dichloroethene	70	µg/L
Diethyl Phthalate	29200	µg/L
Di-n-Butyl Phthalate	3650	µg/L
Bis (2-Ethylhexyl) Phthalate	6	µg/L
Methylene Chloride	5	µg/L
Tetrachloroethylene	5	µg/L
1,1,1-Trichloroethane	200	µg/L
Trichloroethene	5	µg/L
Metals		
Aluminum	8700	µg/L
Antimony	1400	µg/L
Arsenic	50	µg/L
Barium	1000	µg/L
Beryllium	4	µg/L
Cadmium	1.5	µg/L
Calcium	NAL	µg/L
Cesium	NAL	µg/L
Chromium	50	µg/L
Cobalt	NAL	µg/L
Copper	16	µg/L
Iron	300	µg/L
Lead	6500	µg/L
Lithium	NAL	µg/L
Magnesium	NAL	µg/L
Manganese	50	µg/L
Mercury	0.01	µg/L
Molybdenum	1000	µg/L
Nickel	123	µg/L
Potassium	NAL	µg/L
Selenium	10	µg/L
Silver	0.6	µg/L
Sodium	NAL	µg/L

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Table 4 (cont.)
DRAFT RFCA Surface Water Action Levels for Stream Segment 5
(Walnut Creek)

Constituent	Concentrations	Units
Strontium	NAL	µg/L
Thallium	NAL	µg/L
Tin	NAL	µg/L
Vanadium	NAL	µg/L
Zinc	141	µg/L
Radionuclides		
Americium-241	0.15	pCi/L
Cesium-134	NAL	pCi/L
Cesium-137	NAL	pCi/L
Gross Alpha	10	pCi/L
Gross Beta	11	pCi/L
Plutonium-239/240	0.15	pCi/L
Radium 226	5	pCi/L
Radium-228	5	pCi/L
Tritium (total)	500	pCi/L
Uranium-233/234	10	pCi/L
Uranium-235	10	pCi/L
Uranium-238	10	pCi/L

Notes:

µg/L = micrograms per liter
pCi/L = picocuries per liter
NAL = No listed Action Level

APPENDIX A - SUPPORTING DOCUMENTATION FOR LEACHATE CONCENTRATIONS

CALCULATION OF PROBABLE MAXIMUM LEACHATE CONCENTRATIONS

To assist in the design of the leachate treatment system for the Waste Management Facility, the following analysis was performed to determine the probable maximum leachate concentrations for the major organic contaminants found at the Rocky Flats Environmental Technology Site (RFETS). For this analysis, the commonly used soil/water partitioning equation was used to determine the contaminant concentrations in interstitial water in waste soils within the Waste Cell.

Although a more in-depth approach to estimating the leachate concentrations was considered (1D vertical transport modeling), the goals of the analysis (determination of maximum expected concentrations), and the ambiguity of the analysis parameters (amount of waste in place, contaminant concentrations in waste, etc.) indicated a simplified approach would be more appropriate. Because of the simplifying assumptions that would be adopted for 1D vertical transport modeling, the results from transport modeling should be very similar to those presented here.

COMPOUNDS CONSIDERED IN ANALYSIS

To determine which volatile organic compounds (VOC) and semivolatile organic compounds (SVOC) to use in this analysis, the detection frequency for all VOC/SVOC compounds of concern at RFETS was computed. Only those compounds tested for in at least 100 samples, and with a detection frequency of at least 5% were included in the leachate concentration calculations. The compounds and their detection frequency are listed in Table 1.

TABLE 1: Compounds Used in Analysis

COMPOUNDS WITH A DETECTION FREQUENCY OF AT LEAST 5%					
COMPOUND	CAS ID	Non-detects	Detects	Total	% Detects
ACETONE	67-64-1	2713	463	3176	15
CARBON TETRACHLORIDE	56-23-5	4576	1060	5636	19
CHLOROFORM	67-66-3	4477	1177	5654	21
1,1 DICHLOROETHANE	75-34-3	5345	341	5686	6
1,1-DICHLOROETHENE	75-35-4	5215	463	5678	8
1,2-DICHLOROETHENE	540-59-0	2875	338	3213	11
DIETHYL PHTHALATE	84-66-2	552	63	615	10
DI-n-BUTYL PHTHALATE	84-74-2	569	45	614	7
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	470	143	613	23
METHYLENE CHLORIDE	75-09-2	4607	1038	5645	18
TETRACHLOROETHENE	127-18-4	4054	1620	5674	29
1,1,1-TRICHLOROETHANE	71-55-6	5150	516	5666	9
TRICHLOROETHENE	79-01-6	4025	1653	5678	29

DETERMINATION OF LEACHATE CONCENTRATIONS

For this analysis the VOC/SVOC contaminated soils in the waste cell were considered to be directly exposed to rain and snow fall. Leachate concentrations were calculated assuming the soils at the base of the waste soil pile were saturated. This assumption is conservative and will provide maximum leachate concentrations. Drainage from unsaturated soils would result in somewhat lower concentrations.

The saturated-soil, contaminant water concentrations were calculated using the soil-groundwater partitioning equation, as presented in EPA (1994). This equation describes the partitioning of a contaminant between solid, liquid, and gaseous phases assuming equilibrium conditions. It is assumed that the concentrations of the interstitial water in the soil waste is representative of the maximum concentrations of any leachate that would be collected from the waste cell facility. Dilution from other waters collecting in the waste cell are not considered in these calculations. The soil/water partitioning equation is defined as:

$$C_w = C_s / \ [Kd + (\theta_w + \theta_a H') / \rho_b]$$

where:

C_w is the soil water concentration
C_s is the contaminant concentration in the waste soils
Kd is the soil-water partitioning coefficient
θ_w is the water-filled porosity of the waste soils
θ_a is the air-filled porosity of the waste soils
H′ is the Henry's Law constant
ρ_b is the representative bulk density of the waste soils

The contaminant concentrations in the waste soils were assumed to be equal to the values defined by the Universal Treatment Standards (UTS) (Table 2). These values were selected because soils placed in the waste cell will be required to meet the UTS criteria. In many cases, the concentrations of contaminants in the soils placed in the cell will be significantly lower than those defined by the UTS. This is because of the efficiency of the soil treatment technology and/or low initial soil concentrations.

Because waste soils will be coming from various locations within RFETS, values representative of sitewide conditions at RFETS were used for several of the parameters during the calculations. The partitioning coefficients (Kd), which are chemical specific, were computed using the appropriate chemical specific parameters, and representative RFETS sitewide values for environmental parameters. The water filled porosity (θ_w) and soil bulk density (ρ_b) were assumed as 0.40 and 1.5 gm/cm^3 respectively. Since the soils were considered saturated, the Henry's Law constant and air filled porosity values were not used in the calculations.

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Table 2 presents the computed maximum soil water (leachate) concentrations. In addition, the partitioning coefficients (Kd) and UTS soil concentration data used in the calculations are also listed. For comparison purposes the maximum soil concentration observed to date for each compound at RFETS is also listed. Contaminant concentrations greater than those historically observed may be encountered during full scale excavation of contaminant source areas.

TABLE 2: Computed Leachate Concentrations

COMPOUND	Kd	UTS Soil Concen.	Maximum RFETS Soil Concen.	Water Concen.
	(ml/g)	(mg/kg)	(mg/kg)	(mg/L)
ACETONE	0.80	160	5100	150
CARBON TETRACHLORIDE	2.5	6	25000	2.1
CHLOROFORM	1.8	6	63	3.0
1,1 DICHLOROETHANE	1.7	6	0.049	3.1
1,1 DICHLOROETHENE	1.9	6	2	2.8
1,2 DICHLOROETHENE	1.6	30	1.2	16
DIETHYL PHTHALATE	2.1	28	3.1	12
DI-n-BUTYL PHTHALATE	7.5	28	43	3.6
BIS(2-ETHYLHEXYL) PHTHALATE	198	28	190	0.14
METHYLENE CHLORIDE	1.3	30	2400	19
TETRACHLOROETHYLENE	2.7	6	13000	2.0
1,1,1-TRICHLOROETHANE	2.2	6	240	2.5
TRICHLOROETHENE	2.2	6	16	2.5

REFERENCES

EPA, 1994, Soil Screening Guidance (Draft), EPA/540/R-94/101.

ANALYSIS OF INORGANIC CONSTITUENTS AND PROBABLE LEACHATE COMPOSITION FROM WASTE STORED IN THE NEW WASTE CELL AT THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE, GOLDEN, COLORADO

March 29, 1996

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1.0 INTRODUCTION

The composition and volume of wastes to be placed in the proposed Waste Cell at Rocky Flats Environmental Technology Site (RFETS) were evaluated as part of the preparatory analysis for design and construction of the Cell. This report presents an assessment of the inorganic constituents in the waste, as well as estimations of the probable composition of leachate that may emanate from wastes stored in the Cell.

Wastes to be disposed of in the Cell include a variety of materials from a number of Operable Units (OUs) at RFETS. The estimated proportions, by volume, of waste to be placed in the cell are as follows:

OU4 vadose-zone soils	24.1%
OU4 pondcrete	14.5%
OU2 903 Pad and Lip	14.5%
OU4 asphalt liners	14.2%
OU4 subgrade & subsoils	14.2%
OU4 sludge	7.2%
OU9 tanks 14 & 16	4.0%
OU2 mound area	1.8%
OU2 trenches T-5 to T-11	1.2%
OU2 trench T-1	1.2%
OU4 debris	0.8%
OU9 tanks 9 & 10	0.6%
OU2 trench T-3	0.3%
OU2 trench T-4	0.3%
OU10 tank 40	0.2%
IDM wastes	0.2%
OU1 IHSS 119.1	0.1%
Misc. hot spots	0.1%

Chemical analyses of solid materials and groundwater from these areas, in addition to analytical data for leachates derived from Operable Unit 4 (OU4) pondcrete and sludges, were compiled and evaluated for this assessment. Data used in this analysis were retrieved from the Rocky Flats Environmental Database System (RFEDS) and from treatability reports for OU4 pondcrete and sludges. Only data for inorganic constituents are evaluated here; data for organic compounds were evaluated as a separate task.

Analytical data for subsurface soils (i.e., borehole data) and groundwater were obtained from RFEDS. These data were compiled as SAS7 data sets, prepared following standard data-cleanup protocols, and statistically summarized. Locations for which borehole and groundwater data were available are listed in Tables 1 and 2, respectively.

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Table 1.
Sampling Locations with Data Available for Subsurface Soils

Metals		Radionuclides		"Water-Quality"	
02695	13091	02695	13091	02695	13091
02795	21793	02795	21793	02795	21793
02895	40293	02895	40293	02895	40293
02995	40393	02995	40393	02995	40393
04795	40593	04795	40593	*	40593
04895	40793	04895	40793	*	40793
04995	40993	04995	40993	*	40993
05095	41293	05095	41293	*	41293
06591	41593	06591	41593	06591	41593
06691	41793	06691	41793	06691	41793
06791	42193	06791	42193	06791	42193
06891	42493	06891	42493	06891	42493
06991	42593	06991	42593	06991	42593
07091	43193	07091	43193	07091	43193
07191	43393	07191	43393	07191	43393
07291	43693	07291	43693	07291	43693
07391	43793	07391	43793	07391	43793
07891	44093	07891	44093	07891	44093
07991	44393	07991	44393	07991	44393
08091	B217589	08091	B217589	08091	B217589
08191	BH2287	08191	BH2287	08191	BH2287
08291	BH2387	08291	BH2387	08291	BH2387
08391	BH2487	08391	BH2487	08391	BH2487
08491	BH3587	08491	BH3587	08491	BH3587
08591	BH3687	08591	BH3687	08591	BH3687
08691	BH3787	08691	BH3787	08691	BH3787
08791	BH3987	08791	BH3987	08791	BH3987
08891	BH4087	08891	BH4087	08891	BH4087
08991	BH4287	08991	BH4287	08991	BH4287
09091	BH4387	09091	BH4387	09091	BH4387
09191	BH4687	09191	BH4687	09191	BH4687
09391	BH4887	09391	BH4887	09391	BH4887
09591	BH4987	09591	BH4987	09591	BH4987
09891	BH5087	09891	BH5087	09891	BH5087
09991	BH5187	09991	BH5187	09991	BH5187
10191	BH5287	10191	BH5287	10191	BH5287
10291	BH5387	10291	BH5387	10291	BH5387
10491	BH5487	10491	BH5487	10491	BH5487
10591	BH5587	10591	BH5587	10591	BH5587

Asterisk (*) indicates that data were not available for this location.

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Table 2.
Sampling Locations with Data Available for Groundwater Samples

Metals		Radionuclides		Water-Quality
Dissolved	Total	Dissolved	Total	Unfiltered *
*	*	*	*	02695
*	*	*	02795	02795
*	02895	*	*	02895
*	*	*	02995	02995
*	*	*	*	04795
*	*	*	*	04895
*	*	*	*	04995
06591	06591	06591	06591	06591
06691	06691	06691	06691	06691
06791	06791	06791	06791	06791
06891	06891	06891	06891	06891
06991	06991	06991	06991	06991
*	*	*	*	*
07191	07191	07191	07191	07191
07291	*	07291	07291	07291
07391	07391	07391	07391	07391
07891	07891	07891	07891	07891
07991	07991	07991	07991	07991
*	*	08091	08091	08091
*	*	*	*	08391
*	*	*	*	08591
08891	08891	08891	08891	08891
09091	09091	09091	09091	09091
13091	13091	13091	13091	13091
B217589	*	B217589	B217589	B217589

Asterisk (*) indicates that data were not available for this location.

* Samples collected for analysis of anions and water-quality paramters are not filtered; however, anions are assumed to exist in the dissolved state.

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Data for OU4 vadose-zone waters were obtained from tables in the *OU4 Proposed IM/IRA EA Decision Document*, dated February 10, 1995 (EG&G, 1995a). Data for OU4 pondcrete and sludges were available in *Treatability Study Report and Process Formulation Report for Pondcrete* (EG&G, 1995b) and *Treatability Study Report and Process Formulation Report for Pond Sludge and Clarifier* (EG&G, 1995c). Unfortunately, the data presented in these treatability studies do not include major-ion compositions of the leachates; only data for selected radionuclides and trace metals, nitrate, and pH are given. Without major-ion data, standard geochemical modeling cannot be performed for the pondcrete and sludge leachates.

2.0 DATA ANALYSIS

Standard data-treatment protocols for RFEDS data call for the exclusion of QC data from the real-sample data, removal of rejected data (validation code = "R"), and the standardization of units and analyte names. Computation of summary statistics used a simple replacement value of one-half the result for nondetects. One-half the result was used instead of one-half the detection limit, in order to minimize the problems associated with high-value detection limits (i.e., the contract-required reporting limits [CRDL]) reported in the detection-limit field for some records.

Because distributional testing was not performed, these summary statistics should be considered only a general approximations of the true mean. In addition, the user should be cognizant of the detection rate for each analyte; as the detection rate decreases, the calculated mean value is generally less representative of the true population mean (i.e., the mean becomes more strongly influenced by the nondetect replacement values). Subsurface-soil data for background and waste populations were compared using analysis of variance (ANOVA) testing (Wilcoxon Rank Sum). Electronic data were not available to conduct ANOVA testing for pondcrete and sludge samples. Results of the ANOVA testing, as well as a discussion of their meaning, are given in the following sections.

2.1 Subsurface Soil

Data for subsurface soils were available for borehole locations in the 903 Pad and Lip Area, OU2 Mound Area, OU2 Trench T-1, OU2 Trench T-3, OU2 Trench T-4, OU2 Trenches T-5 through T-11, OU9 Tanks 9 & 10, OU10 Tank 40, and OU4 (see Table 1). The largest volume of subsurface soils to be placed in the Cell are the vadose-zone soils of OU4. These subsurface soils comprise an estimated 24.1%, by volume, of all wastes destined for the Cell.

Overall detection rates were calculated for each analyte in the subsurface-soil medium. Quality parameters, such as pH, were also evaluated for these soils. In general, the subsurface soils exhibit a neutral to alkaline condition; pH ranges from 6.23 to 11.0, with a mean value of 8.1. Most metals and radionuclides are less leachable under neutral to alkaline conditions than under a lower pH (i.e., more acidic), so a mean pH of 8.1 is favorable for decreasing the mobility of most constituents of concern. However, the mobility of anionic species, such as nitrate, is not greatly dependent on pH.

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To put the inorganic composition of the waste soils in context, data for soils destined for the Cell were compared with data for background subsurface soils. Background data were obtained on diskette from the *Background Geochemical Characterization Report* (DOE, 1993); only data for the upper hydrostratigraphic unit (UHSU) were used. Summary statistics and detection rates for inorganic analytes in both groups (i.e., waste and background) are shown in Tables 3a and 3b. However, the numbers shown here for the waste soils do not include the data for OU4 pondcrete and sludges, which are estimated to comprise 21.7 percent (by volume) of all waste destined for the Cell. Pondcrete and sludges are addressed separately in Sections 2.4 and 2.5 of this report.

The comparison of waste soils and background soils provides a sort of "reality check" for the general nature of the waste. As shown in the right-hand column of Table 4, the results of nonparametric ANOVA (Wilcoxon Rank Sum) indicate whether or not the two groups (i.e., waste soils and background soils) show statistically significant differences in composition. Taken at the 95-percent confidence level, a p-value of <0.05 indicates a significant difference. Of course, the results of any statistical analysis must be subjected to the scrutiny of professional judgment. A good point in case is the insignificant p-value obtained for tritium. Clearly, some of the waste soils contain substantially higher levels of tritium than do the background soils; however, the huge variance in tritium activities seen for waste soils produces huge uncertainties (i.e., the assumption of equal variances is violated), and, consequently poor power of discernment for the statistical tests. In such cases, an alternative statistical test, such as the quantile test, would have more power than the Wilcoxon test to detect differences between the two populations.

Concentrations of nitrate/nitrite in waste materials are obviously higher than those in background soils, but a significant p-value is not seen, due to the statistical violations discussed in the previous paragraph. The large variances seen for nitrate/nitrite concentrations and tritium activities invalidate the negative ANOVA results for these analytes. The mean and standard deviation for these two analytes, clearly indicate that some of the waste soils contain levels of nitrate/nitrite and tritium that are well above those seen for background soils. Overall, based on results of the ANOVA testing, the waste soils contain significantly higher levels of arsenic, calcium, americium-241, cesium-137, gross alpha, plutonium-239+240, tritium, uranium-233+234, uranium-235, and uranium-238.

2.2 OU4 Vadose-Zone Water

Pore water from the vadose zone in OU4 was collected in a series of lysimeters installed as part of the Phase-1 vadose-zone monitoring in OU4. Data for OU4 pore waters were obtained from tables in the *OU4 Proposed IM/IRA EA Decision Document*, dated February 10, 1995 (EG&G, 1995a), and are compiled here as Tables 5 and 6.

As discussed in the OU4 Decision Document, analyses of pore-water samples and soil materials from the same location were used to derive an estimated, chemical-specific partition coefficient, K_d, for selected trace metals, radionuclides, and nitrate. These K_d values, along with values obtained from the literature were presented in the Treatability Reports for pondcrete and sludges (EG&G, 1995b and 1995c).

Table 3a.
Summary of Data for Subsurface Soils: Waste Boreholes

Analyte	N	% Detects	Min	Max	Mean	Std. Dev.	Units
Aluminum	354	100.0	931	39100	9940	4907	MG/KG
Antimony	333	4.8	1.6	22.4	5.2	2.5	MG/KG
Arsenic	354	92.7	0.3	30.8	5.8	4.9	MG/KG
Barium	354	86.2	16.8	4150	120	332	MG/KG
Beryllium	353	45.9	0.055	22.9	0.71	1.23	MG/KG
Cadmium	320	39.4	0.145	547	5.5	41.3	MG/KG
Calcium	354	99.7	500	232000	22900	41010	MG/KG
Cesium	247	69.2	225	116.5	19.0	27.6	MG/KG
Chromium	354	99.2	1.0	304	14.6	24.4	MG/KG
Cobalt	354	66.4	0.6	78.1	6.6	6.0	MG/KG
Copper	354	91.2	1.8	132	12.3	9.8	MG/KG
Iron	354	100.0	1010	50800	12710	7225	MG/KG
Lead	354	100.0	1.2	278	13.4	28.4	MG/KG
Lithium	243	84.0	0.115	50.8	7.5	6.8	MG/KG
Magnesium	354	94.9	231	6300	2276	979	MG/KG
Manganese	354	100.0	1.3	3140	247	391	MG/KG
Mercury	354	26.8	0.023	6.00	0.088	0.328	MG/KG
Molybdenum	239	21.3	0.415	19.0	2.0	2.5	MG/KG
Nickel	354	84.5	2.15	173	14.7	15.4	MG/KG
Potassium	354	78.5	100	12600	1325	1074	MG/KG
Selenium	354	4.5	0.08	3.4	0.34	0.34	MG/KG
Silicon	216	98.2	1.35	14000	920	1535	MG/KG
Silver	351	10.5	0.16	96.5	1.4	6.3	MG/KG
Sodium	354	57.1	0.8	5990	419	791	MG/KG
Strontium	354	85.0	6.9	220	45.4	39.5	MG/KG
Thallium	353	16.4	0.095	1.00	0.46	0.37	MG/KG
Tin	242	28.1	1.55	91.1	18.0	12.3	MG/KG
Vanadium	354	97.7	5.0	82.2	26.7	12.8	MG/KG
Zinc	354	99.7	2.0	437	41.8	42.6	MG/KG
Ammonia	148	32.4	0.155	8.6	0.56	1.15	MG/KG
Chromium IV	12	16.7	0.265	0.86	0.40	0.22	MG/KG
Cyanide	275	12.7	0.07	43	0.98	2.94	MG/KG
Nitrate/Nitrite	208	80.3	0.0	6100	119	529	MG/KG
Oil & Grease	55	23.6	0.85	508	15.3	76.2	MG/KG
Petroleum Hydrocarbon	35	97.1	2.93	394	134	114	MG/KG
Sulfide	304	9.9	1.0	200	42.6	49.9	MG/KG
TOC	154	98.7	31.2	19200	982	2083	MG/KG
pH	276	100.0	6.23	11.0	8.1	0.5	PH
Americium-241	319	81.5	-0.06	25.0	0.277	1.696	PCI/G
Cesium-134	44	100	0.005	0.15	0.078	0.036	PCI/G
Cesium-137	318	90.9	-0.8	4.7	0.11	0.39	PCI/G
Gross alpha	305	100.0	-7.9	380	26	32.4	PCI/G
Gross beta	346	100.0	2.54	56.7	22.9	7.4	PCI/G
Plutonium-238	13	100	-0.002	0.205	0.036	0.062	PCI/G
Plutonium-239+240	333	88.0	-0.11	94	1.13	7.09	PCI/G
Radium-226	152	94.7	0.23	1.9	0.67	0.26	PCI/G
Radium-228	155	100.0	0.50	3.00	1.460	0.51	PCI/G
Strontium-89+90	315	75.2	-0.50	1.10	1.76	0.24	PCI/G
Strontium-90	6	100.0	-0.21	1.08	0.39	0.55	PCI/G
Tritium	336	74.4	-570	62000	1537	5764	PCI/G
Uranium-233+234	342	100.0	0.045	192	1.75	10.51	PCI/G
Uranium-235	237	90.7	-0.005	11.5	0.118	0.749	PCI/G
Uranium-238	352	100.0	0.23	113	1.44	6.21	PCI/G

Summary statistics calculated for RFEDS data compiled for this assessment, assuming a normal distribution.

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Table 3b.
Summary of Data for Subsurface Soils: Background Boreholes

Analyte	N	% Detects	Min	Max	Mean	Std. Dev.	Units
Aluminum	98	99.0	279	102000	12710	11330	MG/KG
Antimony	66	15.2	0.95	23.5	4.5	3.7	MG/KG
Arsenic	99	70.7	0.27	41.8	3.6	4.4	MG/KG
Barium	99	88.9	12.9	777	96.1	96.6	MG/KG
Beryllium	99	81.8	0.45	23.5	4.7	4.8	MG/KG
Cadmium	81	7.4	0.08	1.5	0.6	0.3	MG/KG
Calcium	99	99.0	580	157000	7053	16180	MG/KG
Cesium	95	1.1	81.8	1415	130.0	135	MG/KG
Chromium	99	84.8	2.1	176	18.8	24.7	MG/KG
Cobalt	99	22.2	1.9	51.4	6.4	7.1	MG/KG
Copper	99	95.0	2.2	123	12.6	12.8	MG/KG
Iron	99	100.0	1300	132000	14530	13260	MG/KG
Lead	99	99.0	2	39.8	10.8	7.1	MG/KG
Lithium	99	61.6	1.4	83.2	10	8.5	MG/KG
Magnesium	99	96.0	356	32500	2853	3246	MG/KG
Manganese	99	100.0	37	3330	218	342	MG/KG
Mercury	86	25.6	0.025	2.95	0.19	0.34	MG/KG
Molybdenum	99	50.5	1	67.6	10.9	8.6	MG/KG
Nickel	96	85.4	4.3	193	19.8	20.6	MG/KG
Potassium	98	52.0	186	18700	1404	2064	MG/KG
Selenium	82	2.4	0.11	6.8	0.9	1.2	MG/KG
Silver	83	39.8	0.3	40.9	5.6	9.5	MG/KG
Silicon	*	*	*	*	*	*	
Sodium	99	17.2	63	3680	304	422	MG/KG
Strontium	99	36.4	10.2	242	52	48.3	MG/KG
Thallium	75	4.0	0.1	2.45	0.5	0.5	MG/KG
Tin	92	27.2	10.1	441	62.5	112	MG/KG
Vanadium	99	98.0	4.2	283	31.5	28.5	MG/KG
Zinc	98	92.9	0.5	486	36.3	51.4	MG/KG
Ammonia	*	*	*	*	*	*	MG/KG
Chromium IV	*	*	*	*	*	*	MG/KG
Cyanide	*	*	*	*	*	*	MG/KG
Nitrate/Nitrite	98	39.8	0.5	7.1	1.3	1.1	MG/KG
Oil & Grease	*	*	*	*	*	*	MG/KG
Petroleum Hydrocarbon	*	*	*	*	*	*	MG/KG
Sulfide	89	16.8	1.0	43000	485	4558	MG/KG
TOC	*	*	*	*	*	*	MG/KG
pH	97	100.0	6.1	9.1	8.0	0.7	PH
Americium-241	28	"100"	-0.015	0.01	-0.002	0.007	PCi/G
Cesium-134	*	*	*	*	*	*	PCi/G
Cesium-137	99	"100"	0	0.2	0.012	0.041	PCi/G
Gross alpha	99	"100"	5	48	24.9	9.3	PCi/G
Gross beta	99	"100"	6	44	24.7	6.1	PCi/G
Plutonium-238	*	*	*	*	*	*	PCi/G
Plutonium-239+240	99	"100"	-0.01	0.03	0.004	0.007	PCi/G
Radium-226	83	"100"	0.5	1.3	0.75	0.23	PCi/G
Radium-228	83	"100"	0.50	2.20	1.40	0.32	PCi/G
Strontium-89+90	99	"100"	-0.60	1.20	0.03	0.36	PCi/G
Strontium-90	*	*	*	*	*	*	PCi/G
Tritium	99	"100"	-150	440	142	127	PCi/G
Uranium-233+234	99	"100"	0.2	8.9	0.78	0.93	PCi/G
Uranium-235	99	"100"	0	0.2	0.02	0.05	PCi/G
Uranium-238	99	"100"	0.2	3.2	0.73	0.38	PCi/G

Summary statistics calculated for RFEDS data compiled for this assessment, assuming a normal distribution.
Asterisk (*) indicates that data are not available. The "100" indicates that no records were qualified as nondetects.

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Table 4.
Comparison of Concentrations of Inorganic Constituents in Waste-Cell Subsurface Soils vs. Background Subsurface Soils

ANALYTE	DETECTIONS		HIGHER	MEAN CONCENTRATIONS		MEAN + 2 SD		UNITS	Wilcoxon
	Waste Cell	UHSU Bkgd	% DETECT	Waste Cell	UHSU Bkgd	Waste Cell	UHSU Bkgd		p-values
Aluminum	100.0	99.0	Cell	9940	12710	19754	35380	MG/KG	0.0155 @
Antimony	4.8	15.2	Back	*	*	*	*	MG/KG	*
Arsenic	92.7	70.7	Cell	5.8	3.6	15.6	12.4	MG/KG	0.0001 @
Barium	86.2	88.9	Back	120	96.1	784	290	MG/KG	0.4236
Beryllium	45.9	81.8	Back	0.7	4.7	3.2	14.3	MG/KG	0.0001 @
Cadium	39.4	7.4	Cell	5.5	*	88.1	*	MG/KG	*
Calcium	99.7	99.0	Cell	22900	7052	104910	39410	MG/KG	0.0001 @
Cesium	69.2	1.1	Cell	19.0	*	74.2	*	MG/KG	*
Chromium	99.2	84.8	Cell	14.6	18.8	63.6	68.2	MG/KG	0.0040 @
Cobalt	66.4	22.2	Cell	6.6	6.4	18.6	20.6	MG/KG	0.1184
Copper	91.2	95.0	Back	12.2	12.6	32.0	38.2	MG/KG	0.9263
Iron	100.0	100.0	*	12710	14530	27160	41046	MG/KG	0.0651
Lead	100.0	99.0	Cell	13.4	10.8	70.2	25.0	MG/KG	0.3489
Lithium	84.0	61.6	Cell	7.5	10.0	21.1	27.0	MG/KG	0.0010 @
Magnesium	94.9	96.0	Back	2276	2853	4234	9345	MG/KG	0.1410
Manganese	100.0	100.0	*	247	218	1028	902	MG/KG	0.6382
Mercury	26.8	25.6	Cell	0.09	0.19	0.75	0.87	MG/KG	0.0001 @
Molybdenum	21.3	50.5	Back	2.0	10.9	7.0	28.1	MG/KG	0.0001 @
Nickel	84.5	85.4	Back	14.7	19.8	45.5	61.0	MG/KG	0.0001 @
Potassium	78.5	52.0	Cell	1325	1404	3473	5532	MG/KG	0.8680
Selenium	4.5	2.4	Cell	*	*	*	*	MG/KG	*
Silicon	98.2	39.8	Cell	920	ND	3990	ND	MG/KG	NA
Silver	10.5	17.2	Back	*	*	*	*	MG/KG	*
Sodium	57.1	36.4	Cell	419	304	2000	1148	MG/KG	0.5814
Strontium	85.0	36.4	Cell	45.4	52.0	124	149	MG/KG	0.5690
Thallium	16.4	4.0	Cell	*	*	*	*	MG/KG	*
Tin	28.1	27.7	Cell	18.0	62.5	42.6	286	MG/KG	0.9318
Vanadium	97.7	98.0	Back	26.7	31.5	52.3	88.5	MG/KG	0.0533
Zinc	99.7	92.9	Cell	41.8	36.3	127	139	MG/KG	0.0713
Americium-241	81.5	"100"	NA	0.277	0.00	3.67	0.01	PCi/G	0.0001 @
Cesium-134	100	"100"	NA	0.078	ND	0.15	ND	PCi/G	NA
Cesium-137	90.9	"100"	NA	0.11	0.01	0.89	0.09	PCi/G	0.0001 @
Gross alpha	100	"100"	NA	26.0	24.9	90.8	43.5	PCi/G	0.0481 @
Gross beta	100	"100"	NA	22.9	24.7	37.7	36.8	PCi/G	0.0046 @
Plutonium-238	100	"100"	NA	0.036	ND	0.16	ND	PCi/G	NA
Plutonium-239+240	88.0	"100"	NA	1.13	0.00	15.3	0.02	PCi/G	0.0001 @
Radium-226	94.7	"100"	NA	0.67	0.74	1.19	1.21	PCi/G	0.0037 @
Radium-228	100	"100"	NA	1.46	1.40	2.47	2.04	PCi/G	0.6431
Strontium-89+90	75.2	"100"	NA	0.18	0.03	0.66	0.75	PCi/G	0.0001 @
Tritium	74.4	"100"	NA	1537	142	13065	396	PCi/L	0.1770
Uranium-233+234	100	"100"	NA	1.75	0.78	22.8	2.6	PCi/G	0.0005 @
Uranium-235	90.7	"100"	NA	0.12	0.02	1.62	0.11	PCi/G	0.0001 @
Uranium-238	100	"100"	NA	1.44	0.73	13.9	1.5	PCi/G	0.0001 @
Ammonia	32.4	ND	NA	0.56	ND	2.9	ND	MG/KG	NA
Chromium-VI	16.7	ND	NA	0.4	ND	0.83	ND	MG/KG	NA
Cyanide	12.7	ND	NA	0.98	ND	6.86	ND	MG/KG	NA
Nitrate/Nitrite	80.3	39.8	Cell	119	1.2	1177	3.4	MG/KG	0.4491
Oil and Grease	23.6	ND	NA	15.3	ND	168	ND	MG/KG	NA
Petro. Hydrocarb	97.1	ND	NA	134	ND	362	ND	MG/KG	NA
Sulfide	9.9	16.8	Back	*	*	*	*	MG/KG	*
TOC	98.7	ND	NA	982	ND	5148	ND	MG/KG	NA
pH	100	100	*	8.1	8.0	9.2	9.4	MG/KG	0.5194

NA = Not Applicable; ND = No Data; * = < 20% Detects, Mean Not Calculated; "100" means 100% detection is assumed (per DOE Order 5400.1).

Nonparametric ANOVA testing was performed using the Wilcoxon Rank Sum test; please see text for discussion and qualification of these results.

An @ indicates that the Wilcoxon test is significant (P-value < 0.05).

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Table 5.
Pore-Water Data for pH and Specific Conductivity

Lysimeter Location	pH		Specific Conductivity (uS)	
	Range	Mean	Range	Mean
40293	10.8-12.6	11.7	2.06-5.01	3.54
40393	10.8-12.9	11.6	1.62-2.58	1.94
40593	7.9-9.1	8.5	1.78-1.88	1.83
40793	9.8-10.9	10.2	0.52-1.18	0.81
40993	6.8-10.3	9.0	8.14-19.9	16.18
40993	6.9-10.9	9.5	NA	19.99
41293	9.0-11.0	10.1	1.11-2.68	2.24
41593	6.2-9.0	6.8	1.24-19.9	15.04
41793	7.8-12.2	9.8	1.06-7.61	2.27
42493	NA	7.6	NA	2.04
42493	7.0-7.8	7.3	1.43-2.64	2.22
42893	7.0-7.8	7.3	0.77-2.47	1.93
43193	7.4-7.9	7.7	2.76-4.55	3.25
43193	6.5-7.3	7.0	8.55-11.22	9.72
43693	7.0-7.8	7.4	4.36-19.9	18.19
43793	7.1-9.7	8.2	1.15-2.90	2.11
43793	8.1-11.4	10.8	2.18-3.84	3.02
44093	6.9-9.6	8.0	0.51-1.29	0.90
44093	8.0-8.5	8.2	2.57-3.20	2.91
44393	7.3-9.8	8.5	0.50-1.35	1.03
44393	9.9-11.5	10.4	0.86-2.50	1.09

Summary data from OU4 IM/IRA EA Decision Document, Draft February 10, 1995.

NA = Not applicable.

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Table 6.
Summary of Pore-Water Data for OU4 Lysimeters

Analyte	N	% Detects	Min	Max	Mean	Units
Aluminum	67	37.3	25	10700	984	UG/L
Antimony	66	56.1	0	ND	ND	UG/L
Arsenic	66	90.1	0	120	8.4	UG/L
Barium	67	86.6	0	1470	122	UG/L
Beryllium	66	56.1	0	ND	ND	UG/L
Cadmium	68	14.7	3	54	14	UG/L
Calcium	66	95.4	0	3490000	110200	UG/L
Cesium	27	11.1	39	75	59	UG/L
Chromium	66	60.1	0	10200	255	UG/L
Cobalt	67	58.2	0	2100	60.2	UG/L
Copper	68	14.7	6	900	107	UG/L
Iron	69	63.8	28	37400	1800	UG/L
Lead	70	47.1	1	1110	48.2	UG/L
Lithium	27	66.7	24	6170	984	UG/L
Magnesium	65	87.7	0	236000	20120	UG/L
Manganese	69	73.9	1	13100	925	UG/L
Mercury	70	0.0	ND	ND	ND	UG/L
Molybdenum	26	53.8	26	3660	547	UG/L
Nickel	66	68.2	0	6460	160	UG/L
Potassium	67	91.0	0	11400000	308700	UG/L
Selenium	66	74.2	0	19	1.4	UG/L
Silicon	26	96.2	11300	288000	71320	UG/L
Silver	69	24.6	4	21	10.3	UG/L
Sodium	66	98.5	0	24000000	905400	UG/L
Strontium	26	96.2	190	20100	2613	UG/L
Thallium	67	56.7	0	89	2.3	UG/L
Tin	27	0.0	ND	ND	ND	UG/L
Vanadium	66	71.2	0	730	24.8	UG/L
Zinc	69	75.4	6	1270	104	UG/L
Nitrate/Nitrite	77	97.4	4	17600000	1064020	UG/L
Sulfide	13	46.2	1	43000	17900	UG/L
Cyanide	18	11.1	0	1000	500	UG/L
Americium-241	1	0.0	ND	ND	ND	PCi/L
Gross alpha	15	66.7	4	6300	706	PCi/L
Gross beta	15	100.0	4	5400	433	PCi/L
Plutonium-239+240	1	100.0	0	0.013	0.013	PCi/L
Radium-226	9	100.0	0	6	1.804	PCi/L
Radium-228	2	100.0	3	5	4.150	PCi/L
Strontium-89+90	1	100.0	1	1	0.60	PCi/L
Total Radiocesium	1	0.0	ND	ND	ND	PCi/L
Tritium	14	35.7	620	5600	2384	PCi/L
Uranium-233+234	14	100.0	1	3400	274	PCi/L
Uranium-235	14	85.7	0	120	11.48	PCi/L
Uranium-238	15	100.0	0	3700	264.5	PCi/L

Summary data from OU4 IM/IRA EA Decision Document, Draft February 10, 1995. ND = not defined.

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The formula used to calculate K_d values from lysimeter data was as follows:

$$K_d = \frac{\text{Concentration in solid phase (i.e., subsurface soil)}}{\text{Concentration in the liquid phase (i.e., pore water)}}$$

These derived K_d values were then refined through model calibration (EG&G, 1995b). In addition, the K_d values from literature sources were also reviewed for comparison to these calculated K_d values (see Tables 7a and 7b).

In addition to using K_d values to determine what concentration in soils will lead to exceedances of groundwater standards, the geochemical modeling of vadose-zone water (i.e., pore water) would be helpful in providing a picture of rock/water interaction under varying Eh-pH conditions. Unfortunately, analyses of major anions (e.g., bicarbonate, chloride, sulfate, etc.) are not reported in the Decision Document, so geochemical modeling cannot be performed separately for vadose-zone waters.

2.3 OU4 Pondcrete

Treatability studies, conducted in support of pondcrete disposal at RFETS, evaluated the leachability of pondcrete. Pondcrete samples were subjected to the toxicity characteristic leaching procedure (TCLP), and the subsequent leachate analyzed for organic and inorganic constituents. These treatability studies evaluated both treated and untreated pondcrete, and both the "triwall" pondcrete and the "metals" pondcrete, which are so-called based on the type of storage container (EG&G, 1995b). Treatment of pondcrete involved the addition of lime, concrete, and fly ash to stabilize the pondcrete material.

Waste acceptance criteria (WAC) were used to determine whether or not leachate derived from treated and untreated pondcrete would meet disposal standards. The liquid-phase WAC is defined as "...the chemical-specific leachate concentration generated from the waste material in an engineered disposal facility which will ensure an acceptable groundwater concentration at the point of compliance (POC) within a required protective time frame" (EG&G, 1995b). The WAC for selected metals and radionuclides for the 1-inch-per-year infiltration rate (assumed as typical for RFETS) were given in tables in the Pondcrete Treatability Report (EG&G, 1995b), and are as follows:

Radionuclides	Waste Criteria	Metals & Nitrate	Waste Criteria
Americium-241	74.5 pCi/L	Arsenic	142 □g/L
Cesium-134	12,800 pCi/L	Beryllium	14.2 □g/L
Cesium-137	737 pCi/L	Cadmium	51.8 □g/L
Plutonium-239+240	4.43 pCi/L	Chromium	881 □g/L
Radium-226	415 pCi/L	Sodium	14,900 □g/L
Uranium-233+234	254 pCi/L	Nitrate	166,000 □g/L
Uranium-235	10.2 pCi/L		
Uranium-238	177 pCi/L		

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Table 7a.
Kd Values (L/kg) for Selected Analytes

Analyte	Calibr'd Kd Vadose Zone	Calibr'd Kd Sat'd Zone	Literature Kd Value	Literature Kd Value	Kd Calculated from Lysimeter	RFETS Vadose	RFETS Sat'd Zone
Americium-241	100	10	8.2 - 300000	700	NA	100	10
Arsenic	2	0.5	*	200	NA	*	*
Beryllium	5	1	250	650	NA	*	*
Cadmium	5	1	2.7 - 625	6.5	597	*	*
Cesium-134	1	0.1	40 - 3968	1000	NA	*	*
Cesium-137	1	0.1	40 - 3968	1000	NA	1	0.1
Chromium	35	1.5	1.7 - 1729	850	NA	*	*
Nitrate	0.01	0.01	*	*	0.127	*	*
Plutonium-239+240	100	20	27 - 36000	4500	NA	100	20
Radium-226	690	106	57 - 21000	450	690	690	106
Sodium	10	1.5	*	100	NA	*	*
Uranium-233+234	17	2	.03 - 2200	450	19.8	17	2
Uranium-235	17	2	.03 - 2200	450	NA	17	2
Uranium-238	17	2	.03 - 2200	450	14.5	17	2

Tables from "Treatability Study Report and Process Formulation Report for Pondcrete," June 1995.
Asterisk (*) indicates data not available in the specific reference. NA = not applicable or not available.

Table 7b.
Kd Values (L/kg) Used at Other DOE Facilities for Selected Radionuclides

Analyte	Oak Ridge	Savannah River	Hanford	INEL Sat'd Zone	INEL Vadose	Fernald Sat'd Zone	Fernald Vadose
Americium-241	40	150	100	NA	NA	10	100
Cesium-137	3000	100	1	20	20	1370	1810
Plutonium-239+240	40	100	100	200	2000	100	1700
Radium-226	3000	500	10	5	50	106	696
Uranium-233+234	40	50	0	100	1000	1.78	3.1
Uranium-235	40	50	0	100	1000	1.78	3.1
Uranium-238	40	50	0	100	1000	1.78	3.1

Tables from "Treatability Study Report and Process Formulation Report for Pondcrete," June 1995.
Asterisk (*) indicates data not available in the specific reference. NA = not applicable or not available.

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Results of the leachate analyses showed a strong dependence between pH and constituent concentrations in the leachate. In general, a moderately alkaline condition (pH = 9 to 11) significantly reduced the concentrations of dissolved trace metals and radionuclides in the leachate (see Figure 1). Nitrate and sodium concentrations were unaffected by variations in pH.

Based on the results of the treatability study, it was determined that pondcrete subjected to "...the treatment process will meet all applicable waste-acceptance criteria..." given stated assumptions (EG&G, 1995b). Only sodium in the treated pondcrete was seen to exceed the waste acceptance criteria (WAC). In contrast, untreated pondcrete leached excessive amounts (i.e., > WAC) of plutonium-239+240, americium-241, uranium-238, beryllium, and cadmium, under a 1-inch-per-year infiltration rate, which is the current best estimate for the infiltration rate at RFETS. Assuming that pondcrete materials are treated prior to placement in the Cell, the possible composition of leachate derived from the stored pondcrete should meet WAC for the scenario of 1-inch-per-year infiltration rate. The mean leachate compositions for pondcrete samples are summarized in Table 8.

The mean concentrations/activities of leachate analytes for **"triwall" pondcrete** are for those samples treated with lime, fly ash, and cement. The mean values for leachate analytes for **"metals" pondcrete** are for those samples treated with lime, fly ash, and cement. For additional details, the reader should refer to the Pondcrete Treatability Report (EG&G, 1995b).

2.4 OU4 Sludges

Sludge samples from the Solar Evaporation Ponds and from the Building 788 clarifier were subjected to TCLP testing, and the subsequent leachate analyzed for organic and inorganic constituents. The leachate was analyzed for selected hazardous constituents, which included arsenic, barium, cadmium, chromium, lead, nickel, sodium, nitrate, and selected radionuclides. These treatability studies evaluated both treated and untreated sludges. Treatment of the sludges involved the addition of lime, concrete, and fly ash to stabilize the sludge materials. Leachability of constituents of concern was determined for both the treated and untreated materials.

As with the pondcrete, results of the leachate analyses for sludges showed a strong dependence between pH and constituent concentrations in the leachate. In general, a moderately alkaline condition (pH = 9 to 11) significantly reduced the concentrations of trace metals and radionuclides in the leachate (see Figure 1).

Based on the results of the treatability study, it was determined that treated sludges will meet all WAC, given the stated assumptions (EG&G, 1995c). Only sodium in the treated sludges was seen to exceed the WAC. In contrast, untreated sludge materials leached excessive amounts (i.e., > WAC) of plutonium-239+240, uranium isotopes, arsenic, beryllium, cadmium, nitrate, and sodium under a scenario of a 1-inch-per-year infiltration rate. Values of WAC are shown in Section 2.3 above. The mean leachate compositions for various sludge materials are listed below and summarized in Table 8.

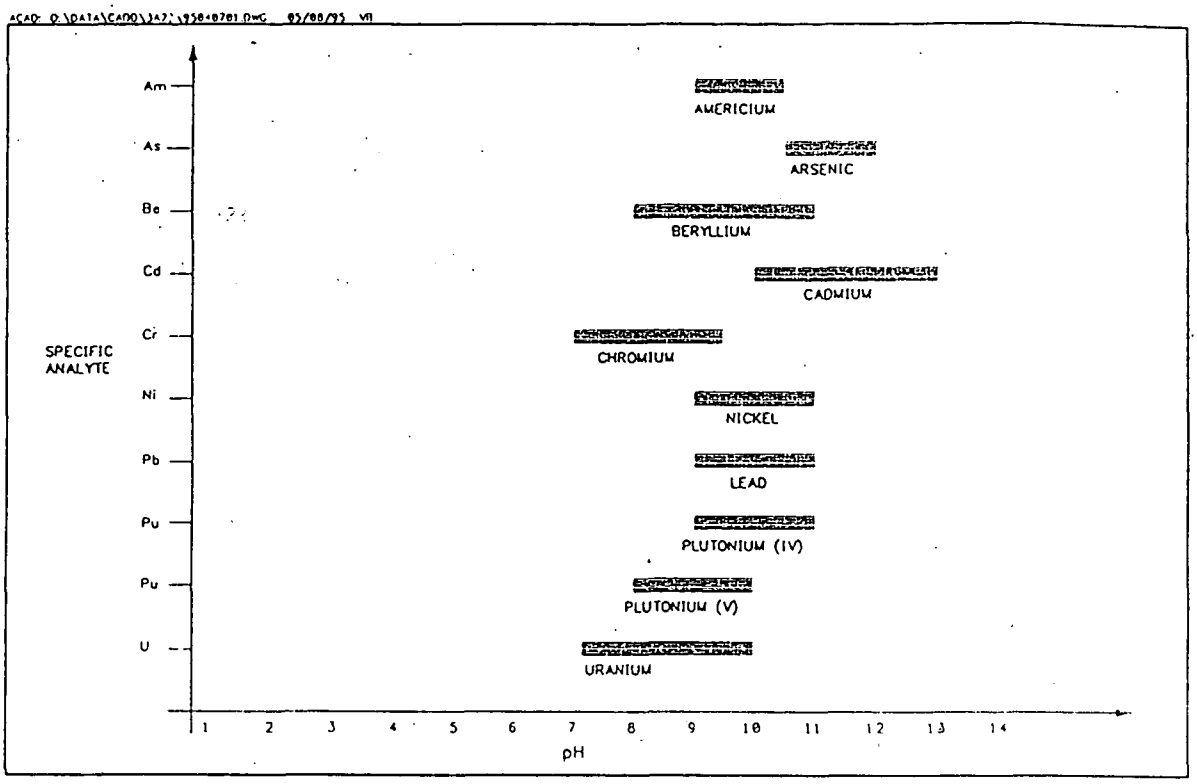

Figure 1. Optimum pH Values for Precipitation of Various Metal Hydroxides. (Figure from *Pondcrete Treatability Study Report and Process Formulation Report*, Revision 0, June 1995).

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Table 8.
Average Leachate (TCLP) Compositions for Treated Pondcrete and Sludges

Analyte	Phase II "Triwall" Pondcrete	Phase I "Metals" Pondcrete	Phase II Pond 207A/B Sludges	Phase II Pond 207C Sludges	Phase II Clarifier Sludges	Phase II Pond 207C & Clarifier Sludges	Units
Americium-241	<0.35	<0.15	<0.24	1	<0.33	<0.3	PCI/L
Cesium-134	<5.5	*	<5.3	<5.5	<5	<5.7	PCI/L
Cesium-137	<5.7	*	<5.8	<6.5	<5.3	<6	PCI/L
Plutonium-238	<0.11	<0.05	<0.095	<0.05	<0.095	<0.1	PCI/L
Plutonium239+240	<0.07	0.034	<0.05	<0.05	<0.054	<0.1	PCI/L
Radium-226	1.4	0.75	0.28	0.52	0.63	0.54	PCI/L
Uranium-233+234	0.044	<0.4	0.06	0.15	0.05	0.08	PCI/L
Uranium-235	<0.038	<0.36	0.08	<0.064	<0.05	<0.07	PCI/L
Uranium-238	0.042	<0.45	0.06	0.16	<0.06	0.08	PCI/L
Arsenic	<100	<100	<100	550	<100	140	UG/L
Beryllium	<0.5	<0.5	<0.5	<3.0	<0.55	<0.8	UG/L
Cadmium	<5.0	<5.0	<5.0	<5.0	5	<5	UG/L
Chromium	198	150	125	150	160	170	UG/L
Lead	<50	<50	<50	<50	<50	<50	UG/L
Nickel	<20	<20	<20	27	<20	<20	UG/L
Sodium	413000	555000	208000	3070000	383000	2397000	UG/L
Nitrate/Nitrite	110700	125000	12900	1320000	84300	1417000	UG/L
pH	11.4	11.1	11.3	11.8	11.1	11.8	PH
Reference	Table 3-11 EG&G, 1995b	Table 3-19 EG&G, 1995b	Table 3-14 EG&G, 1995c	Table 3-27 EG&G, 1995c	Table 3-37 EG&G, 1995c	Table 3-39 EG&G, 1995c	

NOTE: If reported detection rate was > 50%, then a replacement value of one-half the detection limit was used for calculation of summary statistics.

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Assuming that the sludges are treated prior to placement in the Cell, the possible composition of leachate derived from the stored sludges should meet WAC for the scenario of a 1-inch-per-year infiltration rate. The mean concentrations/activities reported for leachate analytes for **Ponds 207 A and B sludges, Pond 207 C sludges,** and **clarifier sludges** are for those samples treated with lime, fly ash, and cement (Phase II). For additional details, the reader should refer to the Pondcrete Treatability Report (EG&G, 1995c).

2.5 Groundwater

An evaluation of the groundwater chemistry in areas of contaminated subsurface soils destined for the Cell may also provide insights as to the likely composition of waste leachates. Locations for which both subsurface-soil and groundwater data were available are listed in Table 2. Summary statistics were calculated for these groundwater data (Table 9), and a series of modeling runs were conducted using mean concentrations and varying Eh conditions. Discussion of geochemical modeling and the results of modeling are given below in Section 3.0.

3.0 GEOCHEMICAL MODELING

Geochemical modeling takes into account solution chemistry, temperature, pH, and Eh to determine speciation and solubilities of various components. These four variables are the main factors influencing the solubility and behavior of inorganic constituents. Geochemical modeling is based on thermodynamic data and does not take into account various kinetic factors that may influence water/rock interactions; professional judgment should always be applied when evaluating model output.

Model input includes concentration data, pH, Eh, temperature, and specification of either the Debye-Huckel or Davies equation for determining individual ion-activity coefficients. By using actual concentration data, but varying selected parameters such as Eh, the general effects of such changes on constituent behavior can be assessed. This allows the user to evaluate and define optimum conditions for a given situation.

Using WATEQF (Plummer *et al.*, 1976), a limited modeling analysis was performed for groundwater related to the wastes destined for the proposed waste cell (see Table 9), in addition to modeling of an estimated leachate solution (see Table 10). Groundwater models were run for three Eh conditions (-0.2, 0.0, and 0.5 volts), whereas the estimated leachate solution was run for only two Eh conditions (0.0 and 0.5 volts).

Model output includes a listing of the distribution of aqueous species for each constituent, as well as the calculated saturation indices (SI) for a variety of phases. The SI is defined as the log of the ratio of the ion-activity product (IAP) to the solubility product (K_{sp}) for a given phase. The SI value for each phase indicates the likelihood that the phase will precipitate from, or dissolve into, the groundwater. If the SI value is approximately zero (i.e., +/- 0.5), then the phase is in equilibrium with the solution; if the SI value is less than zero (i.e., < 0.5), then the phase is likely to dissolve; if the SI value is greater than zero (i.e., > 0.5), then the phase is likely to precipitate. Modeling results are discussed below.

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Table 9.

Summary of Groundwater Data for Areas with Contaminated Subsurface Soils

Analyte (dissolved)	N	% Detects	Min	Max	Mean	Std. Dev.	Units
Aluminum	97	12.4	5.5	269	22.1	34.9	UG/L
Antimony	103	3.9	5.5	51.5	13.1	7.1	UG/L
Arsenic	102	14.7	0.35	9	1.5	1.8	UG/L
Barium	105	99.1	43.3	675	195	114	UG/L
Beryllium	104	2.9	0.11	1.5	0.51	0.19	UG/L
Cadmium	104	4.8	0.9	21.7	1.6	2.1	UG/L
Calcium	100	100.0	33500	678000	160450	147770	UG/L
Cesium	84	1.2	6.5	309	70.1	101	UG/L
Chromium	105	1.0	1	4.8	1.8	0.6	UG/L
Cobalt	105	14.3	1	6.9	2.7	1.4	UG/L
Copper	104	22.1	1	17.6	2.2	1.9	UG/L
Iron	97	20.6	2	342	18.6	43.6	UG/L
Lead	103	5.8	0.35	13.8	0.8	1.3	UG/L
Lithium	100	55.0	1	42.4	12.3	9.5	UG/L
Magnesium	100	100.0	4120	105000	20060	23790	UG/L
Manganese	100	69.0	0.5	1850	228	420	UG/L
Mercury	105	1.0	0.05	0.23	0.099	0.017	UG/L
Molybdenum	96	10.4	1.5	34.1	6.7	5.5	UG/L
Nickel	103	17.5	1.5	86.1	9.3	14.6	UG/L
Potassium	100	91.0	242	11100	3098	2312	UG/L
Selenium	105	19.1	0.5	12	1.4	1.4	UG/L
Silicon	32	100.0	3630	9780	6632	1393	UG/L
Silver	105	1.0	1	25.1	1.8	2.4	UG/L
Sodium	100	100.0	4840	497000	46630	92500	UG/L
Strontium	100	100.0	240	3110	749	749	UG/L
Thallium	105	1.9	0.45	18.9	1.5	2.2	UG/L
Tin	100	17.0	3.6	74.6	14.2	12.5	UG/L
Vanadium	105	19.1	1	93	4.7	9.8	UG/L
Zinc	99	28.3	0.6	65.3	6.1	8.9	UG/L
Bicarb as CaCO3	127	100.0	65000	690000	264800	79440	UG/L
Chloride	130	97.7	500	3010000	170040	439190	UG/L
Fluoride	130	99.2	100	1410	505	240	UG/L
Nitrate/Nitrite	128	94.5	10	444000	9400	39400	UG/L
Orthophosphate	91	45.1	1.9	247	23	44	UG/L
Silica	64	100.0	8000	20965	15830	2894	UG/L
Sulfate	132	96.2	10000	250000	40744	36240	UG/L
TDS	127	100.0	210000	3800000	672095	775800	UG/L
TSS	127	96.1	2000	43000000	1553800	5121800	UG/L
pH	10	100.0	6.8	10.5	7.9	1.0	PH
Americium-241	6	83.3	0.006	0.435	0.108	0.169	PCi/L
Cesium-134	6	100.0	-0.63	0.71	-0.2	0.48	PCi/L
Cesium-137	8	87.5	-0.37	0.37	0.07	0.24	PCi/L
Gross alpha	99	88.9	0.32	67.1	10.4	11	PCi/L
Gross beta	95	90.5	-1.4	56.4	9.5	10.3	PCi/L
Plutonium-239+240	8	87.5	-0.001	1.999	0.403	0.01	PCi/L
Radium-226	45	95.6	0	2.82	0.87	0.67	PCi/L
Tritium (total)	110	53.6	-109	1067	154	163	PCi/L
Uranium-233+234	95	100.0	0.32	24.4	5.63	5.49	PCi/L
Uranium-235	95	76.8	-0.085	1.5	0.27	0.34	PCi/L
Uranium-238	95	100.0	0.24	75.7	7.68	12.01	PCi/L

Summary statistics calculated for RFEDS data compiled for this evaluation. ND = no data.
Locations for which data were evaluated are given in Table 2 of this report.

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Table 10.

Summary of Data and Estimated Leachate Composition for Waste-Cell Wastes

	52.5%		25.8%		14.5%		7.2%		Estimated	
	OU4 Pore Water - 52.5% Waste-site GW				OU4 Pondcrete		OU4 Sludges		Leachate	
Analyte	BKGD	Mean	BKGD	Mean	BKGD	Mean	BKGD	Mean	Composition	Units
Aluminum		984		22.1	X	114	X	114	547	UG/L
Antimony	X	25		13.1	X	25	X	25	22	UG/L
Arsenic		8.4		1.5	X	27		550	48	UG/L
Barium		122		195	X	84	X	84	133	UG/L
Beryllium	X	2.2		0.51	X	2.2	X	2.2	1.8	UG/L
Cadmium		14		1.6	X	2.4		5	8.5	UG/L
Calcium		110200		160450	X	55205	X	55205	111230	UG/L
Cesium		59		70.1	X	446	X	446	146	UG/L
Chromium		255		1.8		180		170	173	UG/L
Cobalt		60.2		2.7	X	20.5	X	20.5	37	UG/L
Copper		107		2.2	X	10.8	X	10.8	59	UG/L
Iron		1800		18.6	X	94	X	94	970	UG/L
Lead		48.2		0.8	X	8.6	X	8.6	27	UG/L
Lithium		984		12.3	X	38.7	X	38.7	528	UG/L
Magnesium		20120		20060	X	10026	X	10026	17910	UG/L
Manganese		925		228	X	32.7	X	32.7	550	UG/L
Mercury	X	0.59		0.099	X	0.59	X	0.59	0.46	UG/L
Molybdenum		547		6.7	X	61.2	X	61.2	302	UG/L
Nickel		160		9.3	X	15.5		15.5	90	UG/L
Potassium		308700		3098	X	11270	X	11270	165300	UG/L
Selenium		1.4		1.4	X	20.5	X	20.5	5.5	UG/L
Silicon		71320		6632	X	62.8	X	62.8	39170	UG/L
Silver		10.3		1.8	X	31900	X	31900	62.8	UG/L
Sodium		905400		46630		555000		3000000	783800	UG/L
Strontium		2613		749	X	352	X	352	1640	UG/L
Thallium		2.3		1.5	X	29.6	X	29.6	8	UG/L
Tin	X	108		14.2	X	108	X	108	84	UG/L
Vanadium		24.8		4.7	X	12.4	X	12.4	17	UG/L
Zinc		104		6.1	X	14.3	X	14.3	60	UG/L
Bicarb as CaCO3	X	223810		264800	X	223810	X	223810	234400	UG/L
Chloride	X	12832		170040	X	12832	X	12832	53400	UG/L
Fluoride	X	690		505	X	690	X	690	640	UG/L
Nitrate/Nitrite		1064020		9400		125000		1000000	651200	UG/L
Orthophosphate	X	13		23	X	13	X	13	16	UG/L
Silica	X	14300		15830	X	14300	X	14300	14700	UG/L
Sulfate	X	86230		40744	X	86230	X	86230	74500	UG/L
TDS	X	354151		672095	X	354151	X	354151	736200	UG/L
pH		8.8		7.9		11.2		11.5	9.1	UG/L
Americium-241	X	0.011		0.108	X	0.011		1	0.11	PCi/L
Cesium-134	X		X		X		X		ID	PCi/L
Cesium-137	X	0.42		0.07	X	0.42	X	0.42	0.33	PCi/L
Gross alpha		706		10.4	X	8.4	X	8.4	375	PCi/L
Gross beta		433		9.5	X	4.9	X	4.9	230	PCi/L
Plutonium-239+240		0.013		0.403		0.034	X	0.011	0.12	PCi/L
Radium-226		1.804		0.87		1.4		0.5	1.4	PCi/L
Radium-228		4.15	X	2.12	X	2.12	X	2.12	3.2	PCi/L
Tritium (total)		2384		154	X	102	X	102	1310	PCi/L
Uranium-233+234		274		5.63	X	6.91	X	6.91	147	PCi/L
Uranium-235		11.48		0.27	X	0.195	X	0.195	6.1	PCi/L
Uranium-238		264.5		7.68	X	4.83	X	4.83	142	PCi/L

X indicates that the background value was used for that analyte; ID indicates insufficient data provided in reference source.

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3.1 Modeling of Groundwater Chemistry

Using the mean concentrations of constituents, models were run for three redox conditions: Eh = -0.2 volts (reducing), Eh = 0.2 volts (mildly oxidizing), and Eh = 0.5 volts (oxidizing). The dominant aqueous species, as well as phases that may control solubility, were then reviewed for each of the three redox conditions (see Figure 2).

At the low Eh value of -0.2 volts, representative of environments isolated from the atmosphere, the solution is oversaturated with respect to Ag_2Se; native silver; copper sulfide - Cu_2S; chromite - $FeCr_2O_4$; PbSe; ferroselite - $FeSe_2$; illite, smectite, and kaolinite clays; ZnSe; native selenium; FeSe; and uranium species - U_4O_9, uraninite (UO_2), and coffinite ($USiO_4$); in addition to various iron oxides, calcite, and quartz.

Unconfined groundwater in the shallow subsurface probably exhibits Eh values in the range of 0.0 to 0.2 volts. At an Eh of 0.2 volts, the solubility of uranium species increases markedly. The solution is still oversaturated with respect to iron oxides and oxyhydroxides, clays, calcite, native silver and silver selenide, and quartz. Molybdenum, vanadium, selenium, arsenic, and uranium have oxyanion complexes or negatively charged carbonate complexes as the dominant aqueous species.

To represent an environment in contact with the atmosphere (e.g., surface water or leachates from wastes stored aboveground), an Eh = 0.5 volts was used. Again, iron, aluminum, and manganese oxides and oxyhydroxides are predicted to precipitate, along with calcite and quartz, and various clay minerals. Actually, the solution appears to be at or near equilibrium with calcite, quartz, barite, pyrolusite, manganese phosphate, and hydroxyapatite. The groundwater remains undersaturated with respect to uranium-bearing phases, such as uranium carbonates. Anionic complexes for molybdenum, uranium, vanadium, chromium, arsenic, and selenium are the dominant species for these constituents in solution.

3.2 Modeling of Estimated Leachate Solution

An estimated leachate composition was derived by assembling data for vadose-zone water, groundwater, and TCLP leachates from treated pondcrete and sludges. The concentration data were then weighted for the relative proportion of a waste type. As shown in Table 10, the mean concentration multiplied by the relative proportion, which is based on the estimated volume of waste, was used to generate an estimate of leachate. If data for specific analytes were unavailable, then the mean concentration for background groundwater was used for that proportion. The mean pH of 9.1, an oxidizing Eh of 0.5 volts, and a temperature of 12°C were used for one model and a more reducing Eh of 0.0 volts was used for the second model (all other parameters unchanged).

The proportions of each waste type used for the estimated leachate composition were 52.5% OU4 vadose-zone water, 25.8% waste-site groundwater, 14.5% treated-pondcrete leachate, and 7.2% treated-sludge leachate (see Table 10). The estimated values shown here should be considered rough, preliminary estimates of constituent concentrations. As noted below, changes in physicochemical conditions can change the leachate composition.

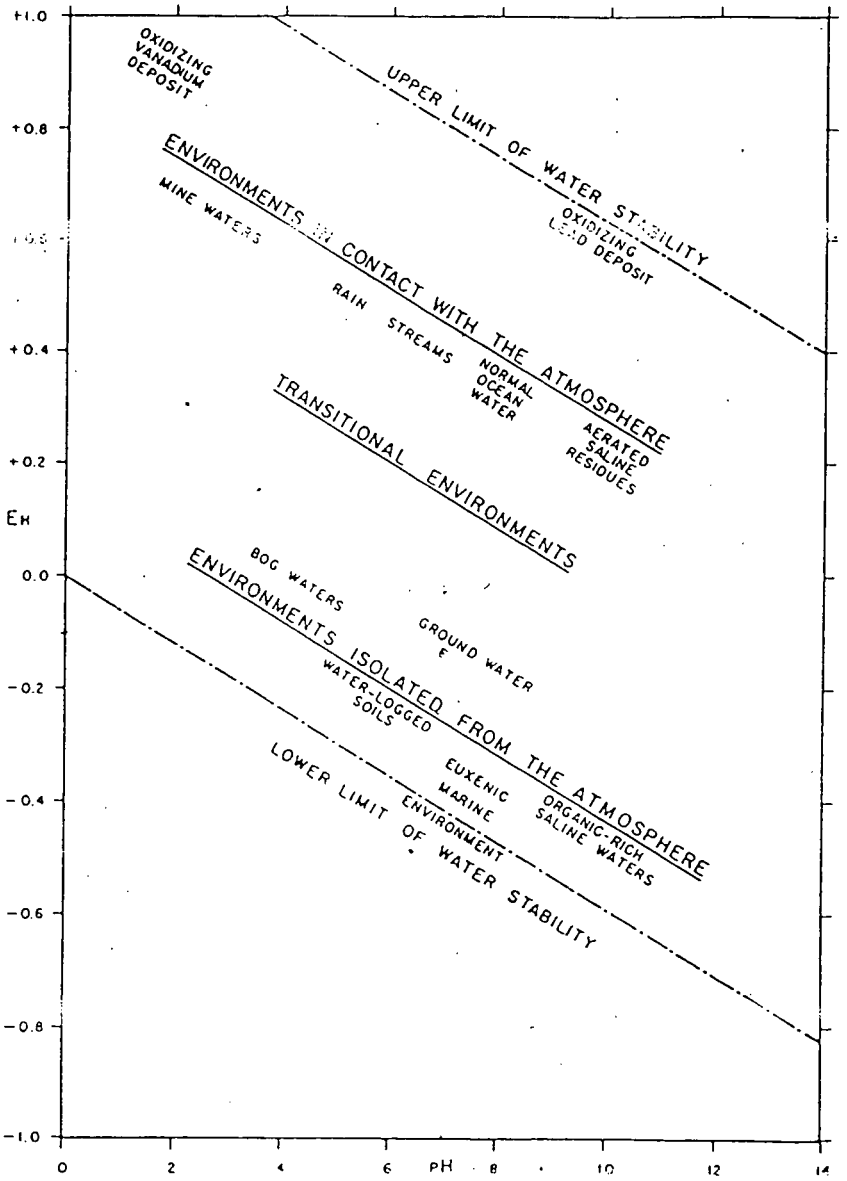

Figure 2. Generalized Eh-pH diagram showing conditions of natural environments. (From Garrels and Christ, 1965).

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The hypothetical leachate solution produced model outputs with a reasonable 9.0% charge-balance error, and a distribution of aqueous species that indicates an abundance of nitrate and sodium as free ions. The dominant species in solution, in order of decreasing molality (for the Eh=0.0 case) are listed in Appendix A tables. (Molality is defined as moles of solute per 1000 grams of water; for dilute solutions at normal temperatures, molality is essentially equal to molarity. Molarity is moles of solute per 1000 grams of solution).

For the case the model run with an oxidizing Eh of 0.5 volts, the speciation indicates the importance of uranium-carbonate complexes. In the presence of carbonate, the solubility of uranium is greatly increased (compare Figures 3a and 3b), and the amount of dissolved uranium is much higher than it would be in carbonate-free water (Drever, 1988). In addition, oxyanions of chromium, molybdenum, arsenic, vanadium, and selenium are predicted to be the dominant aqueous species for these constituents. These species are important from a migration perspective because anions are generally more mobile than cations. The mobility of anions is related to the presence of abundant cation-exchange sites on clays and iron oxides, but fewer anion-exchange sites in the substrate. Thus, anionic species such as nitrate, chloride, sulfate, and oxyanions of metals, are generally less retarded as the solution migrates in the subsurface.

Output from the model run with an Eh of 0.0 volts also shows the importance of oxyanion complexes for molybdenum, chromium, selenium, vanadium, and arsenic. In general, the activities of anionic complexes of chromium, selenium are higher in the case of Eh = 0.0 volts, whereas the activities of major-ion species are largely unchanged. In particular, the activities of $Cr(OH)_4^-$, Fe^{+2}, $FeOH^+$, SeO_3^{-2}, Cu^+, $CuCl_2^-$, CuCl, $HSeO_3^-$ are markedly greater under an Eh of 0.0 volts, as compared to an Eh of 0.5 volts.

4.0 SUMMARY AND CONCLUSIONS

Wastes derived from OU4 will constitute approximately 75 percent of the total waste mass in the Waste Cell, with pondcrete and sludge materials comprising 21.7% of the total waste volume, and OU4 vadose-zone soils comprising 24.1% of the total waste volume. Because OU4 contributes the bulk of waste for the Cell, this evaluation focussed on the existing data for OU4 materials. Based on these data, nitrate, sodium, gross alpha, gross beta, tritium, and uranium isotopes appear to be the most mobile constituents in the OU4 wastes.

For subsurface-soil wastes to be stored at the proposed Cell, constituent concentrations in the waste materials were statistically compared to those in background subsurface soils. This comparison highlights those constituents that may be released in concentrations higher than those of background groundwater. However, just because the solid wastes contain constituent concentrations higher than those of background soils, does not necessarily mean that waste leachates will contain proportionately higher levels of those constituents.

Based on the estimated volumes of waste destined for the Cell and the available data for leachates, pore water, and groundwater from the wastes and waste areas, a general leachate composition was calculated (see Table 10). Geochemical modeling of the leachate suggests that iron, aluminum, and manganese

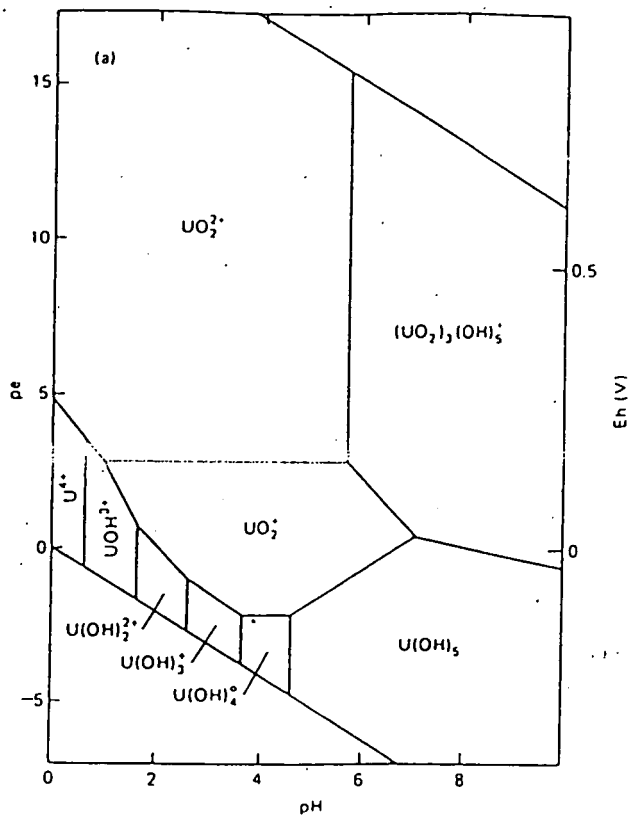

Figure 3a. Distribution of dissolved uranium species in a carbonate-free system at 25°C (Figure from Drever, 1988).

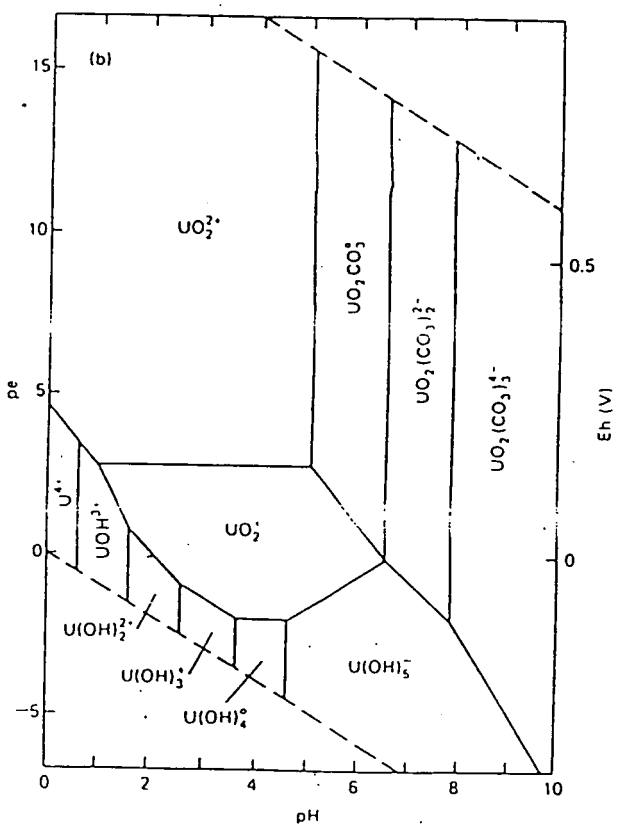

Figure 3b. Distribution of dissolved uranium species in a system containing carbonate, at 25°C. (Figure from Drever, 1988).

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oxides and oxyhydroxides, along with clay minerals, calcium carbonate, and compounds containing zinc, copper, barium, chromium, strontium will precipitate from the leachate. Silver, lead, and molybdenum appear to be at approximate equilibrium with the leachate, under the specified Eh-pH conditions. On the other hand, the leachate is undersaturated with respect to uranium, vanadium, arsenic, radium, and selenium phases, so these constituents would still tend to remain in solution. As long as uranium, vanadium, arsenic, and selenium exist as oxyanions, it is unlikely that they will be strongly retarded under the given Eh-pH conditions.

The solubility and behavior of iron is strongly influenced by Eh-pH conditions. The oxidized form of iron (ferric, Fe^{+3}) is much less soluble than the reduced form (ferrous, Fe^{+2}). Ferric oxyhydroxides, generalized as $Fe(OH)_3$, form suspended particulates. The importance of these ferric oxyhydroxide particulate is that their surfaces have a large capacity for the adsorption of trace metals (Hem, 1992). If Eh decreases and the iron is reduced, the adsorbed trace metals, in addition to the iron, will be released into solution. Where the solubility of trace elements is controlled by adsorption onto oxide surfaces, the dissolved concentrations of these elements will be highly sensitive to changes in Eh and pH. At RFETS, much of the plutonium and americium in near-surface waters may be adsorbed onto iron oxyhydroxide particulates, so Eh conditions may have significant impact on both trace metal and radionuclide mobility.

In general, most metals, including plutonium and americium, are less mobile in a neutral, oxidizing environment; however, those metals and radionuclides that tend to form oxyanions or other negatively charged aqueous species tend to remain mobile. Additionally, anions such as nitrate, chloride, and sulfate tend to be mobile under most naturally occurring Eh-pH conditions. Controlling the migration of anionic species probably presents the greatest challenge for wastes contaminated with numerous metals and radionuclides. Uranium tends to be immobilized under reducing conditions, but plutonium and americium are mobilized under these conditions. By modeling the leachate for a range of Eh-pH conditions, the optimum conditions for immobilization can be defined.

5.0 REFERENCES

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
NO3 -	2.88270E+03	4.66967E-02	NO3 -	2.88270E+03	4.66967E-02
NA +	7.80660E+02	3.41067E-02	NA +	7.80660E+02	3.41067E-02
K +	1.65027E+02	4.23906E-03	K +	1.65027E+02	4.23906E-03
HCO3 -	2.16955E+02	3.57133E-03	HCO3 -	2.16955E+02	3.57133E-03
CA 2+	1.00756E+02	2.52497E-03	CA 2+	1.00756E+02	2.52497E-03
CL -	5.33527E+01	1.51153E-03	CL -	5.33535E+01	1.51155E-03
MG 2+	1.64351E+01	6.78994E-04	MG 2+	1.64352E+01	6.78995E-04
SO4 2-	6.16884E+01	6.45010E-04	SO4 2-	6.16901E+01	6.45028E-04
CO3 2-	1.62828E+01	2.72536E-04	CO3 2-	1.62831E+01	2.72540E-04
H4SIO4	2.15717E+01	2.25426E-04	H4SIO4	2.15717E+01	2.25426E-04
CACO3	1.68300E+01	1.68893E-04	CACO3	1.68295E+01	1.68888E-04
LI +	5.27316E-01	7.63285E-05	LI +	5.27316E-01	7.63285E-05
CASO4	8.54916E+00	6.30733E-05	CASO4	8.54901E+00	6.30722E-05
NASO4 -	5.78539E+00	4.88102E-05	NASO4 -	5.78541E+00	4.88104E-05
NAHCO3	3.85061E+00	4.60479E-05	NAHCO3	3.85056E+00	4.60474E-05
NACO3 -	3.37192E+00	4.08052E-05	NACO3 -	3.37190E+00	4.08050E-05
F -	6.17843E-01	3.26644E-05	F -	6.17843E-01	3.26644E-05
MGCO3	2.71445E+00	3.23339E-05	MGCO3	2.71439E+00	3.23331E-05
CAHCO3 +	2.99946E+00	2.98001E-05	CAHCO3 +	2.99941E+00	2.97995E-05
H3SIO4 -	1.92131E+00	2.02907E-05	H3SIO4 -	1.92133E+00	2.02908E-05
SR 2+	1.63998E+00	1.87995E-05	SR 2+	1.63998E+00	1.87995E-05
AL(OH)4 -	1.71114E+00	1.80894E-05	AL(OH)4 -	1.71114E+00	1.80894E-05
FE(OH)4 -	1.79174E+00	1.45278E-05	FE(OH)4 -	1.89406E+00	1.53575E-05
MGSO4	1.80138E+00	1.50310E-05	MGSO4	1.80135E+00	1.50308E-05
MGHCO3 +	1.08704E+00	1.27956E-05	MGHCO3 +	1.08702E+00	1.27954E-05
MN 2+	4.99737E-01	9.13654E-06	MN 2+	4.99738E-01	9.13656E-06
KSO4 -	9.25961E-01	6.88091E-06	KSO4 -	9.25963E-01	6.88093E-06
H2CO3	3.98652E-01	6.45562E-06	H2CO3	3.98649E-01	6.45558E-06
OH -	9.33412E-02	5.51250E-06	OH -	9.33418E-02	5.51253E-06
MOO4 2-	5.03437E-01	3.16156E-06	MOO4 2-	5.03437E-01	3.16156E-06
AL(OH)5 2-	2.25688E-01	2.02907E-06	AL(OH)5 2-	2.25692E-01	2.02910E-06
FE(OH)3	2.09654E-01	1.97045E-06	FE(OH)3	2.21626E-01	2.08297E-06
UO2(CO3)3 4-	8.22000E-01	1.83451E-06	UO2(CO3)3 4-	8.22001E-01	1.83451E-06
CR(OH)3	1.46351E-01	1.42691E-06	CR(OH)3	2.99286E-12	2.91801E-17
CR(OH)4 -	1.55738E-01	1.30327E-06	CR(OH)4 -	3.18482E-12	2.66518E-17
CS +	1.46000E-01	1.10338E-06	CS +	1.46000E-01	1.10338E-06
BA 2+	1.32744E-01	9.70805E-07	BA 2+	1.32744E-01	9.70805E-07
CU(OH)2	8.52646E-02	8.77824E-07	CU(OH)2	8.80314E-02	9.06309E-07
NACL	4.94403E-02	8.49695E-07	NACL	4.94403E-02	8.49696E-07
FE 2+	4.59251E-02	8.25969E-07	FE 2+	7.07058E-11	1.27165E-15

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
MNHCO3 +	8.94985E-02	7.75245E-07	MNHCO3 +	8.94967E-02	7.75229E-07
ZN(CO3)2 2-	1.29407E-01	7.01076E-07	ZN(CO3)2 2-	1.29408E-01	7.01079E-07
HASO4 2-	8.85985E-02	6.35972E-07	HASO4 2-	8.85985E-02	6.35972E-07
MGF +	2.12824E-02	4.93562E-07	MGF +	2.12820E-02	4.93553E-07
CR(OH)2 +	5.23695E-02	6.11561E-07	CR(OH)2 +	1.07095E-12	1.25064E-17
NAF	1.80013E-02	4.30616E-07	NAF	1.80011E-02	4.30611E-07
HVO4 2-	3.62742E-02	3.14233E-07	HVO4 2-	3.62742E-02	3.14233E-07
NAOH	1.02805E-02	2.58165E-07	NAOH	1.02804E-02	2.58163E-07
CACL +	1.93137E-02	2.56828E-07	CACL +	1.93136E-02	2.56826E-07
MGOH +	1.04177E-02	2.53238E-07	MGOH +	1.04175E-02	2.53235E-07
CAF +	1.44848E-02	2.46262E-07	CAF +	1.44845E-02	2.46257E-07
AL(OH)3	1.89591E-02	2.44126E-07	AL(OH)3	1.89589E-02	2.44124E-07
CAOH +	8.53506E-03	1.50169E-07	CAOH +	8.53494E-03	1.50167E-07
ZNCO3	1.43310E-02	1.14797E-07	ZNCO3	1.43308E-02	1.14795E-07
KCL	8.04242E-03	1.08349E-07	KCL	8.04242E-03	1.08349E-07
FEOH +	7.21382E-03	9.94534E-08	FEOH +	1.11061E-11	1.53115E-16
LISO4 -	1.01144E-02	9.86315E-08	LISO4 -	1.01145E-02	9.86318E-08
ZN(OH)2	8.85994E-03	8.95326E-08	ZN(OH)2	8.85985E-03	8.95317E-08
HPO4 2-	7.22895E-03	7.56502E-08	HPO4 2-	7.23126E-03	7.56744E-08
PBCO3	2.00188E-02	7.52488E-08	PBCO3	2.00186E-02	7.52482E-08
MNOH +	4.59498E-03	6.41496E-08	MNOH +	4.59491E-03	6.41486E-08
SEO3 2-	8.03125E-03	6.35383E-08	SEO3 2-	3.96637E-09	3.13794E-14
AGCL	8.22030E-03	5.76091E-08	AGCL	8.22029E-03	5.76090E-08
PB(CO3)2 2-	1.75898E-02	5.39927E-08	PB(CO3)2 2-	1.75900E-02	5.39933E-08
CAPO4 -	6.54477E-03	4.86753E-08	CAPO4 -	6.54662E-03	4.86890E-08
MNSO4	6.98606E-03	4.64709E-08	MNSO4	6.98593E-03	4.64700E-08
AG +	2.72015E-03	2.53287E-08	AG +	2.72014E-03	2.53287E-08
MNCL +	2.25270E-03	2.50318E-08	MNCL +	2.25269E-03	2.50316E-08
H2VO4 -	2.43053E-03	2.08735E-08	H2VO4 -	2.43049E-03	2.08732E-08
UO2(CO3)2 2-	7.66996E-03	1.97511E-08	UO2(CO3)2 2-	7.66948E-03	1.97498E-08
CUCO3	2.24546E-03	1.82540E-08	CUCO3	2.31831E-03	1.88462E-08
MGPO4 -	2.14997E-03	1.81036E-08	MGPO4 -	2.15058E-03	1.81088E-08
H2SIO4 2-	1.68006E-03	1.79329E-08	H2SIO4 2-	1.68010E-03	1.79333E-08
CAHPO4	2.31770E-03	1.71097E-08	CAHPO4	2.31834E-03	1.71144E-08
FESO4	2.51164E-03	1.66069E-08	FESO4	3.86682E-12	2.55673E-17
KOH	8.66068E-04	1.55045E-08	KOH	8.66061E-04	1.55044E-08
CU +	9.59824E-04	1.51711E-08	CU +	1.44324E-12	2.28121E-17
ZN 2+	6.54952E-04	1.00618E-08	ZN 2+	6.54961E-04	1.00620E-08
AGCL2 -	1.70865E-03	9.59980E-09	AGCL2 -	1.70867E-03	9.59993E-09
CUCL2 -	9.97771E-04	7.45378E-09	CUCL2 -	1.50033E-12	1.12081E-17

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
MN(NO3)2	1.26224E-03	7.08480E-09	MN(NO3)2	1.26219E-03	7.08456E-09
CUCL	6.56438E-04	6.66003E-09	CUCL	9.87057E-13	1.00144E-17
CU(CO3)2 2-	1.19969E-03	6.56435E-09	CU(CO3)2 2-	1.23863E-03	6.77745E-09
HSEO3 -	8.18534E-04	6.42473E-09	HSEO3 -	4.04239E-10	3.17290E-15
MGHPO4	7.63872E-04	6.37822E-09	MGHPO4	7.64084E-04	6.37998E-09
FE(OH)2 +	4.32779E-04	4.83733E-09	FE(OH)2 +	4.57496E-04	5.11360E-09
ASO4 3-	6.58950E-04	4.76434E-09	ASO4 3-	6.58969E-04	4.76448E-09
H2ASO4 -	3.87543E-04	2.76194E-09	H2ASO4 -	3.87537E-04	2.76190E-09
ZNOH +	2.23975E-04	2.73057E-09	ZNOH +	2.23974E-04	2.73056E-09
NAHPO4 -	2.70604E-04	2.28462E-09	NAHPO4 -	2.70685E-04	2.28529E-09
ZNHCO3 +	2.60112E-04	2.06697E-09	ZNHCO3 +	2.60109E-04	2.06696E-09
BANO3 +	3.69232E-04	1.86050E-09	BANO3 +	3.69223E-04	1.86045E-09
CANO3 +	1.27154E-04	1.25107E-09	CANO3 +	1.27152E-04	1.25105E-09
PBOH +	2.28733E-04	1.02469E-09	PBOH +	2.28734E-04	1.02469E-09
H +	9.71697E-07	9.68242E-10	H +	9.71703E-07	9.68247E-10
MNF +	7.04473E-05	9.57017E-10	MNF +	7.04459E-05	9.56997E-10
H2PO4 -	5.56854E-05	5.76686E-10	H2PO4 -	5.57022E-05	5.76860E-10
ZNNO3 +	6.78005E-05	5.34599E-10	ZNNO3 +	6.77999E-05	5.34594E-10
LIOH	1.05336E-05	4.41823E-10	LIOH	1.05335E-05	4.41820E-10
ZN(OH)3 -	5.08938E-05	4.39155E-10	ZN(OH)3 -	5.08936E-05	4.39153E-10
CUOH +	3.30841E-05	4.12524E-10	CUOH +	3.41579E-05	4.25913E-10
PB(OH)2	9.75080E-05	4.06022E-10	PB(OH)2	9.75077E-05	4.06021E-10
AGNO3	6.82005E-05	4.03252E-10	AGNO3	6.81995E-05	4.03246E-10
SROH +	2.95709E-05	2.83878E-10	SROH +	2.95703E-05	2.83873E-10
ZNSO4	4.52244E-05	2.81365E-10	ZNSO4	4.52242E-05	2.81363E-10
KHPO4 -	3.76752E-05	2.80139E-10	KHPO4 -	3.76864E-05	2.80222E-10
FE(OH)3 -	2.65027E-05	2.49088E-10	FE(OH)3 -	4.08027E-14	3.83486E-19
ZNOHCL	2.69604E-05	2.29798E-10	ZNOHCL	2.69604E-05	2.29798E-10
FE(OH)2	1.56102E-05	1.74481E-10	FE(OH)2	2.40327E-14	2.68622E-19
HMOO4 -	2.22191E-05	1.38659E-10	HMOO4 -	2.22187E-05	1.38657E-10
AGSO4 -	2.64680E-05	1.30362E-10	AGSO4 -	2.64680E-05	1.30363E-10
CROH 2+	8.49900E-06	1.23712E-10	CROH 2+	1.73807E-16	2.52994E-21
PBHCO3 +	2.62107E-05	9.81533E-11	PBHCO3 +	2.62107E-05	9.81532E-11
PO4 3-	8.32633E-06	8.80591E-11	PO4 3-	8.32924E-06	8.80898E-11
CU(OH)3 -	9.35824E-06	8.20436E-11	CU(OH)3 -	9.66198E-06	8.47064E-11
PB 2+	1.56215E-05	7.57264E-11	PB 2+	1.56219E-05	7.57281E-11
VO4 3-	8.63026E-06	7.54171E-11	VO4 3-	8.63052E-06	7.54193E-11
CU 2+	3.76080E-06	5.94435E-11	CU 2+	3.88292E-06	6.13739E-11
FEHPO4	7.62012E-06	5.04134E-11	FEHPO4	1.17351E-14	7.76371E-20
CUHCO3 +	6.02892E-06	4.86141E-11	CUHCO3 +	6.22456E-06	5.01917E-11

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
AL(OH)2 +	2.79884E-06	4.60881E-11	AL(OH)2 +	2.79884E-06	4.60881E-11
AGOH	3.20726E-06	2.57971E-11	AGOH	3.20724E-06	2.57969E-11
HF	4.96279E-07	2.49157E-11	HF	4.96276E-07	2.49155E-11
CUCL3 2-	4.21272E-06	2.49040E-11	CUCL3 2-	6.33473E-15	3.74485E-20
PBNO3 +	6.34991E-06	2.36918E-11	PBNO3 +	6.34990E-06	2.36917E-11
HSO4 -	1.88935E-06	1.95498E-11	HSO4 -	1.88936E-06	1.95499E-11
AGCL3 2-	3.51977E-06	1.65026E-11	AGCL3 2-	3.51991E-06	1.65033E-11
CAH2PO4 +	1.84222E-06	1.34996E-11	CAH2PO4 +	1.84274E-06	1.35034E-11
UO2CO3	3.40896E-06	1.03746E-11	UO2CO3	3.40868E-06	1.03738E-11
ZNCL +	1.01104E-06	1.00712E-11	ZNCL +	1.01105E-06	1.00712E-11
BAOH +	1.42119E-06	9.24841E-12	BAOH +	1.42117E-06	9.24825E-12
PB(OH)3 -	1.85895E-06	7.23082E-12	PB(OH)3 -	1.85896E-06	7.23085E-12
MNCL2	8.46711E-07	6.75796E-12	MNCL2	8.46705E-07	6.75791E-12
PBSO4	1.70290E-06	5.64007E-12	PBSO4	1.70290E-06	5.64008E-12
MGH2PO4 +	5.72431E-07	4.74000E-12	MGH2PO4 +	5.72594E-07	4.74134E-12
CUNO3 +	4.85693E-07	3.88557E-12	CUNO3 +	5.01453E-07	4.01166E-12
V2O7 4-	6.63632E-07	3.11654E-12	V2O7 4-	6.63664E-07	3.11669E-12
U(OH)5 -	7.40917E-07	2.30352E-12	U(OH)5 -	1.57142E-24	4.88558E-30
ZNF +	1.48919E-07	1.77269E-12	ZNF +	1.48918E-07	1.77268E-12
ZN(SO4)2 2-	4.30731E-07	1.68010E-12	ZN(SO4)2 2-	4.30740E-07	1.68014E-12
AGF	1.97863E-07	1.56650E-12	AGF	1.97860E-07	1.56648E-12
CUSO4	2.32550E-07	1.46344E-12	CUSO4	2.40097E-07	1.51093E-12
PBCL +	3.52103E-07	1.45746E-12	PBCL +	3.52107E-07	1.45748E-12
HV2O7 3-	1.38701E-07	6.48312E-13	HV2O7 3-	1.38702E-07	6.48317E-13
HMNO2 -	3.18962E-08	3.64272E-13	HMNO2 -	3.18957E-08	3.64266E-13
H3VO4	2.08379E-08	1.77428E-13	H3VO4	2.08374E-08	1.77424E-13
H2V2O7 2-	3.58255E-08	1.66672E-13	H2V2O7 2-	3.58247E-08	1.66669E-13
ZN(OH)4 2-	2.10445E-08	1.58440E-13	ZN(OH)4 2-	2.10448E-08	1.58443E-13
H3ASO3	1.38531E-08	1.10480E-13	H3ASO3	2.93825E-26	2.34329E-31
FEH2PO4 +	1.64541E-08	1.08135E-13	FEH2PO4 +	2.53396E-17	1.66530E-22
UO2(HPO4)2 2-	4.70916E-08	1.02383E-13	UO2(HPO4)2 2-	4.71171E-08	1.02438E-13
AGCL4 3-	2.24702E-08	9.03934E-14	AGCL4 3-	2.24719E-08	9.04002E-14
FEOH 2+	5.39072E-09	7.43197E-14	FEOH 2+	5.69869E-09	7.85656E-14
H2ASO3 -	7.62412E-09	6.12939E-14	H2ASO3 -	1.61710E-26	1.30006E-31
CUCL +	5.48892E-09	5.56890E-14	CUCL +	5.66712E-09	5.74969E-14
H3V2O7 -	9.96006E-09	4.61223E-14	H3V2O7 -	9.95968E-09	4.61205E-14
AG(OH)2 -	5.65228E-09	4.00136E-14	AG(OH)2 -	5.65227E-09	4.00135E-14
PB(OH)4 2-	1.03328E-08	3.77082E-14	PB(OH)4 2-	1.03330E-08	3.77090E-14
CU(OH)4 2-	4.88153E-09	3.72645E-14	CU(OH)4 2-	5.04005E-09	3.84746E-14
ALOH 2+	1.46350E-09	3.34165E-14	ALOH 2+	1.46352E-09	3.34171E-14

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
CU2(OH)2 2+	4.60246E-09	2.86939E-14	CU2(OH)2 2+	4.90612E-09	3.05871E-14
PBHPO4	8.60234E-09	2.84990E-14	PBHPO4	8.60486E-09	2.85074E-14
MN(OH)3 -	2.97956E-09	2.82438E-14	MN(OH)3 -	2.97951E-09	2.82434E-14
CUHPO4	3.89586E-09	2.45294E-14	CUHPO4	4.02347E-09	2.53329E-14
FEH3SIO4 2+	3.32854E-09	2.21474E-14	FEH3SIO4 2+	3.51870E-09	2.34127E-14
RA 2+	4.60000E-09	2.04416E-14	RA 2+	4.60000E-09	2.04416E-14
PBF +	4.48706E-09	1.99244E-14	PBF +	4.48705E-09	1.99244E-14
PB(SO4)2 2-	7.78605E-09	1.95842E-14	PB(SO4)2 2-	7.78627E-09	1.95847E-14
V3O9 3-	5.78183E-09	1.95653E-14	V3O9 3-	5.78175E-09	1.95651E-14
CUF +	1.16114E-09	1.41289E-14	CUF +	1.19882E-09	1.45874E-14
UO2H3SIO4 +	3.83563E-09	1.05511E-14	UO2H3SIO4 +	3.83536E-09	1.05503E-14
ZNCL2	1.34653E-09	9.92381E-15	ZNCL2	1.34654E-09	9.92386E-15
UO2OH +	2.35062E-09	8.22547E-15	UO2OH +	2.35046E-09	8.22490E-15
CU2CL4 2-	1.97974E-09	7.39475E-15	CU2CL4 2-	4.47633E-27	1.67201E-32
UO2 + (5 VALEN	1.94987E-09	7.25286E-15	UO2 + (5 VALEN	2.83956E-18	1.05622E-23
CR 3+	3.38668E-10	6.54211E-15	CR 3+	6.92606E-21	1.33792E-25
ALF2 +	3.48883E-10	5.39293E-15	ALF2 +	3.48879E-10	5.39287E-15
MNCL3 -	7.40510E-10	4.61124E-15	MNCL3 -	7.40515E-10	4.61127E-15
CR3(OH)4 5+	6.77241E-10	3.03651E-15	CR3(OH)4 5+	5.79260E-42	2.59720E-47
PBCL2	8.19388E-10	2.95932E-15	PBCL2	8.19398E-10	2.95936E-15
ALF 2+	9.01809E-11	1.96997E-15	ALF 2+	9.01818E-11	1.96999E-15
H2SEO3	1.94371E-10	1.51371E-15	H2SEO3	9.59910E-17	7.47552E-22
FEF 2+	6.12781E-11	8.22344E-16	FEF 2+	6.47786E-11	8.69320E-16
ALF3	5.28175E-11	6.31731E-16	ALF3	5.28162E-11	6.31716E-16
HSE -	4.29605E-11	5.39593E-16	HSE -	2.02456E-70	2.54289E-75
MG4(OH)4 4+	8.72909E-11	5.30569E-16	MG4(OH)4 4+	8.72926E-11	5.30579E-16
CR2(OH)2 4+	5.97102E-11	4.34572E-16	CR2(OH)2 4+	2.49728E-32	1.81753E-37
H3ASO4	3.49089E-11	2.47022E-16	H3ASO4	3.49081E-11	2.47016E-16
ZN2OH 3+	3.37522E-11	2.29423E-16	ZN2OH 3+	3.37534E-11	2.29431E-16
HF2 -	3.65613E-12	1.74752E-16	HF2 -	3.65611E-12	1.74751E-16
U(OH)4	2.27988E-11	7.48207E-17	U(OH)4	4.83540E-29	1.58687E-34
HASO3 2-	7.57406E-12	6.13866E-17	HASO3 2-	1.60651E-29	1.30205E-34
UO2HPO4	2.10021E-11	5.76351E-17	UO2HPO4	2.10067E-11	5.76478E-17
FEF2 +	4.78282E-12	5.11907E-17	FEF2 +	5.05592E-12	5.41138E-17
V(OH)3	4.96009E-12	4.88607E-17	V(OH)3	1.05204E-29	1.03634E-34
H3PO4	4.36920E-12	4.47827E-17	H3PO4	4.37049E-12	4.47960E-17
UO2F +	9.30440E-12	3.23344E-17	UO2F +	9.30370E-12	3.23320E-17
CUCL2	3.43497E-12	2.56607E-17	CUCL2	3.54649E-12	2.64938E-17
VOOH +	1.91911E-12	2.29616E-17	VOOH +	2.79492E-21	3.34404E-26
UO2 2+	4.49144E-12	1.67067E-17	UO2 2+	4.49120E-12	1.67058E-17

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
AL 3+	4.36401E-13	1.62455E-17	AL 3+	4.36420E-13	1.62462E-17
ZNCL3 -	2.65592E-12	1.55332E-17	ZNCL3 -	2.65597E-12	1.55335E-17
PBH2PO4 +	3.69384E-12	1.21969E-17	PBH2PO4 +	3.69495E-12	1.22006E-17
CRCL 2+	1.00995E-12	1.16001E-17	CRCL 2+	2.06540E-23	2.37226E-28
CUH2PO4 +	1.63968E-12	1.02591E-17	CUH2PO4 +	1.69340E-12	1.05952E-17
PBF2	2.15644E-12	8.83357E-18	PBF2	2.15641E-12	8.83345E-18
H2MOO4	1.01877E-12	6.31843E-18	H2MOO4	1.01875E-12	6.31828E-18
UO2F2	1.59818E-12	5.21137E-18	UO2F2	1.59804E-12	5.21092E-18
PB2OH 3+	1.64721E-12	3.83509E-18	PB2OH 3+	1.64730E-12	3.83528E-18
PBCL3 -	1.02136E-12	3.27168E-18	PBCL3 -	1.02138E-12	3.27177E-18
ALF4 -	2.44013E-13	2.38010E-18	ALF4 -	2.44008E-13	2.38004E-18
ALSO4 +	2.21894E-13	1.81134E-18	ALSO4 +	2.21894E-13	1.81135E-18
FEF3	1.07771E-13	9.59273E-19	FEF3	1.13923E-13	1.01404E-18
UO2SO4	3.05405E-13	8.37929E-19	UO2SO4	3.05382E-13	8.37868E-19
VO2 +	3.46573E-14	4.19704E-19	VO2 +	3.46567E-14	4.19697E-19
H4VO4 +	4.57846E-14	3.86539E-19	H4VO4 +	4.57838E-14	3.86532E-19
VO 2+	2.35386E-14	3.53186E-19	VO 2+	3.42814E-23	5.14376E-28
SEO4 2-	4.27668E-14	3.00478E-19	SEO4 2-	9.95778E-03	6.99630E-08
HCL	6.61742E-15	1.82294E-19	HCL	6.61746E-15	1.82295E-19
FE 3+	5.68642E-15	1.02271E-19	FE 3+	6.01146E-15	1.08117E-19
FESO4 +	7.79888E-15	5.15659E-20	FESO4 +	8.24431E-15	5.45111E-20
UO2F3 -	1.38126E-14	4.24239E-20	UO2F3 -	1.38114E-14	4.24203E-20
PB3(OH)4 2+	2.61967E-14	3.81544E-20	PB3(OH)4 2+	2.61972E-14	3.81551E-20
AL(SO4)2 -	6.44660E-15	2.95524E-20	AL(SO4)2 -	6.44664E-15	2.95525E-20
ZN2(OH)6 2-	6.34278E-15	2.73655E-20	ZN2(OH)6 2-	6.34282E-15	2.73656E-20
UO2CL +	5.37984E-15	1.76888E-20	UO2CL +	5.37951E-15	1.76877E-20
UO2(SO4)2 2-	7.51406E-15	1.63310E-20	UO2(SO4)2 2-	7.51372E-15	1.63302E-20
ZNCL4 2-	3.20297E-15	1.55272E-20	ZNCL4 2-	3.20311E-15	1.55279E-20
V(OH)2 +	5.34910E-16	6.32412E-21	V(OH)2 +	1.13456E-33	1.34136E-38
ASO3 3-	6.15942E-16	5.03305E-21	ASO3 3-	1.30649E-33	1.06757E-38
PBCL4 2-	1.08860E-15	3.13286E-21	PBCL4 2-	1.08866E-15	3.13302E-21
H2F2	1.04498E-16	2.62316E-21	H2F2	1.04497E-16	2.62313E-21
PBF3 -	5.56643E-16	2.11624E-21	PBF3 -	5.56637E-16	2.11622E-21
H2SE	1.69995E-16	2.10860E-21	H2SE	8.01117E-76	9.93697E-81
CRCL2 +	1.87853E-16	1.53523E-21	CRCL2 +	3.84164E-27	3.13958E-32
ALF5 2-	1.53693E-16	1.26562E-21	ALF5 2-	1.53691E-16	1.26560E-21
FE(SO4)2 -	2.53604E-16	1.02723E-21	FE(SO4)2 -	2.68090E-16	1.08591E-21
FECL 2+	5.72297E-17	6.29599E-22	FECL 2+	6.04997E-17	6.65573E-22
MOO2 +	7.91494E-17	6.21376E-22	MOO2 +	1.15270E-25	9.04948E-31
SE 2-	4.37757E-17	5.56851E-22	SE 2-	2.06301E-76	2.62427E-81

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
CRO4 2-	5.82198E-17	5.04138E-22	CRO4 2-	3.85425E-01	3.33748E-06
VOSO4	7.44671E-17	4.58875E-22	VOSO4	1.08451E-25	6.68286E-31
U(OH)3 +	1.12456E-16	3.90770E-22	U(OH)3 +	2.38509E-34	8.28789E-40
FEHPO4 +	5.75863E-17	3.80965E-22	FEHPO4 +	6.08932E-17	4.02842E-22
VOF +	1.87099E-17	2.18672E-22	VOF +	2.72483E-26	3.18465E-31
(UO2)2(OH)2 2+	1.23239E-16	2.15623E-22	(UO2)2(OH)2 2+	1.23223E-16	2.15596E-22
CUCL3 -	1.83220E-17	1.08313E-22	CUCL3 -	1.89171E-17	1.11831E-22
SE2 2-	1.23844E-17	7.87683E-23	H2SEO4	2.34132E-17	1.62213E-22
V4O9 2-	2.20125E-17	6.35775E-23	V4O9 2-	9.90257E-53	2.86010E-58
(UO2)3(OH)5 +	4.93402E-17	5.53647E-23	(UO2)3(OH)5 +	4.93294E-17	5.53525E-23
H4ASO3 +	6.78183E-18	5.36565E-23	H4ASO3 +	1.43844E-35	1.13807E-40
UO2F4 2-	1.17273E-17	3.40414E-23	UO2F4 2-	1.17264E-17	3.40389E-23
H2SO4	1.80148E-18	1.84490E-23	H2SO4	1.80148E-18	1.84491E-23
FEH2PO4 2+	1.55319E-18	1.02075E-23	FEH2PO4 2+	1.64241E-18	1.07938E-23
FECL2 +	1.04324E-18	8.26679E-24	FECL2 +	1.10283E-18	8.73906E-24
FE2(OH)2 4+	7.97240E-19	5.49562E-24	FE2(OH)2 4+	8.90976E-19	6.14178E-24
UO2H2PO4 +	1.59390E-18	4.36206E-24	UO2H2PO4 +	1.59427E-18	4.36305E-24
AL2(OH)2 4+	8.36922E-20	9.55490E-25	AL2(OH)2 4+	8.36988E-20	9.55565E-25
V4O12 4-	2.74488E-19	6.96636E-25	V4O12 4-	2.74489E-19	6.96640E-25
HCRO4 -	7.71763E-20	6.62530E-25	HCRO4 -	5.10911E-04	4.38598E-09
VOF2	3.76326E-20	3.60202E-25	VOF2	5.48057E-29	5.24575E-34
ALF6 3-	2.16917E-20	1.54552E-25	ALF6 3-	2.16920E-20	1.54554E-25
HMOO3 +	9.59304E-21	6.64739E-26	HMOO3 +	9.59287E-21	6.64728E-26
PBF4 2-	1.38605E-20	4.91595E-26	PBF4 2-	1.38605E-20	4.91595E-26
VOH 2+	2.39841E-21	3.54532E-26	VOH 2+	5.08718E-39	7.51985E-44
HV6O17 3-	1.41562E-20	2.45724E-26	HV6O17 3-	1.41551E-20	2.45705E-26
FE3(OH)4 5+	2.16811E-21	9.24428E-27	FE3(OH)4 5+	2.56153E-21	1.09217E-26
HSEO4 -	5.65482E-22	3.94524E-27	HSEO4 -	1.31664E-10	9.18590E-16
CUCL4 2-	1.79979E-22	8.80287E-28	CUCL4 2-	1.85830E-22	9.08901E-28
FECL3	1.30862E-22	8.10327E-28	FECL3	1.38338E-22	8.56619E-28
U(OH)2 2+	9.41146E-23	3.47481E-28	U(OH)2 2+	1.99612E-40	7.36990E-46
VOF3 -	3.36711E-23	2.72881E-28	VOF3 -	4.90366E-32	3.97408E-37
H2V2O4 2+	6.56295E-24	3.92619E-29	V2(OH)2 4+	1.91254E-80	1.41356E-85
AL3(OH)4 5+	1.74939E-25	1.17948E-30	AL3(OH)4 5+	1.74960E-25	1.17962E-30
V 3+	4.92052E-26	9.70182E-31	V 3+	1.04370E-43	2.05788E-48
UO2(H2PO4)2	4.03178E-25	8.72750E-31	UO2(H2PO4)2	4.03386E-25	8.73201E-31
MN 3+	5.76598E-27	1.05418E-31	MN 3+	3.95923E-18	7.23853E-23
U(HPO4)4 4-	1.70461E-27	2.75287E-33	U(HPO4)4 4-	3.61994E-45	5.84605E-51
H2V6O17 2-	6.63413E-28	1.14955E-33	H2V6O17 2-	6.63340E-28	1.14942E-33
H2SEO4	1.00558E-28	6.96692E-34			

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
MOO2 2+	6.78321E-29	5.32528E-34	MOO2 2+	6.78321E-29	5.32528E-34
VOH +	3.81920E-30	5.64552E-35	VOH +	1.17976E-56	1.74392E-61
UOH 3+	1.22294E-29	4.81632E-35	UOH 3+	2.59386E-47	1.02155E-52
H2CRO4	3.10199E-30	2.64020E-35	H2CRO4	2.05352E-14	1.74782E-19
U(HPO4)3 2-	1.10978E-29	2.11929E-35	U(HPO4)3 2-	2.35588E-47	4.49891E-53
V 2+	4.41282E-31	8.70079E-36	V 2+	1.36316E-57	2.68775E-62
PB(OH)6 2-	4.60697E-31	1.49633E-36	PB(OH)6 2-	2.17206E-13	7.05479E-19
U(HPO4)2	1.79503E-31	4.19304E-37	U(HPO4)2	3.80934E-49	8.89829E-55
SIF6 2-	5.59232E-32	3.95353E-37	SIF6 2-	5.59228E-32	3.95350E-37
UO2(H2PO4)3 -	2.60205E-32	4.65881E-38	UO2(H2PO4)3 -	2.60419E-32	4.66263E-38
UF2 2+	5.00518E-33	1.82130E-38	UF2 2+	1.06156E-50	3.86286E-56
UF3 +	3.63191E-33	1.23649E-38	UF3 +	7.70285E-51	2.62245E-56
UF4	3.38219E-33	1.08181E-38	UF4	7.17313E-51	2.29436E-56
UF 3+	8.16813E-34	3.19196E-39	UF 3+	1.73246E-51	6.77015E-57
UHPO4 2+	7.46342E-34	2.24437E-39	UHPO4 2+	1.58343E-51	4.76161E-57
U(SO4)2	8.23956E-36	1.92399E-41	U(SO4)2	1.74754E-53	4.08062E-59
UF5 -	4.42369E-36	1.33422E-41	UF5 -	9.38202E-54	2.82968E-59
USO4 2+	3.34529E-36	1.00574E-41	USO4 2+	7.09522E-54	2.13314E-59
U 4+	3.99321E-37	1.68502E-42	U 4+	8.47000E-55	3.57410E-60
UF6 2-	7.54603E-38	2.15311E-43	UF6 2-	1.60043E-55	4.56649E-61
UCL 3+	1.40145E-39	5.14708E-45	UCL 3+	2.97251E-57	1.09171E-62
CR2O7 2-	7.32216E-42	3.40505E-47	CR2O7 2-	3.20898E-10	1.49228E-15
MO 3+	4.09938E-44	4.29172E-49	MO 3+	1.26637E-70	1.32579E-75
V2(OH)2 4+	4.25093E-45	3.14185E-50	H2V2O4 2+	1.39201E-41	8.32752E-47
U 3+	2.42153E-47	1.02182E-52	U 3+	7.48016E-74	3.15641E-79
MNO4 2-	2.38971E-51	2.01812E-56	MNO4 2-	5.31177E-16	4.48581E-21
V10O28 6-	1.40982E-51	1.47906E-57	V10O28 6-	1.40980E-51	1.47904E-57
PB(OH)8 4-	1.58176E-52	4.62842E-58	PB(OH)8 4-	7.45809E-35	2.18233E-40
HV10O28 5-	1.83567E-55	1.92380E-61	HV10O28 5-	1.83553E-55	1.92365E-61
MNO4 -	7.03952E-62	5.94489E-67	MNO4 -	1.07437E-17	9.07307E-23
PB 4+	9.02677E-62	4.37578E-67	PB 4+	4.25617E-44	2.06320E-49
H2V10O28 4-	1.12304E-61	1.17571E-67	H2V10O28 4-	1.12289E-61	1.17556E-67

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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APPENDIX B: HELP MODEL OUTPUT

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To
Wayne Belchel
RMRS T893B
Fx 7193

FAX MEMO
PAGES ____ DATE ____ FAX # ____
TO ____
FROM ____
CC ____
PH # ____ FAX # ____

From
Leon Collins - RMRS
X 0108
3/25/96

6 Pages

output filename Rain1PPL.out

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	15.44	(2.909)	560443.0	100.00
RUNOFF	0.060	(0.0993)	2176.92	0.388
EVAPOTRANSPIRATION	14.299	(2.5270)	519043.47	92.613
LATERAL DRAINAGE COLLECTED FROM LAYER 6	1.08088	(0.64998)	39236.066	7.00090
PERCOLATION/LEAKAGE THROUGH FROM LAYER 8	0.00000	(0.00000)	0.135	0.00002
AVERAGE HEAD ACROSS TOP OF LAYER 8.	0.001	(0.001)		
Waste Layer is #10 LATERAL DRAINAGE COLLECTED FROM LAYER 13 Concrete Slab	0.00000	(0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH FROM LAYER 14	0.00000	(0.00000)	0.1[illegible]	0.00002
AVERAGE HEAD ACROSS TOP OF LAYER 14	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 15.	0.00000	(0.00000)	0.051	0.00001
PERCOLATION/LEAKAGE THROUGH FROM LAYER 17	0.00000	(0.00000)	0.0845	0.00001

INITIAL SOIL WATER CONTENT = 0.1591 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.370000005000E-01 CM/SEC

LAYER 10

TYPE 1 - VERTICAL PERCOLATION LAYER - compacted Waste
MATERIAL TEXTURE NUMBER 19

THICKNESS	=	204.00	INCHES
POROSITY	=	0.1680	VOL/VOL
FIELD CAPACITY	=	0.0730	VOL/VOL
WILTING POINT	=	0.0190	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0730	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 11

TYPE 1 - VERTICAL PERCOLATION LAYER - drainage Net.
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 12

TYPE 1 - VERTICAL PERCOLATION LAYER - Concrete slab with drain Pipes
MATERIAL TEXTURE NUMBER 43

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3600	VOL/VOL
FIELD CAPACITY	=	0.0358	VOL/VOL
WILTING POINT	=	0.0210	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0358	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.30900002000	CM/SEC

LAYER 13

TYPE 2 - LATERAL DRAINAGE LAYER - Gravel under Slab
MATERIAL TEXTURE NUMBER 43

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3600	VOL/VOL
FIELD CAPACITY	=	0.0358	VOL/VOL
WILTING POINT	=	0.0210	VOL/VOL

INITIAL SOIL WATER CONTENT	=	0.0358	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.30900002000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	235.0	FEET

LAYER 14

TYPE 4 - FLEXIBLE MEMBRANE LINER — Leachate Collection Membrane
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.08	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

LAYER 15

TYPE 2 - LATERAL DRAINAGE LAYER — Geocomposite
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	1.00	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	235.0	FEET

LAYER 16

TYPE 4 - FLEXIBLE MEMBRANE LINER — Leak detection membrane
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.08	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

LAYER 17

TYPE 3 - BARRIER SOIL LINER — Bottom Clay
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	36.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 1 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 235. FEET.

SCS RUNOFF CURVE NUMBER	=	64.60	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	10.000	ACRES — actually only 4½ acres per 100K yd³ cell
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.939	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.438	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.828	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	49.658	INCHES
TOTAL INITIAL WATER	=	49.658	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR — Above Grade

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
DENVER COLORADO

MAXIMUM LEAF AREA INDEX	=	1.80	
START OF GROWING SEASON (JULIAN DATE)	=	139	
END OF GROWING SEASON (JULIAN DATE)	=	254	
AVERAGE ANNUAL WIND SPEED	=	8.80	MPH — slow!
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	54.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	50.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	49.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	54.00	%

wet ∴ conservative for site.

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DENVER COLORADO

RAGE HEAD ACROSS TOP OF LAYER 17	0.000 (	0.000)		
CHANGE IN WATER STORAGE	0.000 (	0.3851)	-13.57	-0.002

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	2.49	90387.000
RUNOFF	0.392	14236.7549
DRAINAGE COLLECTED FROM LAYER 6	0.58248	21143.84180
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000001	0.01920
AVERAGE HEAD ACROSS LAYER 8	0.330	
DRAINAGE COLLECTED FROM LAYER 13	0.00000	0.00001
PERCOLATION/LEAKAGE THROUGH LAYER 14	0.000000	0.00377
AVERAGE HEAD ACROSS LAYER 14	0.000	
DRAINAGE COLLECTED FROM LAYER 15	0.00000	0.00345
PERCOLATION/LEAKAGE THROUGH LAYER 17	0.000000	0.00025
AVERAGE HEAD ACROSS LAYER 17	0.000	
SNOW WATER	1.55	56425.5508

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.2237

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0370

****

0.00025 ft^3/day

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.01    (14 OCTOBER 1994)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\HELP3\RAIN100.D4
TEMPERATURE DATA FILE:        C:\HELP3\RAIN100.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\RAIN100.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\RAIN100.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\RAIN18.D10
OUTPUT DATA FILE:             C:\HELP3\RAIN100N.OUT


TIME:  11:18      DATE:   4/ 7/1996


******************************************************************************

     TITLE:  interim cover (no cover)

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   2
          THICKNESS                    =     12.00   INCHES
          POROSITY                     =      0.4370 VOL/VOL
          FIELD CAPACITY               =      0.0620 VOL/VOL
          WILTING POINT                =      0.0240 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.0495 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.579999993000E-02 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.0620	VOL/VOL
WILTING POINT	=	0.0240	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0572	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.579999993000E-02	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

THICKNESS	=	1.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.0620	VOL/VOL
WILTING POINT	=	0.0240	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0981	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.579999993000E-02	CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	6.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4178	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 19

THICKNESS	=	204.00	INCHES
POROSITY	=	0.1680	VOL/VOL
FIELD CAPACITY	=	0.0730	VOL/VOL
WILTING POINT	=	0.0190	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0730	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0703	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 7

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 43

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3600	VOL/VOL
FIELD CAPACITY	=	0.0358	VOL/VOL
WILTING POINT	=	0.0210	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0522	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.30900002000	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 43

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3600	VOL/VOL
FIELD CAPACITY	=	0.0358	VOL/VOL
WILTING POINT	=	0.0210	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0358	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.30900002000	CM/SEC
SLOPE	=	3.00	PERCENT
DRAINAGE LENGTH	=	235.0	FEET

LAYER 9

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.08	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE

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FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

LAYER 10

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	1.00	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	235.0	FEET

LAYER 11

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.08	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

LAYER 12

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	36.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 2 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 235. FEET.

SCS RUNOFF CURVE NUMBER	=	73.10	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	10.000	ACRES
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.740	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.866	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.432	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	35.229	INCHES
TOTAL INITIAL WATER	=	35.229	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM DENVER COLORADO

MAXIMUM LEAF AREA INDEX	=	1.00	
START OF GROWING SEASON (JULIAN DATE)	=	137	
END OF GROWING SEASON (JULIAN DATE)	=	254	
AVERAGE ANNUAL WIND SPEED	=	8.80	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	54.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	50.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	49.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	54.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DENVER COLORADO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.51	0.69	1.21	1.81	2.47	1.58
1.93	1.53	1.23	0.98	0.82	0.55

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DENVER COLORADO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
29.50	33.60	38.00	47.40	57.20	67.00
73.30	71.40	62.60	51.90	38.70	32.60

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DENVER COLORADO

STATION LATITUDE = 39.77 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.53	0.78	1.25	1.75	2.39	1.60
	2.01	1.48	1.32	0.92	0.80	0.61
STD. DEVIATIONS	0.37	0.44	0.66	0.98	1.21	0.94
	1.12	0.84	0.88	0.71	0.55	0.36
RUNOFF						
TOTALS	0.006	0.028	0.023	0.000	0.001	0.000
	0.000	0.000	0.000	0.000	0.000	0.004
STD. DEVIATIONS	0.020	0.076	0.066	0.000	0.005	0.001
	0.000	0.000	0.001	0.000	0.002	0.018
EVAPOTRANSPIRATION						
TOTALS	0.549	0.592	1.076	1.521	2.096	1.703
	2.215	1.372	1.217	0.763	0.717	0.613
STD. DEVIATIONS	0.262	0.338	0.465	0.688	0.913	0.826
	0.932	0.767	0.693	0.512	0.440	0.306
LATERAL DRAINAGE COLLECTED FROM LAYER 8						
TOTALS	0.0521	0.0451	0.0464	0.0415	0.0393	0.0353
	0.0414	0.0479	0.0530	0.0563	0.0548	0.0554
STD. DEVIATIONS	0.0224	0.0211	0.0243	0.0247	0.0263	0.0267
	0.0264	0.0254	0.0190	0.0187	0.0177	0.0198
PERCOLATION/LEAKAGE THROUGH LAYER 9						
TOTALS	0.0325	0.0284	0.0299	0.0272	0.0262	0.0232
	0.0265	0.0295	0.0325	0.0343	0.0335	0.0340
STD. DEVIATIONS	0.0102	0.0095	0.0110	0.0114	0.0126	0.0137
	0.0136	0.0133	0.0089	0.0085	0.0076	0.0085
LATERAL DRAINAGE COLLECTED FROM LAYER 10						

TOTALS	0.0325	0.0284	0.0299	0.0272	0.0262	0.0232
	0.0265	0.0295	0.0325	0.0343	0.0335	0.0340
STD. DEVIATIONS	0.0102	0.0095	0.0110	0.0114	0.0125	0.0137
	0.0136	0.0133	0.0089	0.0085	0.0076	0.0085

PERCOLATION/LEAKAGE THROUGH LAYER 12

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 9

AVERAGES	0.0010	0.0010	0.0009	0.0009	0.0008	0.0008
	0.0008	0.0010	0.0011	0.0011	0.0011	0.0011
STD. DEVIATIONS	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
	0.0005	0.0005	0.0004	0.0003	0.0003	0.0004

DAILY AVERAGE HEAD ACROSS LAYER 12

AVERAGES	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
STD. DEVIATIONS	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002
	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	15.44	(2.909)	560443.0	100.00
RUNOFF	0.062	(0.0998)	2251.85	0.402
EVAPOTRANSPIRATION	14.434	(2.5623)	523949.44	93.488
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.56843	(0.21235)	20634.100	3.68175
ERCOLATION/LEAKAGE THROUGH FROM LAYER 9	0.35784	(0.09918)	12989.652	2.31775
AVERAGE HEAD ACROSS TOP OF LAYER 9	0.001	(0.000)		

LATERAL DRAINAGE COLLECTED FROM LAYER 10	0.35783	(0.09919)	12989.262	2.31768
ERCOLATION/LEAKAGE THROUGH FROM LAYER 12	0.00001	(0.00000)	[illegible]205	0.00004
AVERAGE HEAD ACROSS TOP OF LAYER 12	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.017	(0.7303)	618.08	0.110

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	2.49	90387.000
RUNOFF	0.394	14310.1660
DRAINAGE COLLECTED FROM LAYER 8	0.00395	143.20885
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.001778	64.55125
AVERAGE HEAD ACROSS LAYER 9	0.002	
DRAINAGE COLLECTED FROM LAYER 10	0.00169	61.37564
PERCOLATION/LEAKAGE THROUGH LAYER 12	0.000000	0.00078
AVERAGE HEAD ACROSS LAYER 12	0.001	
SNOW WATER	1.55	56425.5508

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.1896
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0146

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FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	0.3697	0.0308
2	1.8921	0.1577
3	0.4370	0.4370
4	2.5620	0.4270
5	14.8920	0.0730
6	0.0160	0.0800
7	0.9514	0.0793
8	0.4296	0.0358
9	0.0000	0.0000
10	0.0104	0.0104
11	0.0000	0.0000
12	15.3720	0.4270
SNOW WATER	0.000	

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Appendix I

NEPA Values Analysis Backup Documentation

Table I-1 Summary of Criteria Used to Evaluate Environmental Impacts[1]

Criteria	Included in Onsite vs Offsite Screen	Included in Siting Study	Included in Facility Design Screen	Included in Final Comparison	Included in OU 4 February DD
Human Health	§B7.1, Table 7.1		(A1, A2, A4, B1, F6)	NCP threshold: human health & regulatory requirements	§IV.10.1
Environment	§B7.2	§C2.4.1, §C2.4.3	Broken into the following criteria	NCP threshold: human health & regulatory requirements	Table IV.10-22
Ecological Risk	§B7.3.3	§C2.4.1			§IV.10.2
Air Quality	§B7.3.1, §B7.3.2, §B7.3.3		(F5)		§IV.10.3
Water Quality	§B7.3.1, §B7.3.2, §B7.3.3	§C2.4.1	(B1, B5, B10, B11, B12)		§IV.10.4, §IV.10.5
Soils & Sediments	§B7.3.1, §B7.3.2, §B7.3.3				
Commitment of Resources		§C2.4.2, §C2.4.4, §C2.4.6	(C8, E6)		§IV.10.6
Natural Phenomenon Mitigation/ Mitigation Measures		§C2.4.1	(B2, B3)		§IV.10.7
Transportation		§C2.4.2			§IV.10.8
Short-term vs. Long-term		§C2.4.1, §C2.4.2, §C2.4.3	(A5, A6, F7)	NCP primary balancing: long-term and short-term effectiveness, treatment	§IV.10.9
Cultural/archeological Resources					§IV.10.10
Cumulative Impacts		§C2.4.2	(C1, C9)		§IV.10.11
Direct/Indirect Effects[2]					Table IV.10-22

1) This table identifies the selection in this DD containing criteria used to evaluate the NEPA-values in the Onsite vs Offsite Evaluation (Appendix B) and the Remediation Waste Storage Facility Siting Study. For the Facility Design Screen, the criteria alpha-numeric designation is shown; these criteria are noted throughout the screen. For the Final Comparison, the related NCP criteria are listed. The Solar Ponds location was evaluated in the OU 4 February Proposed DD, and the sections where the criteria are discussed are also indicated. Additional criteria were also used in some of the studies (for example, cost); for a complete listing of the criteria used in each study, see the appropriate document section.

2) Direct effects which occur at the same time and place as an action and indirect effects which occur at a later time and greater distance are generally considered by medium in this criterion

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Table I-2 Summary of Results: Evaluation of Environmental Impacts Onsite vs. Offsite Waste Management

Criteria	Potential Impact Onsite	Potential Impact Offsite	Potential Impact for No Action
• **Schedule**	The concept of reducing overall risk to the public and the environment [from unremediated locations at RFETS] is more attractive than an extended waste removal process using offsite disposal. §B6.0	-	-
• **Human Health**	After the waste is placed in the cell, the risks associated with onsite and offsite disposal should not be significantly different. During construction, risk to the public will be minimal and worker risks can be tightly controlled. §B7.1	National statistics suggest five accidents would occur during transportation of the waste. The magnitude of risk to the public is difficult to quantify; however these exposures would be involuntary and uncontrolled. §B7.1 & Table 7-1	Presents the greatest human health risk to the community in the long-term, depending on future actions taken to prevent migration and future land uses. These risks are calculated for selected Buffer zone operable units to be low. Industrial Area risks have not been calculated, but are expected to be higher. §B7.1
• **Environmental**	Long-term waste management options onsite and offsite were deemed to be equally effective in containing contaminants because of similar design and similar regulatory requirements. §B7.2	-	-
- **Air Quality**	Vehicle exhausts and potential for spills exists. Fugitive dust during excavation and placement. §B7.3.3	Vehicle exhausts and potential for spills exists. Fugitive dust during excavation and placement. §B7.3.2	There could be local air quality impacts resulting from future events such as construction or erosion. §B7.3.1
- **Ecological**	Impacts would depend on the location of the RWSF. Impacts would be minimized if the selected location was previously developed. Impacts expected to be minimal. §B7.3.3	No direct impact expected. A spill could create impacts. §B7.3.2	Not significant. §B7.3.1
- **Soils & Sediments**	Minimal damage to topsoil, site selection and erosional controls would minimize impacts. Spills could impact surface soils. §B7.3.3	No direct impact expected. A spill could create impacts. §B7.3.2	Contamination could spread. §B7.3.1
- **Water Quality**	No impact on water quality is anticipated. A spill could create impacts, however this risk is lower than the offsite option due to close proximity of an onsite RWSF. §B7.3.3	No direct impact expected. A spill could create impacts. §B7.3.2	Groundwater plumes will continue to spread. §B7.3.1

This table shows which screening-criteria include evaluations of environmental impacts, summarizes the potential environmental impacts of the three alternatives screened, and references the document section where more information is available. See also Table 7-2 in Appendix B for summary of the study results.

Table I-3 Summary of Results: Evaluation of Environmental Impacts Remediation Waste Storage Facility Siting Study[1]

Criteria	Potential Impacts for Onsite Locations	Specific to Proposed Location at Solar Ponds Area
Environment	• All sites have approximately the same geomorphic conditions with the degree of erosion occurring at a predictable rate. (§2.4.2 Public Protection) • A reliable, effective, and protective facility can be engineered at any of the sites being considered. (§2.4.1 CAMU)	none noted
Ecological Risk	• The presence of significant springs and seeps in certain Buffer Zone sites reduces their suitability because of potential impacts to sensitive habitats. (§2.4.2 Public Protection)	none noted
Ground Water Quality	• All the sites are located in recharge areas. (§2.4.2 Public Protection) • All of the sites have minimal groundwater flow. (§2.4.2 Public Protection) • Downward migration from the unconfined aquifer is thought to be nonexistent.. (§2.4.2 Public Protection) • Groundwater flow in fractured claystone bedrock is thought to be minimal. (§2.4.2 Public Protection) • The sites have seasonally shallow water tables that may require engineered barriers. (§2.4.2 Public Protection)	• Local variations in shallow bedrock lithology at the Solar Ponds area is caused by subcropping sandstones, but vertical flow to deeper sandstones and the Laramie/Fox Hills aquifer is minimal. (§2.4.2 Public Protection)

[1]This table summarized the results of the evaluations for the Onsite Remediation Waste Storage Facility Siting Study. References in the table indicate the section of the study where discussion of the criteria are found.

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Table I-3 (continued)

Criteria	Potential Impacts for Onsite Locations	Specific to Proposed Location at Solar Ponds Area
Surface Water Quality	• Estimates of lateral groundwater travel times from the proposed sites to their nearest discharge pints are well below 1,000 years. (§2.4.2 Public Protection) • None of the sites are located in areas that will be impacted by surface water. The sites are not expected to have a significant impact on surface water. (§2.4.2 Public Protection)	none noted
Commitment of Resources	• Alluvial thicknesses greater than 40 feet are potentially economic for the gravel resource. Portions of the Buffer Zone have alluvial thicknesses of 40 feet or more. (§2.4.3 RFETS Special Issues) • Minimization of the land area upon which remediation wastes would remain in place is generally dependent on the design selected rather than location. (§2.4.3 RFETS Special Issues) • Jefferson County has stated a desire to maintain the Buffer Zone as undeveloped open space; sites in the Buffer Zone would impinge on this. (§2.4.6 Other Stakeholder Concerns)	• Solar Ponds area do not constitute an economical gravel resource. (§2.4.3 RFETS Special Issues) • The Solar Ponds site coincides with the Site Vision by locating the WMF within the larger footprint of the final cap cove. (§2.4.3 RFETS Special Issues & §2.4.4 Regulator Support) • Sites within the Industrial Area, including the Solar Ponds area, would be more readily acceptable. (§2.4.6 Other Stakeholder Concerns)
Natural Phenomenon Mitigation/ Mitigation Measures	• Geotechnical stability of foundation soils is not expected to be a problem at any of the sites. (§2.4.2 Public Protection) • The inferred bedrock faults are not considered to pose a seismic risk. (§2.4.2 Public Protection)	none noted

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Table I-3 (continued)

Criteria	Potential Impacts for Onsite Locations	Specific to Proposed Location at Solar Ponds Area
Transportation	• Most of the waste targeted for the RWSF originates in the Industrial Area; haul distances would be shorter to sites inside the Industrial Area. (§2.4.3 RFETS Special Issues)	none noted
Short-term vs. Long-term	• The presence of significant clay fraction provides a relatively favorable environment for waste disposal, especially for strongly sorbed contaminants such as metals. (§2.4.2 Public Protection) • Several locations would require construction or upgrade of the onsite roads and site preparation, including building demolition, subsurface line removal, and rerouting access. (§2.4.3 RFETS Special Issues) • The timing of remedial activity implementation is more dependent on the WMF design and the permitting process than on the site selected. (§2.4.1 CAMU)	• Site preparation costs for the Solar Ponds area are at the upper end of the range for the various sites. (§2.4.3 RFETS Special Issues)
Cumulative Impacts	•Impacts from plutonium consolidation or residue stabilization activities are not a factor for siting the WMF. (§2.4.3 RFETS Special Issues)	•Solar Ponds would be an ideal candidate to support the Site Vision (i.e., Buffer Zone as open pace and Industrial Area as industrial/waste management) (§2.4.3 RFETS Special Issues)

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Table I-4 Summary of Results: Evaluation of Environmental Impacts Facility Design Screen

Attributes	Design										
	Above-grade Landfill	**Concrete Lined Cell with Bulk Placement**	**Concrete Lined Cell with Cargo Containers**	**Hardened Concrete Vault**	**Silo Design**	**Slab on Grade**	**Metal Buildings**	**Entomb-ment**	**Pyramid Design**	**Waste Pile**	**No Action**
Ground-water Protection	waste isolated from substrate and ground-water, run-off diverted to edges	provides reasonable assurances substrate and ground water protected, drainage around cap	see previous column; containers provide an additional barrier	drainage around cap	drainage around cap, includes a liner system	temporary facility, maintenance to avoid cracks	adequate for 30 years	numerous barriers	could require more maintenance to maintain protectiveness	adequate for 30 years	equivalent to better than landfill
Consistency	relatively larger footprint, supports Site Vision	relatively smaller footprint, supports Site Vision	relatively smaller footprint, supports Site Vision	footprint not as large as some options, some resource competition with Site Vision	small footprint, ties well to Site Vision	large footprint, short-term support to Site Vision	large footprint, short-term support to Site Vision	very large footprint, could negatively impact other Site activities	large footprint, timing could impact Site Vision	does not suport RFCA	consistent with Site Vision

The facility design screen compared designs independent of location. This screen addresses technical issues and is not a primary source of environmental evaluation. Potential impacts are inherent in some of the criteria. The potential impacts to the environment cluster around a few attributes:

- Some designs offer more protection to the groundwater; the presence or absence of a liner and leachate collection system being an important design feature.
- Designs that are consistent with the Site Vision tend to reduce commitment of land. Location of the facility would also effect the consistency.

Table I-5 Summary of Results: Evaluation of Environmental Impacts Proposed Facility Design at Solar Ponds Location[1]

Criteria	Potential Impacts
Human Health §IV.10.1	Minimize existing risks due to long-term potential exposure to surficial soil, vadose zone soil, materials from D&D, and other remediation waste*(including all soils and materials noted in the list of wastes tentatively planned for placement in the RWSF).* Short-term risks due to worker exposure to remediation waste that exceed PRGs during remediation. Potential adverse effects to workers as a result of encountering unknown utilities or uncharacterized areas of high contamination. Risks to workers associated with soil excavation, relocation, treatment processes and construction activities (e.g., increased fugitive dust generation, increased transportation requirements)
Environment Table IV.10-22	Temporary physical disruption of industrial area during construction; *approximately 10 acres for RWSF* affected by soil excavation, material staging, and construction activities Temporary physical disruption of borrow area used for clean fill material Increased local traffic requirements, increased dust generation during construction *and possibly during operation*, and increased potential for erosion due to changes in surface topography at *both the construction area* and borrow area Three small wetlands *may* require protection during construction, *depending on the details of the RWSF construction*. Wetlands banking *may be* considered as a mitigation measure *if the detailed design or in-field activities indicate impacts to the wetlands occur*. Mitigation measures may be required for the Prebles Meadow Jumping Mouse, which is being considered for listing as a federal endangered species. No floodplains will be affected
Ecological Risk §IV.10.2	*The area* has been characterized as a highly disturbed industrial area which can support only the most hardy species of plants and animals. The natural environment at and adjacent to *the RWSF site* has been significantly altered by construction and operation of the SEPs *(Solar Evaporation Ponds)* and other industrial facilities.... It is highly probable that these construction activities will interfere with any existing vegetation and animal use of the site.
Air Quality §IV.10.3	*Atmospheric dispersion calculations were prepared for the project proposed in the OU 4 Proposed IM/IRA-EA Decision Document. Those calculations demonstrate little risk due to exposure to site contaminants to remediation workers, on-site workers, or the public during construction. The original project included considerable excavation; the RWSF as currently envisioned will be constructed with less excavation and so should create less fugitive dust.* Potential increase in PM_{10} emissions at both *the construction area* and the borrow areas during construction
Ground Water Quality §IV.10.4	Potential effect on local hydrogeology by reducing percolation and changing topography in a potential recharge area *(Impacts specific to the design from the OU 4 DD have been omitted)*

[1]This table summarized the results of the evaluations at the Solar Ponds location. For further information, see indicated portion of Section IV.10 and Table IV.10-22 from the *OU 4 Proposed IM/IRA-EA Decision Document* (February, 1995). Some modifications from the OU 4 document are included in the RWSF; those modifications are noted by *italics*.

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Table I-5 (continued)

Criteria	Potential Impacts
Surface Water Quality §IV.10.5	No surface water bodies exist within *the construction area* Consolidation of soil contamination *in the RWSF* will minimize or eliminate precipitation run-off *potentially contaminated by remediation wastes* *(Impacts specific to the design from the OU 4 DD have been omitted)*
Commitment of Resources §IV.10.6	Clean fill from borrow areas, construction materials, and area underneath and adjacent to *the RWSF*
Natural Phenomenon Mitigation/ Mitigation Measures §IV.10.7	*The design proposed in the OU 4 DD and the final, capped form of the RWSF are similar. The OU 4 DD considered damage from excess snow loading, lightning strikes, tornado generated missile impacts, meteorite impacts, volcanism: these were found to be incredible or unlikely to cause damage. Glacial activity and reactivation of the alluvial fan would not effect the site within the timespan of 1,000 years used in the evaluation. Wind erosion and flooding would not damage the site. Earthquake analysis suggested the conditions under which a seismically induced slope failure could occur. Several faults are known to exist in the vicinity of Rocky Flats. None of the faults investigated to date have been found capable (movement within the last 1 million years displacing alluvial sediments). DOE will investigate the RWSF for capable faults before finalizing the design and proceeding to construction.*
Transportation §IV.10.8	Minor increase in traffic volume and patterns during construction activities; negligible impact on surrounding transportation infrastructure
Short-term vs. Long-term §IV.10.9	Short-term interruption of industrial area and borrow area required to minimize potential risks associated with exposure to site contamination Construction of *RWSF* will preclude unrestricted use of area underlying and adjacent to *the RWSF*
Cultural/ Archeological Resources §IV.10.10	No resources present
Cumulative Impacts §IV.10.11	Implementation of the preferred IM/IRA is consistent with the long-term mission of remediating the RFETS Implementing may interfere slightly with other activities in progress at the RFETS *(Impacts specific to the design from the OU 4 DD have been omitted)*
Direct/Indirect Effects Table IV.10-22	As described above Remediation of OU 4 sludges *and other remediation wastes to be placed in the RWSF* currently stored onsite will be expedited Short-term direct increase in remediation jobs; indirect job loss due to eliminating production functions at RFETS

Draft IM/IRA for CAMU Designation Overview
AGENDA
10/21/96

I. Overall Objectives

II. Schedule

III. Overview of IM/IRA Designation

IV. Additional Actions

V. Other

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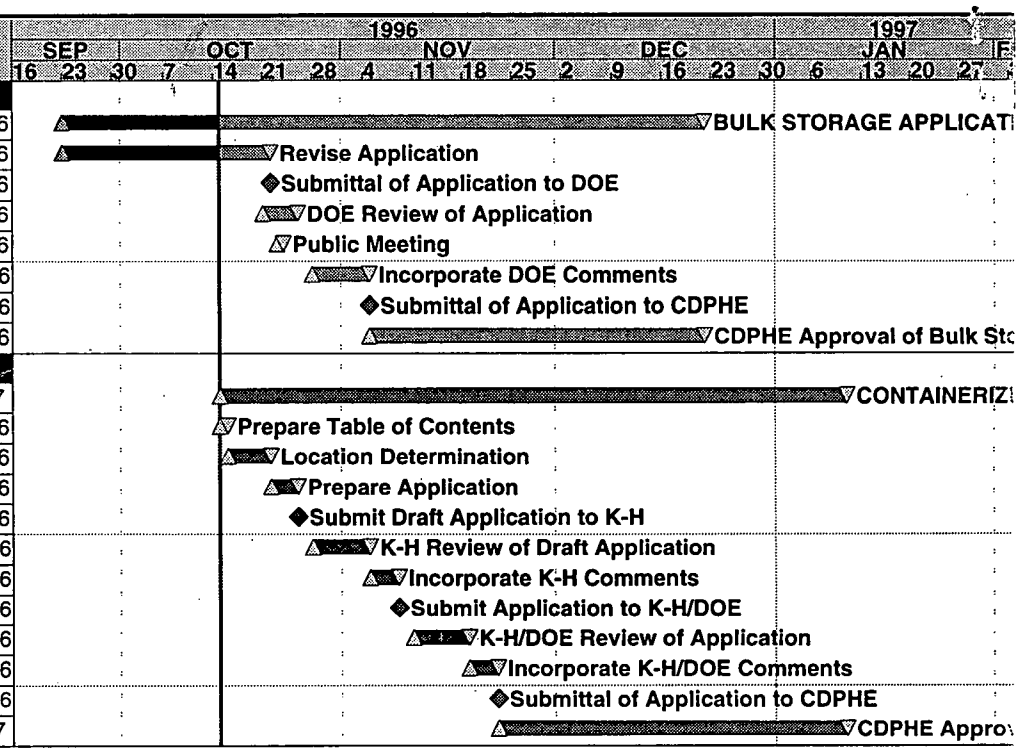
Activity ID	Activity Description	Orig Dur	Rem Dur	%	Early Start	Early Finish
BULK STORAGE APPLICATION						
1000	BULK STORAGE APPLICATION	88*	66*	25	23SEP96A	21DEC96
1010	Revise Application	21	4	81	23SEP96A	21OCT96
1020	Submittal of Application to DOE	0	0	0		21OCT96
1030	DOE Review of Application	5	5	0	21OCT96	25OCT96
1040	Public Meeting	1	1	0	23OCT96*	23OCT96
1050	Incorporate DOE Comments	5	5	0	28OCT96	04NOV96
1060	Submittal of Application to CDPHE	0	0	0		04NOV96
1070	CDPHE Approval of Bulk Storage Application	45	45	0	05NOV96	21DEC96
CONTAINERIZED WASTE APPLICATION						
2000	CONTAINERIZED WASTE APPLICATION	84*	84*	0	15OCT96	10JAN97
2010	Prepare Table of Contents	1	1	0	15OCT96	15OCT96
2020	Location Determination	3	3	0	16OCT96	21OCT96
2030	Prepare Application	4	4	0	22OCT96	25OCT96
2040	Submit Draft Application to K-H	0	0	0		25OCT96
2050	K-H Review of Draft Application	5	5	0	28OCT96	04NOV96
2060	Incorporate K-H Comments	4	4	0	05NOV96	08NOV96
2070	Submit Application to K-H/DOE	0	0	0		08NOV96
2080	K-H/DOE Review of Application	5	5	0	11NOV96	18NOV96
2090	Incorporate K-H/DOE Comments	4	4	0	19NOV96	22NOV96
2100	Submittal of Application to CDPHE	0	0	0		22NOV96
2110	CDPHE Approval of Containerized Wst Application	45	45	0	23NOV96	10JAN97



Project Start	01OCT96
Project Finish	10JAN97
Data Date	15OCT96
Plot Date	16OCT96

Early Bar
Progress Bar
Critical Activity

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CAMU

Sheet 1 of 1

ROCKY MOUNTAIN REMEDIATION SERVICES

Environmental Restoration Projects

CAMU Designation

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KAISER•HILL
COMPANY

October 17, 1996

96-RF-05996

Regina Sarter
Environmental Restoration
DOE, RFFO

TRANSMITTAL OF DRAFT INTERIM MEASURE/INTERIM REMEDIAL ACTION (IM/IRA) CORRECTIVE ACTION MANAGEMENT UNIT (CAMU) DESIGNATION REQUEST - JLU-001-96

Four copies of the draft IM/IRA CAMU designation request are attached for review. This document is in the final draft stage. After review by DOE this document will be revised and transmitted to CDPHE on November 4, 1996.

Kaiser-Hill and RMRS will provide an overview of the application to DOE on Monday, October 21, 1996. In order to meet the schedule for submittal of the CAMU designation request to CDPHE, we would appreciate comments by COB Friday, October 25, 1996. A meeting time can be scheduled on October 21 to discuss DOE's comments, if necessary. Please feel free to contact me at ext. 5976 with any questions or concerns.

Tim Schall for
J.L. Uhland
Management Integrator
ER/WM & I Operations

bag

Orig. and 1 cc - R. Sarter

Attachment:
As Stated

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Jennifer U comments

2.0 VERIFICATION OF CAMU DESIGNATION CRITERIA

The ability to designate the RWSF as a CAMU is dependent on compliance with the criteria found in 6 CCR 1007-3 264.552 (c), Corrective Active Management Units (CAMU). In order to demonstrate a need for a CAMU at RFETS, these seven criteria were made an integral part of the decision-making process. Each of the seven CAMU criteria listed below is followed by a description of how the selected RWSF remedy demonstrates compliance with the criterion.

1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies.

The CAMU designation of the RWSF would be the cornerstone in successfully completing environmental restoration activities within the accelerated schedule for Site closure proposed in RFCA. The ability of the RWSF to provide readily accessible storage capabilities for large volumes of remediation waste, with generally low levels of contamination, facilitates reliable, effective, protective, and cost effective remedies by:

- Accelerating IHSS closures by providing a facility for interim storage and/or treatment of contaminated material while simultaneously developing cost effective offsite disposal capabilities. Currently, the logistics of offsite disposal limit schedules for closing IHSS. Designation of a CAMU will allow limited resources to be focused on supporting near-term risk reduction.

- Allowing RFETS to maximize economies of scale for treatment, storage, and disposal so that action levels for Site closure can be achieved.

The effectiveness of specific cleanup actions will be enhanced by the availability of the RWSF. This will allow for a more aggressive remediation strategy. Source materials, including contaminated soils that might have been left in place for a number of years as a continuing source of contamination will be removed from the environment and placed in the RWSF.

From a logistical standpoint, the RWSF will offer individual site clean up actions a reliable, readily available facility that can accept large quantities and wide varieties of remediation waste. The waste will not have to be transported offsite, so little in the way of staging and packaging for transportation will be necessary. There will not be the questions of whether a shipment can be transported, whether the shipment will be returned, or whether the facility will be in operation when needed. The RWSF will accept only remediation waste (including D&D waste). The flow of waste into the facility, therefore, will not be impacted by waste from other generators.

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Because of the modular, compartmentalized design of the RWSF, it will be able to accept a wide variety of remediation waste including D&D waste. The waste will not have to be homogeneous. Changes in waste form can be accommodated so that operations will not be held up due to unanticipated conditions in the field. For example, if during remedial excavation of soils, a drum or block of concrete is uncovered, this material can be put into the RWSF without shutting down remedial or RWSF operations or requiring extensive paperwork. Also, a wide variety of waste forms can be accepted so that even if the contaminants change, the RWSF can accommodate that change and the environmental remediation project can proceed without much delay. This availability of immediate storage will facilitate the effectiveness of cleanup actions by allowing all of the contaminants and source materials to be removed at once and with minimal delay.

The RWSF CAMU offers more protectiveness than no action, cap-in-place, or several small storage facilities because it consolidates the remediation waste into an engineered barrier protective of human health and the environment. The remediation waste can be physically removed from an IHSS or building and placed into the RWSF. Additional engineered protection can be provided for the same cost because it is a single large facility as opposed to numerous smaller facilities. Remediation waste that might have been left capped in place or placed in several smaller storage facilities will have the benefit of being centrally located and completely surrounded by multi-layered impermeable protection. In addition, the remediation waste will be monitored at a single location. The leachate generated by all the remediation waste will be isolated and recovered at this single location.

The design proposed was selected based on the ability of the RWSF to provide a low-cost storage alternative while achieving compliance with applicable design standards as well as ensuring protectiveness of human health and the environment. Even with multiple protective design features, the concrete lined cell was still the most cost effective of any design considered. The cost was kept low by utilizing bulk storage in modular compartments as opposed to containers, by keeping the waste onsite for the immediate future, and by using a design that minimizes the footprint and material costs. Another factor that lowered cost was the ability of the RWSF to accept a wide variety of waste forms. The ability to accept the waste from D&D activities represents significant cost savings that can be directly translated into money available for additional Site closure activities.

~~Contaminated areas require more active management and, therefore, cost more to manage.~~ Sources that may impact other site activities and workers as well as potential exposures to offsite receptors can be removed from the environment sooner if the RWSF is available. This supports the concept of accelerated site closure by allowing previously contaminated areas to be cleaned up to interim cleanup levels agreed to in RFCA rather than closed with contamination above action levels in place. Once contaminant sources

Weak
I'm not sure how many ~~$~~ ~~[illegible]~~ it takes for LL of IHSS & empty bldg.

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are removed from the environment through deactivation, D&D, and environmental restoration activities, cost savings can be realized since these areas no longer require active landlord management. This early closure can result in what is termed "mortgage reduction". Savings achieved from reducing the mortgage through these cleanup activities can be applied to accelerate additional activities supporting Site closure.

Treatment requirements which are not necessary to protect human health and the environment can be deferred under the flexibility of the CAMU regulations. This further allows finite resources to be focused on actual cleanup sooner rather than in the future.

2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure~~s~~ to hazardous waste or hazardous waste constituents. (264.552(c)(1))

Not only does the RWSF CAMU not create unacceptable risks but it eliminates risks that might be associated with alternative remedies. The RWSF CAMU minimizes risks to human health and the environment in the following ways:

- Remediation waste is removed from the environment and put into an effective and protective facility. No longer will it be exposed to natural transport phenomena that could spread the contamination.

- Safety precautions will be taken during construction of the facility. All activities will be performed within the safety and radiological protection standards that exist at the Site. Individuals with expertise specific to safety construction will ensure that all construction activities are carried out in a safe manner. Construction quality assurance efforts will ensure that the RWSF will meet all design criteria and performance standards for protectiveness.

- Initial transportation of the wastes will be performed in a controlled environment over short distances on non-public roads with minimal or controlled traffic. Operations will be closely monitored and safely controlled. Public exposure will be limited because the waste will not leave the plant site until final closure of the Site rather than throughout the life of site closure operations. Because the distances will be so short and the process will be tightly controlled, the risk of transportation accidents will also be minimized. Administrative and engineered controls will be used to ensure that high winds do not mobilize the contamination during transport. These measures may include precautions such as covered loads, spraying water or other dust suppressants on the loads, high wind shut downs, and other appropriate precautions. Final disposition of the wastes will be conducted once cleanup is complete, allowing resources to be more efficiently focused, economies of scale to be achieved, and support operations to be appropriately scaled. Not necessarily

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- Safety during filling of the facility will also be closely monitored and controlled. Precautions being considered include spraying the waste for dust suppression, keeping the waste covered, high wind shut downs, and appropriate personal protective equipment. All filling activities will be conducted under appropriate health and safety plans.

Indirect effects and cumulative impacts of the Environmental Restoration program at the Site will be reduced by utilizing the centralized RWSF. Impacts to the environment will be minimized because the footprint of contaminated areas will be reduced to one facility compared to multiple IHSSs that now exist, and the RWSF will be constructed and thus will not impact previously undisturbed areas of the Site.

3) The CAMU shall include uncontaminated areas of the facility, only if including such areas for the purposes of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.

This CAMU criteria was a major influence upon the selection of the RWSF location east of the Solar Ponds. This location is in a contaminated area of the Site. The proposed RWSF location east of the Solar Ponds overlaps with the following areas of contamination:

- **IHSS 165 - The Triangle Area** This IHSS was part of the former OU 6. Drums containing plutonium-bearing wastes were stored in this area. The drums leaked and contaminated the soil. In 1973, 200 cubic yards of soil were removed from this site.

- **IHSS 176 - Swinerton and Walberg Contractor Storage Yard** This IHSS was part of the former OU 10. Water spray from the Solar Ponds blew into this area. Also, leaking drums containing waste oils and volatile organic compounds were stored here. Volatile organic compounds were detected during the soil gas survey characterization of this site.

- **HSS 101 - Solar Ponds Area** These are former OU 4 solar evaporation ponds which were used for storage and evaporation of liquid low-level radioactive waste. All of the sludge has been removed from the Solar Ponds but the liners are still in place. The proposed CAMU location overlaps the eastern edge of the ponds. Additional facilities may be placed on the ponds themselves if expansion of the RWSF is needed and designated in the future. Placement of the facility at this location is expected to facilitate cleanup operations at the Solar Ponds.

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- **Building 964** - This building housed low-level waste storage. It was also exposed to the water spray coming from the solar ponds.

Although this area is contaminated, it is not expected that placement of the RWSF in this area will hamper any cleanup operations. Likewise, the levels of contaminants that would be found at the RWSF construction site are not expected to hamper its construction or operation.

4) Areas within that CAMU, where remediation wastes remain in place after closure of the CAMU, shall be managed and contained so as to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment.

This criterion is not applicable. At this time, the intended use of this facility is for monitored, retrievable waste storage.

(Criteria 1 & 2 listed above)

5) The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). The Department shall designate a CAMU in accordance with the following:

- what is this?

(1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

(2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to hazardous wastes or hazardous constituents.

Once constructed, the facility will expedite remedial activities. Waste will be transported directly from excavation or treatment into the RWSF. Planning documents for cleanups will be simplified since the waste management methodology will be established. It will be possible to establish work crews that could clean up IHSSs in an almost assembly-line fashion, moving from IHSS to IHSS with the necessary equipment while trucks transport the remediation waste to the RWSF. Concurrent to these activities, new modules to the RWSF could be constructed so that there would be sufficient capacity available to accept the waste. Crews could be simultaneously performing deactivation followed by D&D and environmental restoration, moving from building to building, and transporting these waste materials to the RWSF.

maybe bring in the logistics of offsite disposal could slow the process down.

6) The CAMU shall enable the use, when appropriate, of treatment technologies (including innovative technologies) to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste that will remain in place after closure.

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Most likely we will TD first before placement to remove NAPL's with concentrations of org. Don't we want to mention that

The selected remedy supports the ability to treat waste before or after placement. Wastes could be treated in-place prior to excavation, after excavation, or because the RWSF design supports retrievability, the waste could be retrieved and treated. ~~It could even be possible to apply some types of innovative technologies in the facility itself since the waste will be completely contained.~~ No.

The CAMU will also support treatment technologies by acting as a centralized location for remediation waste treatment. This will also allow economies of scale to be achieved so that technologies not cost-effective for small quantities of wastes might be more applied to large volumes.

Temporary or permanent staging areas near the facility could be set up, and mobile or permanent treatment equipment could be bought in. These treatment technologies could include soil washing, solidification, thermal desorption or more innovative technologies identified in the future.

(Criteria 1 & 2 listed above)

7) The CAMU shall minimize the land area of the facility upon which remediation wastes will remain in place after closure of the CAMU unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). ~~The Department shall designate a CAMU in accordance with the following:~~

(1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

(2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to hazardous wastes or hazardous constituents.

This criterion is supported by the fact that multiple source areas at RFETS that might have previously been closed in place now have the option of closure to the action levels agreed to in the RFCA. The CAMU will support a bias towards removal rather than isolating sources in place. This will facilitate release of areas at RFETS for future land use, as described in the RFETS Vision.

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To: Jennifer Uhland
From: O Rourke
Pages: 10

CAMU²

2.0 VERIFICATION OF CAMU DESIGNATION CRITERIA

The ability to designate the CSF as a CAMU is dependent on compliance with the criteria found in 6 CCR 1007-3 264.552 (c), Corrective Active Management Units. In order to demonstrate a need for a CAMU at RFETS, these seven criteria were made an integral part of the decision-making process. Each of the seven CAMU criteria listed below as numbers 1 through 7 is followed by a description of how the selected CSF remedy demonstrates compliance with the criterion.

1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies.

The CAMU designation of the CSF, in conjunction with the bulk-storage RWSF would be the cornerstone in successfully completing environmental restoration ~~activities~~ and D+D within the accelerated schedule for Site closure proposed in RFCA and the TYP. The ability of the CAMU-designated containerized storage CSF to provide readily accessible offsite storage capabilities for large volumes of remediation waste awaiting shipment, would facilitate reliable, effective, protective, and cost effective remedies by:

- Accelerating IHSS closures by providing a facility for interim storage of contaminated material while simultaneously developing cost effective offsite disposal capabilities. Currently, the logistics of offsite shipment and disposal limit schedules for closing IHSSs. Designation of a CAMU would allow limited resources to be focused on supporting near-term risk reduction and ~~with~~ also impact D+D activities.
- Allowing RFETS to maximize economies of scale for treatment, storage, and disposal so that action levels for final Site closure can be achieved. Final Site closure will include offsite disposal of all low level and low level mixed remediation wastes.

current costs for offsite shipment and treatment limit the amount of resources that can be focused on near term risk reduction including source remediation and D+D.

The effectiveness of specific cleanup actions will be enhanced by the availability of the CSF. This storage capacity will allow for a more aggressive remediation strategy than could be implemented if the rate of generation of remediation were limited to the rate of offsite shipment and disposal. Source materials, including contaminated soils that might have been left in place for a number of years as a continuing source of contamination will be removed from the environment and placed in the CSF. D+D

the aggressive waste shipment assumptions in the TYP require large scale staging, storage, and shipment capabilities currently not available at RFETS.

From a logistical standpoint, the CSF will offer individual site cleanup actions a reliable, readily available facility that can accept large quantities and wide varieties of remediation waste. The waste will not have to be transported offsite during the

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cleanup action, so little in the way of staging for transportation will be necessary. The issues of whether a shipment can be transported, whether the shipment will be returned, or whether the disposal facility will be in operation when needed will be deferred until the waste is shipped. The CSF will accept only remediation waste (including D&D waste). The waste will be accepted in transportable containers that have accompanying documentation to meet the waste acceptance criteria of the anticipated target disposal facility. The flow of waste into the facility, therefore, will not be impacted by waste from other generators.

Because of the modular, compartmentalized design of the CSF, it will be able to accept a wide variety of remediation waste including D&D waste. The waste will not have to be homogeneous. Changes in waste form can be accommodated so that operations will not be held up due to unanticipated conditions in the field. ~~For example, if during remedial excavation of soils, a drum or block of concrete is uncovered, this material can be put into separate containers in the CSF without shutting down remedial or CSF operations.~~ Also, a wide variety of waste forms can be accepted by placing different types of waste into different containers, so that even if the contaminants change, the CSF can accommodate that change and the environmental remediation project can proceed without much delay. This availability of immediate storage will facilitate the effectiveness of cleanup actions by allowing all of the contaminants and source materials to be removed at once and with minimal delay.

The CSF CAMU designation will offer more protectiveness than no action, cap-in-place, or several small storage facilities because it would consolidate the remediation waste into an engineered facility protective of human health and the environment. The remediation waste could be physically removed from an IHSS or building and placed into the CSF. Additional engineered protection would be provided for the same cost because it is proposed as a single large facility as opposed to numerous smaller facilities. Remediation waste that might have been left capped in place or placed in several smaller storage facilities would have the benefit of being centrally located and staged for offsite disposal in a facility where the waste would be inspectable and underlain by impermeable protection. In addition, the remediation waste would be monitored at a single location. While generation of leachate from the shipping containers is unlikely, leachate generated by the remediation waste would be isolated and recovered at this single location.

The design proposed was selected based on the ability of the CSF to provide ~~a low-cost~~ cost-effective temporary storage alternative while achieving compliance with applicable design standards as well as ensuring protectiveness of human health and the environment. The module nature of the CFS would allow for construction of only the buildings

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needed to meet the storage/surge capacity as future waste is generated and shipped. The cost was kept relatively low by using a modular design that will minimize the facility footprint and material costs. Another factor that lowered cost was the ability of the CSF to accept a wide variety of waste forms. The ability to accept the waste from D&D activities represents significant cost savings that can be directly translated into money available for additional Site closure activities. Treatment requirements not necessary to protect human health and the environment can be deferred under the flexibility of the CAMU regulations. This further allows finite resources to be focused on actual cleanup sooner rather than in the future.

2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents.

Not only does the CSF CAMU not create unacceptable risks but it eliminates risks that might be associated with alternative remedies. The CSF CAMU minimizes risks to human health and the environment in the following ways:

- Remediation waste is removed from the environment and put into an effective and protective facility. No longer will it be exposed to natural transport phenomena that could spread the contamination.

- Safety precautions will be taken during construction of the facility. All activities will be performed within the safety and radiological protection standards that exist at the Site. Individuals with expertise specific to safety construction will ensure that all construction activities are carried out in a safe manner. Construction quality assurance efforts will ensure that the RWSF will meet all design criteria and performance standards for protectiveness.

- Initial on site transportation of the wastes will be performed in a controlled environment over short distances on non-public roads with minimal or controlled traffic. Operations will be closely monitored and safely controlled. Public exposure will be limited because the waste will not leave the plant site until final closure of the Site rather than throughout the life of site closure operations. Because the distances will be so short and the process will be tightly controlled, the risk of transportation accidents will also be minimized. Administrative and engineered controls will be used to ensure that high winds do not mobilize the contamination during transport. These measures may include precautions such as covered loads, spraying water or other dust suppressants on the loads, high wind shut downs, and other appropriate precautions. Final shipping and offsite disposition of the wastes will be conducted

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once cleanup is complete, allowing resources to be more efficiently focused, economies of scale to be achieved, and support operations to be appropriately scaled.

This is more appropriate for bulk

- Safety during filling of the facility will also be closely monitored and controlled. Precautions being considered include spraying the waste for dust suppression, keeping the waste covered, high wind shut downs, and appropriate personal protective equipment. All filling activities will be conducted under appropriate health and safety plans.

Indirect effects and cumulative impacts of the Environmental Restoration program at the Site will be reduced by utilizing the centralized CSF, and disposing of all low level and low level mixed remediation wastes in offsite permitted facilities. Impacts to the environment will be minimized because the footprint of contaminated areas will be reduced to one facility compared to multiple IHSSs and buildings that now exist, and the CSF will be constructed in areas that have already been disturbed, and thus will not impact previously undisturbed areas of the Site.

3) The CAMU shall include uncontaminated areas of the facility, only if including such areas for the purposes of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.

This CAMU criteria was a major influence upon the selection of the CSF location in the west portion of the IA. In a facility siting study performed for the Remediation Waste Storage Facility (RWSF) CAMU designation, the IA West location ranked second only to the Solar Ponds locations for a CAMU location. The Solar Ponds location was selected for the possible RWSF location. The IA West is more advantageous for a CSF CAMU because it is outside the protected area, thus, making access easier from all areas of the Site. This site is also near the rail spur running into the IA, and could be easily accessed by a short rail spur to facilitate rail shipment to offsite disposal facilities. This location is in a previously disturbed ~~area within an~~ area that has been subject to significant industrial uses.

4) Areas within that CAMU, where remediation wastes remain in place after closure of the CAMU, shall be managed and contained so as to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment.

This criterion is not applicable. At this time, the intended use of this facility is for monitored, retrievable waste storage pending offsite disposal.

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5) The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). See criteria 1 and 2 above.

Once constructed, the facility will expedite remedial activities. Waste will be loaded into containers directly from excavation or treatment and transported to the CSF. Planning documents for cleanups will be simplified since the waste management methodology will be established. It will be possible to establish work crews that could clean up IHSSs in an almost assembly-line fashion, moving from IHSS to IHSS with the necessary equipment while trucks transport the remediation waste in roll-off type containers to the CSF. Concurrent to these activities, waste would be shipped offsite and, if necessary, new modules to the CSF could be constructed so that there would be sufficient capacity available to accept the waste. Crews could be simultaneously performing deactivation followed by D&D and environmental restoration, moving from building to building, and transporting these waste materials to the CSF.

6) The CAMU shall enable the use, when appropriate, of treatment technologies (including innovative technologies) to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste that will remain in place after closure.

Because the proposed CFS will be for storage of containerized waste only, it will not impact or be impacted by the use of treatment technologies. Treatment to enhance the long-effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste that will remain in place after closure is a key element of the ER program and of all cleanup actions at RFETS. At RFETS, most IHSS source removals will involve treatment to remove the hazardous component of mixed low level waste. Treated waste that meets the action levels in RFCA will be placed back in the IHSS and will remain in place after closure. This waste minimization and reduction of toxicity and mobility approach results in only shipping for offsite disposal wastes that are either above the RFCA action levels for radiological dose, or from which the hazardous component cannot be removed easily. D&D wastes are not anticipated to need treatment (other than sizing) prior to shipment for offsite disposal.

If it were deemed cost-effective for a specific cleanup or treatment technology, temporary or permanent staging areas near the facility could be set up, and mobile or permanent treatment equipment could be bought in. However, this would not be performed as part of the CAMU, and is not part of the CAMU designation request.

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7) The CAMU shall minimize the land area of the facility upon which remediation wastes will remain in place after closure of the CAMU unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). See criteria 1 and 2 above.

This criterion is supported by the fact that multiple source areas at RFETS that might have previously been closed in place now have the option of closure to the action levels agreed to in the RFCA. The CAMU will support a bias towards removal rather than isolating sources in place. This will facilitate release of areas at RFETS for future land use, as described in the RFETS Vision.

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Jennifer's Copy

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3.0 WASTE CHARACTERISTICS

3.1 REMEDIATION WASTE CHARACTERIZATION

General waste types characteristics and volumes which may be placed into the RWSF are described in this section. Identification of waste characteristics, sources and projected volumes for the RWSF clarify and substantiate the need for a contingency to existing waste storage. Only remediation waste will be considered for management in this facility.

Remediation waste is defined as follows by RFCA, part 5, paragraph 25 bf.:

Remediation waste means all: "(1) solid, hazardous, and mixed wastes; (2) all media and debris that contain hazardous substances, listed hazardous or mixed wastes or that exhibit a hazardous characteristic; and (3) all hazardous substances generated from activities regulated under this Agreement as RCRA corrective actions or CERCLA response actions, including decommissioning. Remediation waste does not include wastes generated from other activities. Nothing in this definition confers RCRA or CHWA authority over source, special nuclear, or byproduct material as those terms are defined in the Atomic Energy Act."

italicize so we know this is a quote

The potential contaminants of concern in remediation waste include:

- Radionuclides (such as plutonium, americium, and uranium)
- Metals (such as cadmium and chromium)
- Volatile organic compounds (such as carbon tetrachloride, trichloroethene [TCE], tetrachloroethene [PCE])
- Semivolatile organic compounds
- Asbestos
- Polychlorinated biphenyls (PCBs) (such as Aroclor-1254)

Low-level waste, as defined by RFCA, is radioactive waste that is not high-level waste, spent nuclear fuel, by-product material, or transuranic waste (although it may contain small amounts of transuranic elements). The majority of the low-level waste managed at the RWSF will have a radionuclide activity much less than 10 nanocuries per gram (nCi/g] based on the Hazard Categorization Analysis (see Section 9.0 References, Kaiser-Hill, 1996a). Residuals from the Solar Evaporation Ponds, such as portions of the liners and sludge, will be considered remediation waste and suitable for placement in the RWSF. No process waste will be accepted. Waste media and forms (e.g., under 6 CCR 1007-3 Part 264.312-264.317, subpart N) for placement in the RWSF were modeled after Landfill restrictions, which include the following:

- No free liquids
- No compressed gases
- No transuranic (TRU) waste
- No incompatible wastes (such as pyrophoric uranium)
- No ignitable or reactive wastes

Remediation waste types include:

- Contaminated soil collected from remedial actions
- Treated and untreated sludge and sediments
- Toxic Substance Control Act (TSCA) waste (such as asbestos and PCBs)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions
- IDM from past and future characterization activities, such as wells, and borings, if the IDM is characterized as hazardous, low-level, or mixed remediation waste
- D&D waste which has been characterized as hazardous, low-level, or mixed waste. D&D waste includes building rubble, equipment, and utilities removed from the building prior to demolition.

The LLMW and HW placed in the RWSF will consist of remediation waste which is currently stored at the Site and the remediation waste which will be generated in the future.

where does the addtl volume go?

3.2 REMEDIATION WASTE VOLUME

Waste volume estimates were based on planned risk reduction activities. A preliminary estimate of remediation waste types, and volumes is presented in the Table 3-1. The total volume of remediation waste is estimated to be 123,000 cu yd of which 114,000 cu yd could be placed in a RWSF ~~after treatment~~. These estimates were based on current information and coincide with the Ten Year Plan waste volumes. These volume estimates are not intended to limit the size of the facility, but serve as a tool to create alternatives for the decision making process.

The actual volume of soil defined by Tier 1 and Tier 2 cleanup levels in RFCA could be larger or smaller because volume estimates were made with preliminary data. Final volumes will be determined in the field based on RFCA action levels ~~and any other negotiated cleanup levels~~.

What treatment diff than what we said in Section 2 Criteria 6

Put new table w/ 10yr2 plan

What is the difference here

Table 3-1 Waste Identification and Volumes for a Remediation Waste Storage Facility

Waste Source (OU/IHSS's)	Description of Media	Waste Type	Estimated Total Volume (cubic yds)	Volume after T. D. Treatment (cubic yds)[1]
OU 4 Solar Ponds				
Liners	Asphaltic Material & Soils	LLMW (rads/metals)	120	120
Sludge [2]	Sludge	LLMW (rads/metals)	6,000	10,000
Accelerated Actions (Top IHSSs)				
OU 2 Trench T-1	Soil, Drums; Pyrophoric U	LLMW (rads/VOC)	1,100	1,100
OU 2 Trench T-3	Soil, Drums, San. Sludge	LLMW (rads/VOC)	1,700	60
OU 2 Trench T-4	Soil, Drums, San. Sludge	LLMW (rads/VOC)	2,100	60
OU 2 Mound Area	Soil & Drums	LLMW (rads/VOC)	600	20
OU 2 903 Pad	Soil & Asphaltic Mat.	LLMW (rads/VOC)	9,800	8,600
OU 2 Lip Area	Soil	LLW (rads)	13,500	13,500
OU 9 Tanks 9 & 10 (includes IHSS 118.1)	Soil, tanks, piping	LLMW (rads/VOC)	2,000	50
OU 9 Tanks 2 & 3	Soil, tanks, piping	LLMW (rads/VOC)	25	25
OU 1 IHSS 119.1	Soil	LLMW (rads/VOC)	1,500	20
OU 9 Tanks 14 & 16	Soil, tanks, piping	LLMW	120	120
OU 10 IHSS 129	Soil	HW (VOC)	2,200	0
Subtotal for Accelerated Actions			34,645	23,555
Investigative Derived Material (IDM)[3]	Drill Cuttings/Soil	LLMW, HW, LLW	1,300	130
D & D Waste[4]	Soil, Debris, rubble, etc.	LLMW, LLW, HW	64,880	64,880
Subtotal			106,945	98,685
Expansion Factor; 15%			16,042	14,803
GRAND TOTAL			122,987	113,488
Revision Date 10/10/96				

1. T.D. Treatment signifies Thermal Desorption Treatment.
2. The volume after treatment accounts for expansion due to the solidification process. ?
3. The 1,300 yd^3 represents an inventory of 4,800 drums of which 1,600 drums or 430 yd^3 meet Tier 1 put back levels and will go to the Sanitary Landfill.
4. D&D waste volumes are estimated within a range of 44,880 to 164,880 cu yd.

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-20 + 100%

Jennifer's Uhland

4.0 ANALYSIS OF ALTERNATIVES AND SELECTION BASIS

As stated in Section 3, part of the CAMU designation process, paragraph 109 of the RFCA requires that the IM/IRA present an analysis of alternatives showing that the DOE has considered the following:

1. Worker safety
2. Protection of public health and the environment
3. Transportation
4. Facility design, containment and monitoring
5. Institutional controls
6. Cost, and
7. Community acceptance.

A wide variety of alternatives could be considered ranging from No-Action to highly engineered storage vaults. Four alternatives were selected to represent the spectrum of technologies available. These alternative serve as a contingency to the Ten Year Plan should waste volume, storage, or shipping assumptions in the Ten Year Plan prove invalid. These four alternatives are:

- No Action - Remediation waste would be treated and shipped to an offsite disposal facility as soon as it is recovered or it would remain in storage at the point of recovery until shipment would be possible.

- Slab on Grade - Waste is stored in cargo containers placed on abovegrade concrete slab; Secondary containment would be built into slab. The facility would have no roof or walls.

- Metal Buildings - Waste would be enclosed in cargo containers placed inside engineered metal buildings on concrete slabs; Secondary containment would be built into the floor slabs.

- Hardened Concrete Vault - Waste in cargo containers would be placed in an abovegrade freestanding concrete structure. The floor of this structure would serve as a secondary containment system. This is a current practice at the DOE Savannah River Site, for LLW & LLMW

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Except for the No-Action alternative, all of the alternatives considered would have an underlying double liner with a leachate collection system to meet the requirements of 6 CCR 1007-3, Part 264, Subpart N, Landfills as required by paragraph 80 of RFCA. This would effectively give all of the alternatives tertiary containment since a secondary containment system would be incorporated into the floor or slab of these structures. All of the alternatives except No-Action, would also provide loading and unloading capabilities for offsite transport. A summary of the analysis of alternatives using the seven RFCA criteria is presented in Table 4-1. The following text discusses each of the alternatives.

The No Action alternative, although the least costly, was rejected for the following reasons:

- Permitted storage capacity at RFETS would not support the waste volume estimated in the Ten Year Plan to be generated during closure of RFETS.
- Generating large volumes of remediation wastes and leaving large numbers of containers exposed to the elements and spread across RFETS for an unknown duration would create undesirable risks of exposure and not support the levels of protectiveness desired at RFETS.
- Schedule impacts resulting from an inability to ship waste would leave contaminant sources, including buildings, exposed to the environment for time frames longer than acceptable as described in the Ten Year Plan.
- Resources necessary for the additional waste management requirements under this scenario—such as additional treatment costs—would limit the amouint of risk reduction that could be achieved.

The Slab On Grade alternative was rejected for reasons similar to the No-Action alternative. This design is not as protective of human health and the environment relative to other storage alternatives. This alternative would not protect the wastes from corrosion due to the weather or from dispersal by the wind if containers leaked. The uncertainties associated with offsite disposal resources that would drive the need for storage would also compound the problem of leaving containers exposed to the environment for an unknown duration. For

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these reasons, this alternative would not adequately address worker safety, protection of public health and the environment, or facility design, containment and monitoring criteria.

The Hardened Concrete Vault was rejected primarily due to cost. Although it adequately addressed worker safety, protection of public health and the environment and containment. For short-term storage, it would not provide any more protectiveness than the Metal Buildings. If the facility needed to be utilized for more than 30 years this facility might be a better alternative; however, since the facility is intended for short-term use only (as described in the Ten Year Plan strategy), the added durability of the Hardened Concrete Vault was not a factor in the selection process. The Hardened Concrete Vault also might not offer the flexibility needed for changing waste volumes or transportation requirements: specifically, once constructed the facility would be difficult to reconfigure. When the facility is no longer needed, its closure would be more complicated and costly than the other alternatives since this type of structure is more permanent by design.

Metal Buildings were selected as the best alternative for short-term storage (10-20 yr). Metal buildings would provide adequate protectiveness at a lower cost. Other advantages that Metal Buildings offer include:

- Containers would be protected from the elements and potential airborne dispersal should any of the containment units fail. Air monitoring could be incorporated into existing programs.
- The use of a modular building design allows flexibility in addressing changing storage requirements, i.e. buildings could be constructed as needed.
- The level of containment would be protective of workers, the public, and the environment. The combination of liners, leachate collection system, and secondary containment would provide protectiveness to surface water and ground water.
- Metal buildings would offer the same protection as more sophisticated designs, and at a lower cost. The use of pre-engineered buildings would reduce cost and expedite the schedule. Lower costs allows more resources to be directed towards risk reduction activities.

- Use of Metal Buildings for the storage of waste is an established and implementable technology currently in use at RFETS.
- Container retrieval and shipment would be greatly facilitated by this alternative, as the containers would be received and stored ready for shipment.
- Closure of the facility would be less complicated and more cost effective than the hardened concrete vault.

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Table 4-1 Summary of Analysis of Alternatives

	~~RFCA Criteria~~	RFCA Criteria	~~RFCA Criteria~~	~~RFCA Criteria~~
Final Design Alternatives	**Worker Safety**	**Protection of Public Health and the Environment**	**Transportation**	**Facility Design, Containment and Monitoring**
No-Action	Waste would need to be immediately shipped in bulk to reduce exposure. Potential cleanup schedule may be impacted.	Visual inspections would allow leaks to be detected before release to the environment. Remediation waste would be stored uncovered prior to shipment. Exposed containers could eventually pose a ~~serious~~ risk to the environment. Lack of adequate storage could delay some remediation work.	The necessity of immediate shipping could limit transportation options. Loading and unloading could be hampered by the lack of a waste handling facility. Shipping could be required through several population centers.	Containment would be less if containers were unconsolidated across RFETS. Inspection costs would be more.
Slab on Grade	Exposure could result if waste leaked from ~~from~~ containers. Construction of the facility poses minimal risk.	Visual inspections would allow leaks to be detected before release to the environment. RCRA double-liner system would provide groundwater protection. Containerized waste would be stored uncovered prior to shipment. Exposed containers could eventually pose a ~~serious~~ risk to the human health and the environment.	The Slab on Grade would facilitate transportation. Facility could double as a loading and unloading facility. Facility could be accessed from many different sides. Facility would not be expected to have a detrimental impact to traffic flow. Shipping could be required through several population centers.	Containers would be exposed to the elements which could accelerate deterioration and leakage. The slab itself is a containment and collection system in addition to the liner/leachate collection system beneath it Exposed contaminants could be subject to airborne migration.
Metal Buildings	Waste would be isolated from workers. Construction of the facility poses minimal risk.	Visual inspections would allow leaks to be detected before release to the environment. RCRA double-liner system would provide groundwater protection.	The CSF would allow coordination of transportation and more transportation options for offsite shipment. CSF would double as a loading and unloading facility. Facility is not expected to have a detrimental impact to traffic flow. Shipping could be required through several population centers.	Secondary containment would be incorporated into the building design. Monitoring would be accomplished through visual inspection and secondary containment system. Liner/ leachate collection system would provide additional containment and monitoring capabilities.
Hardened Concrete Storage Vault	Waste would be isolated from workers. Construction of the facility poses minimal risk	Visual inspections would allow leaks to be detected before release to the environment. RCRA double-liner system would provide groundwater protection. Vault would provide better long-term protection than other alternatives.	Access to facility would be more limited. Facility would not be expected to have a detrimental impact to traffic flow. Shipping could be required through several population centers.	Secondary containment would be incorporated into the building design. Monitoring would be accomplished through visual inspection and secondary containment system. Liner/ leachate collection system would provide additional containment and monitoring capabilities.

Table 4-1 Summary of Analysis of Alternatives (continued)

	RFCA Criteria	RFCA Criteria	RFCA Criteria
	Institutional Controls	**Cost**	**Community Acceptance**
No-Action	The current RFETS site access limitations and RFCA would be institutional controls for waste stored at remedial action and D&D sites prior to shipment off site. Each site with waste stored pending shipment would require regularly scheduled inspections. Once shipped, institutional controls would exist offsite; The nature of those institutional controls would be dependent on the selected disposal facility.	Least expensive of alternatives. Some cost savings could be realized by not constructing a storage unit. Although significant near-term ~~and~~ shipment cost and schedule impacts would reduce amount of risk reduction conducted which is not supportive of Ten Year Plan Strategy. Although some risk reduction activities would be delayed leaving contaminant sources uncontrolled longer. Some of these savings would be offset by costs associated with immediate treatment. Some type of staging/shipping facility would likely be necessary to support this alternative.	Waste containers would continue to be exposed to the environment prior to shipment. ~~Option~~ Alternative supports desire for offsite disposal.
Slab on Grade	The RFCA would be an institutional control requiring continued maintenance, inspection and monitoring of the facility. Since the use of the facility is for short-term storage, controls beyond existing controls are not necessary.	Least expensive storage facility to construct and operate. Cost savings come at the expense of protectiveness due to lack of an enclosed facility. Final disposal costs still apply.	This alternative provides less protective measures to the public than the other two facilities evaluated. The Slab on Grade supports the overall RFETS strategy of offsite shipment. It is easy to retrieve waste and transport it.
Metal Buildings	The RFCA would be an institutional control requiring continued maintenance, inspection and monitoring of the facility. Since the use of the facility is for short-term storage, controls beyond existing controls are not necessary.	Metal Buildings were in the mid-range cost for the storage facilities evaluated. Final disposal costs still apply.	The CSF provides better monitoring and retrieval capabilities. The CSF supports the overall RFETS strategy of offsite shipment. It is easy to retrieve waste and transport it.
Hardened Concrete Storage Vault	The RFCA would be an institutional control requiring continued maintenance, inspection and monitoring of the facility. Since the use of the facility is for short-term storage, controls beyond existing controls are not necessary.	Most expensive of the storage facility alternatives to construct due to expense of constructing hardened concrete shell. Less resources would be available for risk reduction. Final disposal costs still apply.	This alternative is protective. Facility is more permanent than other facilities considered but still can support Ten Year Plan goals. Waste is more difficult to retrieve. Closure of this alternative would be more difficult.

These do not seem to support comm. acept.

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What ethics?

Table 4-1 Summary of Analysis of Alternatives (continued)

Final Design Alternatives	NEPA EVALUATION SHORT-TERM EFFECTIVENESS	NEPA EVALUATION LONG-TERM EFFECTIVENESS
No Action	Readily available to support on-going projects. Additional effort would be needed for inspecting waste left at cleanup sites until shipment. The limited ability to store large quantities of waste on site could limit risk reduction activities in the short term.	All offsite disposal facilities under consideration have been designed for long-term use. The No Action alternative would not be effective if it causes delay of source term removals.
Slab on Grade	Rapid construction due to modular design would accelerate the availability of the facility. Un-enclosed transport containers could be subject to weather damage. Run-on and run-off would be controlled. Slab drainage and leachate collection system could be impacted by heavy rains. This alternative would not be suitable for volumes over 100,000 cu yd.	Not designed as a long-term facility. No long-term protection. All offsite disposal facilities under consideration have been designed for long-term use.
Metal Buildings	Rapid construction due to modular design would accelerate the availability of the facility. This alternative would not be suitable for volumes over 100,000 cu yd.	Not designed as a long-term facility. All offsite disposal facilities under consideration have been designed for long-term use.
Hardened Concrete Storage Vault	Rapid construction due to modular design would accelerate the availability of the facility. Containerized waste storage inside a concrete vault would not be suitable for volumes over 100,000 cu yd.	~~Designed~~ as a long-term, permanent facility with cap and liner design to support long-term waste placement. thereby supporting waste storage for a long period

Allows risk reduction to continue in a timely manner?

Could be used

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4.0 IDENTIFICATION OF SUBSTANTIVE CRITERIA

Paragraph 80 of RFCA provides: "(I)f the application meets the appropriate substantive criteria CDPHE will issue a CAMU designation." Likewise, the CAMU rule, promulgated pursuant to the CHWA, states that "(t)he Department shall specify, in the permit or order, requirements for CAMUs..." (See 6 CCR 1007-3, Part 264.552 [e).

4.1 ~~CAMU Objectives~~ RCRA Rqmts

The designation of a Corrective Action Management Unit must be performed in accordance with the seven criteria enumerated in 6 CCR 1007-3, Part 264.552(c). The seven criteria are, by nature, high level objectives. For that reason, the seven criteria were adapted and used in Section 6.0 as the decision criteria for comparison and selection of an alternative. The seven CAMU objectives include:

1. The CAMU must facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

2. The waste management activities associated with the CAMU must not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents;

3. The CAMU may only include uncontaminated areas of the facility if including such areas is more protective;

4. Where remediation wastes will remain in place after closure the CAMU must be managed and contained so as to control, minimize or eliminate future releases to the extent necessary to protect human health and the environment;

5. The CAMU must expedite the timing of remedial actions;

6. The CAMU must enable the use, when appropriate, of treatment technologies to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste.

7. The CAMU must be placed on the minimal area necessary to provide a reliable, effective, protective, and cost effective remedy.

This section presents the criteria that CCR & RFCA requires for a CAMU to be designated at the site.

No

This criteria was discussed in Section 2 of this designation

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4.2 RFCA Requirements

The requirements under RFCA for CAMU designation are presented in ¶80 of the RFCA.

Paragraph 80 of RFCA provides:

> ...that the design criteria for the facility described in this paragraph shall be the same whether the facility is for the retrievable, monitored storage of remediation wastes or for the disposal of remediation wastes. Specifically, the facility described in this paragraph must ensure retrievability of wastes and protection of human health and the environment through a combination of requirements that include, but are not limited to: detection and monitoring/inspection requirements; operating and design requirements, including cap/liner system that meets the requirements as set forth in 6 CCR 1007-3, Part 264, Subpart N; a groundwater monitoring system; and requirements for responding to releases of wastes or constituents from the units. In addition, where necessary for protection of human health and the environment, waste treatment will be required."

In response to RFCA paragraph 80, the following design and operating requirements will be addressed and implemented:

- leak detection;
- inspections;
- a cap that meets RCRA Subpart N requirements; liner
- a groundwater monitoring system;
- corrective action for releases; and
- a waste acceptance criteria, consistent with design and operation, that provides treatment of wastes where necessary.

The above requirements are discussed in Section 7 for the specific selected alternative, the Concrete Lined Cell. As part of the IM/IRA process, paragraph 109 of RFCA also directs consideration of seven topics, including:

- worker safety;
- protection of human health and the environment;
- transportation;
- facility design, containment, and monitoring;
- institutional controls;
- cost; and
- community acceptance.

DOE to present an analysis of alternatives showing that DOE has considered the following.

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What about Subpart B, C, D & E 264.552 (a)?

4.3 CAMU Requirements

what ABOUT 264.552(a)(3)?

after the designation of the CAMU

This is confusing b/c this is the CAMU design

Additional requirements for designation are enumerated in Part 264.552(e) of the CAMU rule. The following are the additional requirements:

- specification of the area configuration, Part 264.552 (e) (1));
- specification of the design requirements (Part 264.532 (e) (2);
- specification of operation requirements (Part 264.552 (e) (2);
- specification of groundwater monitoring requirements (Part 264.552 (e) (3);
- specification of closure and post closure requirements (Part 264.552 (e) (2) ~~that:~~
  - minimize the need for further maintenance and (Part 264.552 (e) (4) (iii) (A);
  - consider the CAMU design (Part 264.552 (e) (4) (iii) (A);
  - *consider the potential for releases (Part 264.552 (e) (4) (iii) (C);*
  - consider the physical and chemical characteristics of the waste (Part 2 64.552 (e) (4) (iii) (D);
  - consider hydrological and other environmental conditions at the facility that may influence the migration of any releases (Part 264.552 (e) (4) (iii) (E);
  - consider potential human or environmental exposures to releases (Part 264.552 (e) (4) (iii) (F)
  - requirements for excavation, removal, treatment, or containment of remediation wastes (Part 264.552 (e) (4) (ii) (A);
  - requirements for removal and decontamination of equipment, devices and structures used in remediation waste management activities within the CAMU (Part 264.55 (e) (4) (ii) (C);

These requirements will be met after a designation has been approved.

Where do we address this info?

Paragraph 80 of RFCA provides: "(I)f the application meets the appropriate substantive criteria CDPHE will issue a CAMU designation." Likewise, the CAMU rule, promulgated pursuant to the CHWA, states that: "(t)he Department shall specify, in the permit or order, requirements for CAMUs..." (See 6 CCR 1007-3 Part 264.552 (e).

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Jennifers Uhland

~~Text editing~~ (1) Formatting (2) Organize (3) Alt. facility.

5.0 FACILITY DESCRIPTION

This section describes the conceptual design of the Containerized Storage Facility (CSF) which has been proposed for the management of remediation wastes. The CSF has been proposed to be located in the southwest corner of the Industrial Area (Figure 5-1). The CSF would be composed of a series of engineered metal buildings, as shown on Figure 5-2, which would be constructed to serve as a staging facility in the receiving, storage, and ultimate shipment of remediation waste. The proposed location benefits from minimal site preparation costs, verses alternate locations, and the presence of an adjacent rail spur for offsite shipment. A footprint of 6.8 acres would include up to four modular buildings which could ultimately store 5,000, 20-cu-yd-capacity cargo containers each, for a total capacity of up to 100,000 cu yds. The modular design would allow the final configuration and storage capacity to be flexible in order to meet changing waste-storage requirements. The Metal Buildings would be constructed on reinforced concrete foundations with a double liner and leachate collection system under each building foundation. The double liner and leachate collection system, (see Figure 5-3) would comply with RCRA Subtitle C requirements as defined in 6 CCR 1007-3, Part 264 Subpart N. The remediation waste would be effectively isolated from the environment by the following three barrier systems:

Why do we show an alternate facility? Have we mentioned this before?

- Containers
- Structural concrete floor slab with integral leachate collection system
- Double liner system (e.g. primary barrier HDPE geomembrane and secondary barrier combined HDPE geomembrane and clay liner) with leachate detection and collection system

Why would we do this if we have

The CSF would have a design life of twenty years (e.g. 10 years operation under the Ten Year Plan (Ten Year Plan) and operation for an additional 10 years as a contingency) at which time it assumed the remediation waste would have been transported to an offsite facility for disposal.

5.1 RFCA DESIGN CONSIDERATIONS

RFCA paragraph 80 describes requirements that have been incorporated into the conceptual design such as leachate detection and collection. Details of how these requirements will be

I'm not sure this belongs here?

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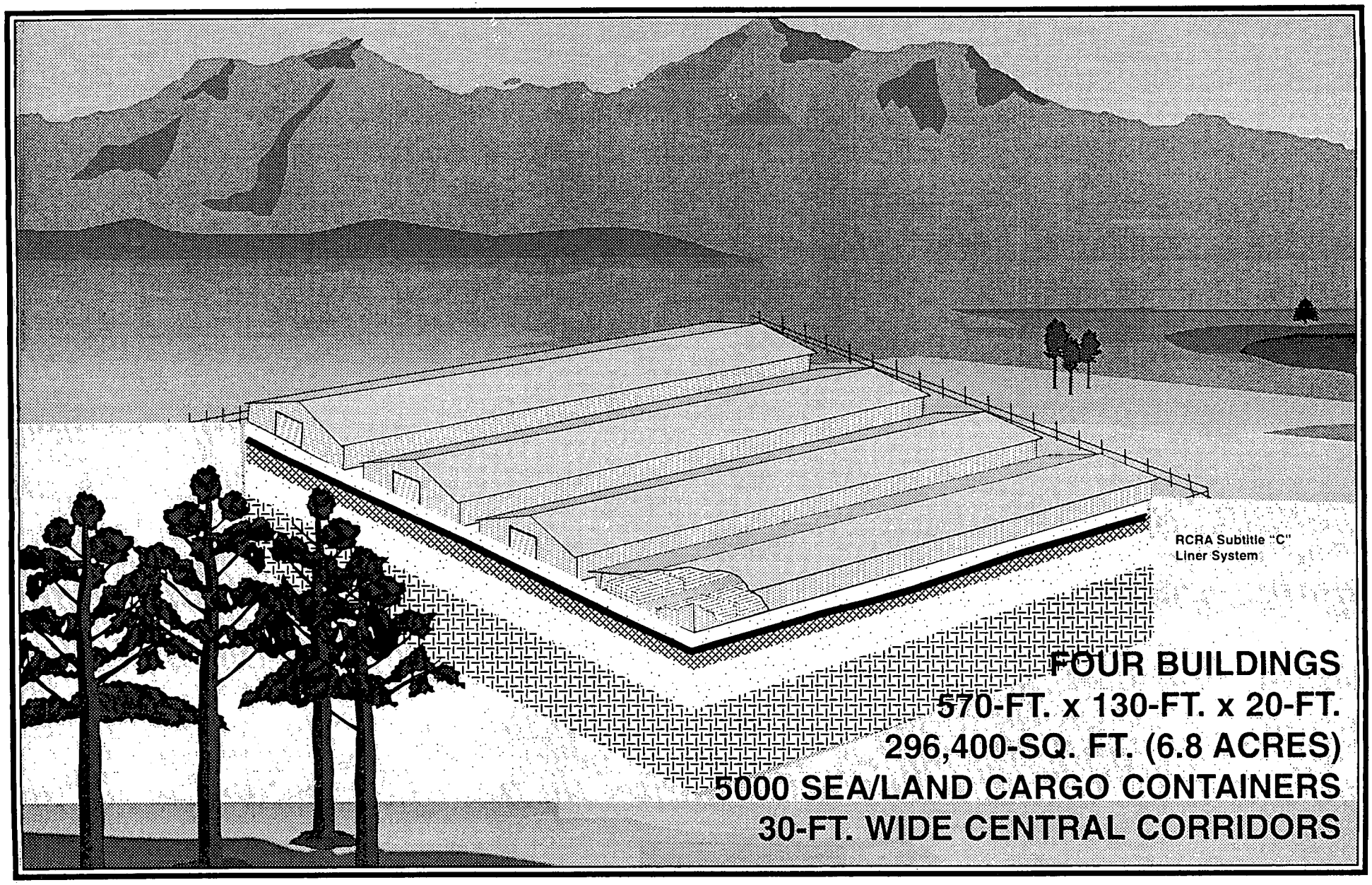

Figure 5-2

CONTAINERIZED STORAGE FACILITY

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CONTAINERIZED STORAGE FACILITY LINER

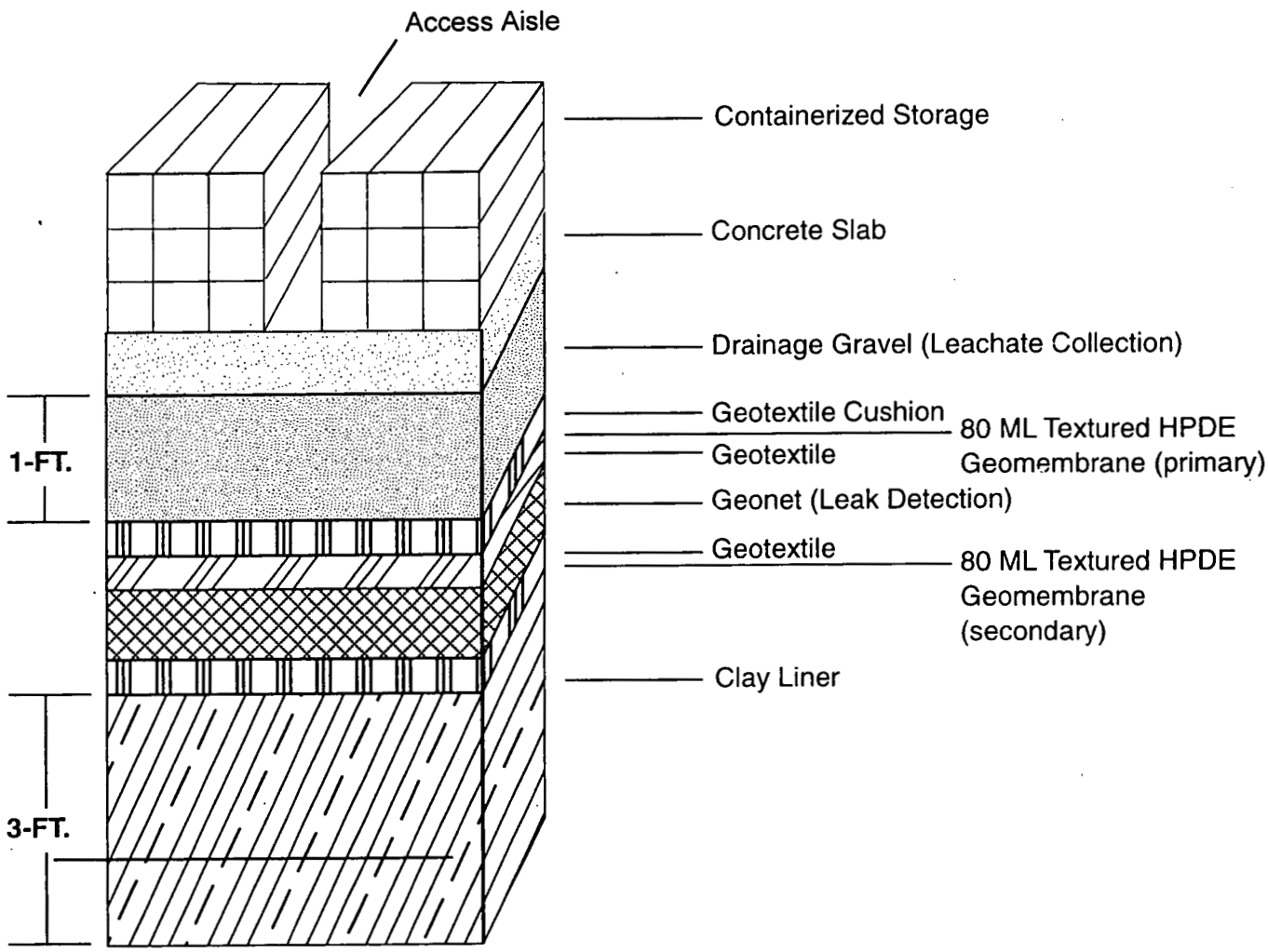

Figure 5-3

CONTAINERIZED STORAGE FACILITY CROSS SECTION

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met will be submitted during the design phase. Incorporated as part of the proposal alternative are the following:

- Detection and monitoring/inspection (part of the alternatives analysis and facility operational plans)

  isn't applicable here is it?

- Cap/liner in compliance with 6 CCR 1007-3 Part 264, Subpart N
- Ground water monitoring system to be developed as part of the design/construction

How are these

Also, the following would be developed as part of the design/construction:

- Operating and design requirements (to be included as design submittals and operational plans)
- Requirements for responding to releases of wastes or constutuents from the units

  SP

- Waste treatment requirements (to be provided in the WAC)

- I do not understand this w.r.t. ¶ 5.3

The following features were used to develop a conceptual cost estimate (see Table 5-1):

- Four metal buildings, each 570 ft. long by 130 ft. wide and 20 ft. eave height
- Each building would be constructed, when required, dependent upon waste volumes
- Buildings would be constructed over a reinforced concrete floor
- A maximum total of 5000 - 20 cu yd cargo containers for the entire four building CSF
- Cargo containers would be stacked three high in the buildings
- Each building would have a thirty foot wide central corridor and personnel access aisles for routine monitoring and inspection
- A twenty year design life
- Cargo containers

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- Double liner system and leachate collection system
- Groundwater monitoring wells (six total maximum) would be installed both up gradient and down gradient and would be operated through the life cycle of the CSF (20 years)

TABLE 5-1 SUMMARY OF COSTS FOR THE CSF

TASK DESCRIPTION	ESTIMATED COST
Containers	$68,177,000
Site Preparation	$1,209,000
Engineering Design / Project & Const. Mgmt.	$3,685,000
Construction	
A. Four Metal Buildings	$9,307,000
B. Double Liner System	$3,236,000
C. Leachate Collection/Detection System	$386,000
Total Cost [1]	**$86,000,000**

Notes:
1. A 25% contingency cost is included in the estimate

The leachate collection and retrieval system would collect any potential leachate and it would be transferred to a facility for treatment.

5.2 WASTE CHARACTERISTICS AND CONCEPTUAL WASTE ACCEPTANCE CRITERIA

The following sections describe the waste and associated acceptance criteria for the CSF. Section 5.2.1 gives a brief identification of the waste characteristics which could be received at the CSF. Section 5.2.2 gives estimates of the waste volumes and section 5.2.3 briefly explains what the Waste Acceptance Criteria (WAC) would address for the CSF.

5.2.1 Remediation Waste Characterization

This section describes the general waste types characteristics which may be placed in the CSF. Identification of waste characteristics, sources and projected volumes for the CSF clarify and substantiate the need for a contingency to existing waste storage. Only remediation waste would be considered for management in this facility.

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Remediation waste is defined as follows by RFCA, part 5, line 26, item (bf):

> (1) solid, hazardous, and mixed wastes; (2) all media and debris that contain hazardous substances, listed hazardous or mixed wastes or that exhibit a hazardous characteristic; and (3) all hazardous substances generated from activities regulated under this Agreement as RFCA corrective actions or CERCLA response actions, including decommissioning. Remediation waste does not include wastes generated from other activities. Nothing in this definition confers RCRA or CHWA authority over source, special nuclear, or byproduct material as those terms are defined in the Atomic Energy Act.

In addition, low-level waste, as defined by RFCA, is radioactive waste that is not high-level waste, spent nuclear fuel, by-product material, or transuranic waste (although it may contain small amounts of transuranic elements). The majority of the low-level waste managed at the CSF would have an average radionuclide activity much less than ten nanocuries per gram (nCi/g) based on the Hazard Categorization Analysis (Kaiser Hill, 1996).

Remediation waste types for the CSF are expected to include the following:

- Contaminated soil collected from remedial actions, usually treated to remove volatile organics
- Treated and untreated sludge and sediments
- Toxic Substance Control Act (TSCA) waste (such as asbestos and PCBs)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions
- IDM from past and future characterization activities, such as wells, and borings, if the IDM is characterized as hazardous, low-level, or low-level mixed remediation waste
- D&D waste which has been characterized as hazardous, low-level, or mixed waste. D&D waste includes building rubble, equipment, and utilities removed from the building prior to demolition.

5.2.2 Remediation Waste Volume

Waste volume estimates were based on planned risk reduction activities. A preliminary estimate of remediation waste volumes the may require storage prior to ultimate disposal is presented in Table 5-2 below. The total volume of remediation waste is estimated to be 101,800 m^3 or 133,000 cu yd which would be placed in the CSF. These estimates were based on current information and coincide with the Ten Year Plan waste volumes. These volume estimates are not intended to limit the size of the facility, but serve as a tool to create alternatives for the decision making process.

Table 5-2 Remediation Waste Volumes for the Containerized Storage Facility

Remediation Waste Types	Total Estimated Volume (m^3)	Total Estimated Volume (yd^3)	Volume Ranges (m^3)
Low Level Waste	40,716	53,293	32,573 m^3 to 81,432 m^3
Low Level Mixed Waste	53,438	79,945	48,863 m^3 to 122,156 m^3
Total	94,000	133,238	81,435 m^3 to 203,588 m^3

Font

this needs to be pulled with ES for consistency

Notes:
1. These waste volumes are estimated within a range of -50% to +100%.

The actual volume of soil defined by Tier 1 and Tier 2 cleanup levels in RFCA could be larger or smaller because volume estimates were made with preliminary data from limited characterization.

5.2.3 Conceptual Waste Acceptance Criteria

The purpose of the CSF is to provide ER and D&D activities the services of a staging facility for the receiving, interim storage and ultimate shipping of remediation waste. Waste acceptance criteria (WAC) would be developed for the CSF to ensure remediation wastes comply with applicable regulatory and site requirements. The CSF would accept remediation waste in transportable containers which have accompanying documentation that meets the waste acceptance criteria of the anticipated target disposal facility. The WAC would be specific for the CSF and may not address specific requirements as required by other offsite disposal facilities which ultimately would receive the waste. For criteria which can be

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quantified, specific levels would be identified. The following objectives would be achieved in compliance with the WAC:

1. Remedial wastes are effectively isolated from potential natural environmental pathways to protect the public health and the environment.
2. Operating personnel of the CSF ensure continuous protection to the public health and the environment.
3. Remediation waste is routinely monitored and inspected.
4. Characterization data of the remediation waste is documented to the extent necessary to support project specific waste management objectives and WAC requirements for the CSF.

As previously mentioned, the CSF would receive remediation waste from ER and D&D activities which would be handled as bulk wastes in customized cargo containers verses crates or drums. The CSF **is not** a handling facility and is not intended to repackage waste once received.

The WAC would provide physical and chemical limitations and requirements for the proper management of remediation waste. Process knowledge and/or chemical and radiological analyses would become the tools to document accurate characterization of the remedial waste.

5.2.3.1 Physical Requirements

A summarized list of physical requirements which the WAC would address are listed below:

- Physical properties of bulk wastes such as soils, sediments, and treated sludge (e.g. maximum size range, specific weight, moisture content)
- Physical properties of wastes classified as debris (e.g. maximum size range, specific weight, moisture content, non-biodegradable)
- No free liquids (e.g. 6 CCR 1007-3 Subpart N 264.314; EPA Paint Filter Test)
- Conditions for filled and emptied containers (6 CCR 1007-3 Subpart N 264.315)
- Prohibitions of containerized gases, ignitable or reactive wastes (6 CCR 1007-3 Subpart N 264.312, 313)

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5.2.3.2 Chemical Requirements

A summarized list of chemical requirements which the WAC would address are listed below:

- Chemical analyses, acceptable analytical methods, and detection ranges.
- Prohibited constituents and chemical characteristics including reactive or ignitable substances (e.g. pyrophoric uranium; 6 CCR 1007-3 Subpart N 264.312)
- Chemical compatibility's (6 CCR 1007-3 Subpart N 264.313)
- pH limitations
- Composition of wastes

5.2.3.3 Health and Safety Issues

The primary concerns of Health and Safety for the CSF are itemized as follows:

- Operations involving heavy equipment (e.g. large forklifts/cranes) for the handling of containers
- Health and Safety issues for the industrial worker
- Threshold limits of radionuclides for the CSF
- The CSF would require operating and administrative procedures for the assurance of safe operations involving heavy equipment and protective measures for the industrial worker.

The WAC would address the following radiological requirements:

- Radiochemical analyses for characterization
- Threshold limits of radionuclides for the CSF

The majority of low level remediation waste to be managed at the CSF would have an average radionuclide activity less than ten nanocuries per gram (nCi/g) as mentioned previously under section 5.2.1. A preliminary hazard category analysis was performed for the CSF. The CSF

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was categorized less than a Category 3 facility and designated as a Radiological Non-nuclear Facility based on preliminary threshold quantities of plutonium and other radioactive isotopes (Kaiser-Hill, 1996c). This categorization analysis was based on sampling data from some of the more radioactive IHSSs at RFETS (e.g. Solar Ponds, 903 Pad and Lip Area, and the Original Process Waste Lines). To be conservative in the hazard analysis, the highest activity concentrations were used from these IHSSs. The CSF would not receive transuranic waste (TRU).

5.3 Technical and Administrative Controls

Technical and administrative controls would be implemented in order to ensure that human health and the environment would be protected from areas where present or past activities preclude unrestricted access or use, controls are implemented. The technical and administrative controls would be met the requirements in RFCA paragraph 80 for a CAMU. Discussion of controls for the CSF is grouped into four major elements:

- Engineering Controls (e.g. double liner system, leachate collection/detection system, interim cover)
- Facility Monitoring (e.g. groundwater monitoring plan)
- Operational Controls (e.g. waste acceptance criteria, inspection, H&S plan, contingency/spill response plan)
- Administrative Controls (e.g limited access; institutional controls)

Engineering controls - There would be specific engineering controls designed into the facility in order to support protection of human health and the environment throughout the operational life of the facility. The following engineering controls of the CSF would comply with 6 CCR 1007-3, Part 264, Subpart N, 264301 - Design and operating requirements: 264.302 - Action leakage rate; 264.303 - Monitoring and inspection; and 264.304 - Response actions:

- Double liner system (e.g. primary barrier - geosynthetic layer; secondary barrier - composite layer consisting of clay layer overlain by geosynthetic)

- Leachate collection/removal system (e.g. two systems; the first system is an integral collection/removal system constructed in the floor slab with sumps and piping; the second system is the coarse sand drainage layer above the primary barrier with integral collection pipes, pumps and sumps)

- Leak detection system (e.g. geonet layer between the primary and secondary barriers)

- An internal infrastructure designed to facilitate retrieval of wastes

Facility Monitoring - In addition to the monitoring and inspection per 264.303 for the double liner system and a fully instrumented leak detection system, an extensive monitoring network would ensure no releases pass undetected from the unit boundary. This would include both air and surface water monitoring stations and groundwater monitoring wells upgradient and downgradient of the CSF which would require a groundwater monitoring plan. These requirements would also be integrated into the overall RFETS monitoring program to ensure that a comprehensive network was in place to help protect human health and the environment.

Do we want to commit to this?

Operational Controls - Operational controls would be put in place to ensure that waste management operations were conducted in such a way as to minimize the risk of release from the facility or exposure to personnel:

- An agency-approved waste acceptance criteria specifying a safety envelope for chemical and physical waste parameters including appropriate treatment requirements

- An operational health and safety plan approved by the agencies designed to provide operational constraints for personnel protection, weather conditions, decontamination procedures, training requirements, emergency response, and health and safety monitoring

- Standard operating procedures that establish clear repeatable guidelines for conduct of operations, including packaging and transporting of waste from D&D or IHSS remediation locations to the CSF

- Numerous quality assurance procedures from construction quality assurance, as cited earlier per Subpart 264.303 (a) monitoring and inspection, to procedural audits all designed to ensure the facility and operations meet designated performance standards

- Closure plans that define how the facility would be decommissioned after the life of the operations and the performance standards for closure per Subpart 264.310 and 264.552 (e)

- Contingency/spill response plans per Subpart 264.304 would define how the facility responds to a release of waste or constituents from the CSF.

Administrative Controls - Administrative controls are defined to ensure that risk of exposure during construction, operations, and closure are minimized. These may include:

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- Appropriate institutional controls (e.g. warning signs, fences, deed restrictions)

- Security plans which define site restriction requirements throughout the life of the project

- Cleanup standards which define the level of cleanup necessary to certify closure

In summary, numerous technical and administrative controls would be in place to insure that all aspects of this effort were conducted in such a way that risks to human health and the environment would be minimal.

5.4 NEPA VALUES

The proposed CSF would be authorized using a single, integrated Decision Document that would be signed by the DOE, and the State of Colorado, when approved. The Decision Document and review process would satisfy the documentation and procedural requirements of the RFCA. The National Environmental Policy Act (NEPA) process was integrated into the RFCA documentation and procedure, especially public involvement and decision-making, to reduce duplication and paperwork, and streamline the combined NEPA/CERCLA process. In accordance with the DOE Secretarial Policy issued in June 1994, integrated CERCLA/RCRA documents for environmental clean up activities are to incorporate NEPA values to the extent practical. This policy is intended to minimize the cost and time for document preparation and review while meeting the requirements of both acts.

The CSF would be anticipated to minimize cumulative effects on the environment by being placed in the Western Industrial Area because of the following:

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- The proposed area in the industrial area has been already disturbed and consolidation of waste is achieved
- Existing infrastructure already exists which would support the CSF
- The proposed area was selected based on a detailed siting study which screened out sensitive areas (e.g. areas populating the endangered species Prebles Jumping Mouse, steep slopes, wetlands, etc., were avoided)

The analyses required by NEPA were integrated throughout the Decision. Based on the analyses, the decision-making process requires no further documentation to complete the NEPA process.

5.5 REMEDIATION WASTE STORAGE FACILITY OPERATIONS

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The CSF would be operated and maintained under a number of administrative requirements, as previously mentioned in section 5.3 "Technical and Administrative Controls," to ensure compliance with paragraph 80 of RFCA. Administrative controls would be administered for activities of waste operations in the following areas:

1. WAC documents and forms - These would be required to demonstrate compliance with the RWSF WAC and paragraph 80 of RFCA requirements previously mentioned in section 2.2
2. Operating procedures - Procedures for handling and placement of waste, facility maintenance and documentation to ensure safe and efficient operation of CSF
3. Training Plans - A plan to administer required training for operating personnel in procedures, safety, and quality assurance
4. Health & Safety plans - The health and safety requirements for operating personnel to conduct operations in a safe manner
5. Contingency/spill response plans would define, per Subpart 264.03, how the facility would respond to a release of waste or constituents from the CSF

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6. Limiting operating conditions - Identification of abnormal events which would require operations to temporarily stop activities (e.g. excessive wind velocities, and other weather conditions) to ensure safety to the public, the workers, and the environment

7. Administrative procedure and plans - Additional procedures and plans to ensure compliance with RFCA, DOE orders, and RFETS rules and policies

8. Control of fugitive dust emissions - Facility Monitoring plan as cited in section 5.3 to reduce dust emissions and monitor results to protect the public and worker

9. Closure Plan - This would include the requirements and performance standards for closure per Subpart 264.310 and 264.552 (e) to close the facility after the end of its operational life

Additional requirements addressed in the WAC or Facility Operations Plan for compliance would be areas addressing administrative controls. The following requirements would ensure the RWSF to be operated in a safe manner:

- Recordkeeping and documentation
- Waste information from process knowledge and/or sampling and analysis data for waste characterization
- Quality assurance/quality control (QA/QC) certification program and verification;
- Status reports and waste forecasts
- Shipment notification
- Packaging and labeling requirements

5.4.3 CLOSURE REQUIREMENTS FOR THE CSF

Once the CSF has shipped offsite all remediation waste it would be subjected to closure requirements under RFCA Part 9 Subpart B paragraphs 97, 118, and 121. A closure plan would be submitted which described the following items to meet the closure performance goals of 264.111:

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- A description of how the CSF would be closed to meet the closure performance standards
- A description of how final closure would be conducted
- An estimate of the maximum inventory of remediation waste managed within the CSF
- A detailed description of the steps required to decontaminate all hazardous waste residues, containment system components, equipment, structures, and soils for final closure
- A description of how other activities ensure the closure performance standards are satisfied (e.g. ground-water monitoring, leachate collection, run-on and run-off controls.
- A schedule for final closure.

5.5 CONCLUSION

The CSF is proposed as a contingency to the existing Ten Year Plan. This IM/IRA Decision Document is the tool to designate the proposed IA-West area as a CAMU for storage of remediation waste as a contingency to the Ten Year Plan. The Decision Document identifies and explains, in a detailed study and analysis, the best location onsite for the selected remedy—Metal Buildings. In the event remediation waste could not be shipped offsite as originally anticipated under the Ten Year Plan, the DOE would have the option of implementing the CAMU as their contingency for interim storage of remediation waste pending shipment.

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7.0 REFERENCES

DOE, 1996a, *Final Rocky Flats Cleanup Agreement*, July 16.

DOE, 1996b, *Draft Ten Year Plan*, July 30.

Kaiser-Hill, 1996a, Hazard Categorization Analysis for Waste Management Facility, January.

5.1 Description of Facility
5.2 Waste Charact. & Concept. WAC
waste WAC
5.3 Technical & Administ. Controls
Eng
Facility
Oprnl
Admin.
5.4 Nepa
5.5 RW Shmm
Facil. Opr.

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Jennifer's Comments

5.0 SCREENING OF ALTERNATIVES

A two-phase decision-making process was developed for screening and selecting remediation waste management storage alternatives that support the best remediation waste management strategy for the Site. The first phase evaluated different onsite locations and the second phase evaluated conceptual storage design alternatives. The onsite location selected was then coupled with the conceptual storage design alternative for inclusion in the Final Comparison of Alternatives. (See Figure 5.1, Decision Process for Remediation Waste Management).

5.1 PHASE 1 - ONSITE REMEDIATION WASTE STORAGE FACILITY SITING STUDY

The selection of a location for a RWSF at the Site is detailed in Appendix C, Onsite Remediation Waste Storage Facility Siting Study. The objective of Phase I was to evaluate and select an onsite location for a RWSF. The method used was as follows:

- Identify and rank criteria to be used for siting of an onsite RWSF location;
- Develop a methodology for a comparative analysis of different sites;
- Evaluate the criteria subjectively and assign a relative weighting factor to each criteria; and
- Recommend an onsite location based on the above criteria and methodology.

This process is described below.

1. Identify and rank criteria to be used for siting an onsite RWSF location. This criteria required, at a minimum, substantive requirements as discussed in Section 4, as well as general guidelines that had been discussed at various stakeholders meetings regarding a RWSF at the Site. The criteria were then organized into the six major categories summarized below, and further divided into specific issues within each of these major categories. Further details of the criteria are in Appendix D.

    - The ability to designate the RWSF as a Corrective Action Management Unit (CAMU): All CAMU criteria were evaluated, but the deciding criteria was the ability to facilitate the implementability of reliable, effective, protective, and cost-effective remedies, and to not include uncontaminated areas of the Site in the footprint of the RWSF.

    - The ability to ensure the protection of the public, per 6 CCR 1007-2 Part 2, Requirements for Siting of a Hazardous Waste Disposal Site: Although the RWSF is a storage facility, these criteria which relate to long-term disposal were used to

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evaluate locations for storage as an additional degree of protectiveness. There are 12 separate associated criteria under this requirement; a summary of these criteria is as follows:

- Geological and hydrogeological conditions of a site in which hazardous waste is to be disposed shall be such that reasonable assurance is provided that the wastes are isolated within the disposal area and away from natural environmental pathways that could expose the public for 1,000 years;
- Structural-related issues including slope and geotechnical stability will be addressed;
- The immediate area of the site should be in a strata of minimal groundwater flow;
- Relative depth to bedrock and groundwater; and
- The evaluation of the relative distance to the nearest discharge area will include consideration of groundwater flow direction and travel time.

- The ability to support the RFCA. The Preamble to RFCA Section B.2 states: "Waste management activities for low-level, low-level mixed, hazardous, and solid wastes will include a combination of onsite treatment, storage in a retrievable and monitored manner, disposal, and offsite removal. Low-level and low-level mixed wastes generated during cleanup will be stored in a safe, monitored and retrievable manner for near-term shipment offsite, long-term storage with subsequent shipment offsite and/or long-term storage with subsequent disposal onsite of the remaining wastes."

- Cost criteria, including the cost of preconstruction activities, and the following:

  - Building demolition;
  - Subsurface utility line removal and rerouting;
  - Access requirements and power/facility requirements; and
  - The cost of engineering and construction of protective measures.

- Regulatory Support focused on using CDPHE guidelines (Looby, 1995) for onsite waste management of contaminated materials. Key points evaluated include the minimization of the number of disposal sites, consolidation of contaminated materials, and having a centralized site in an area with optimum geologic parameters preferably close to or within the Industrial Area with limited future land use.

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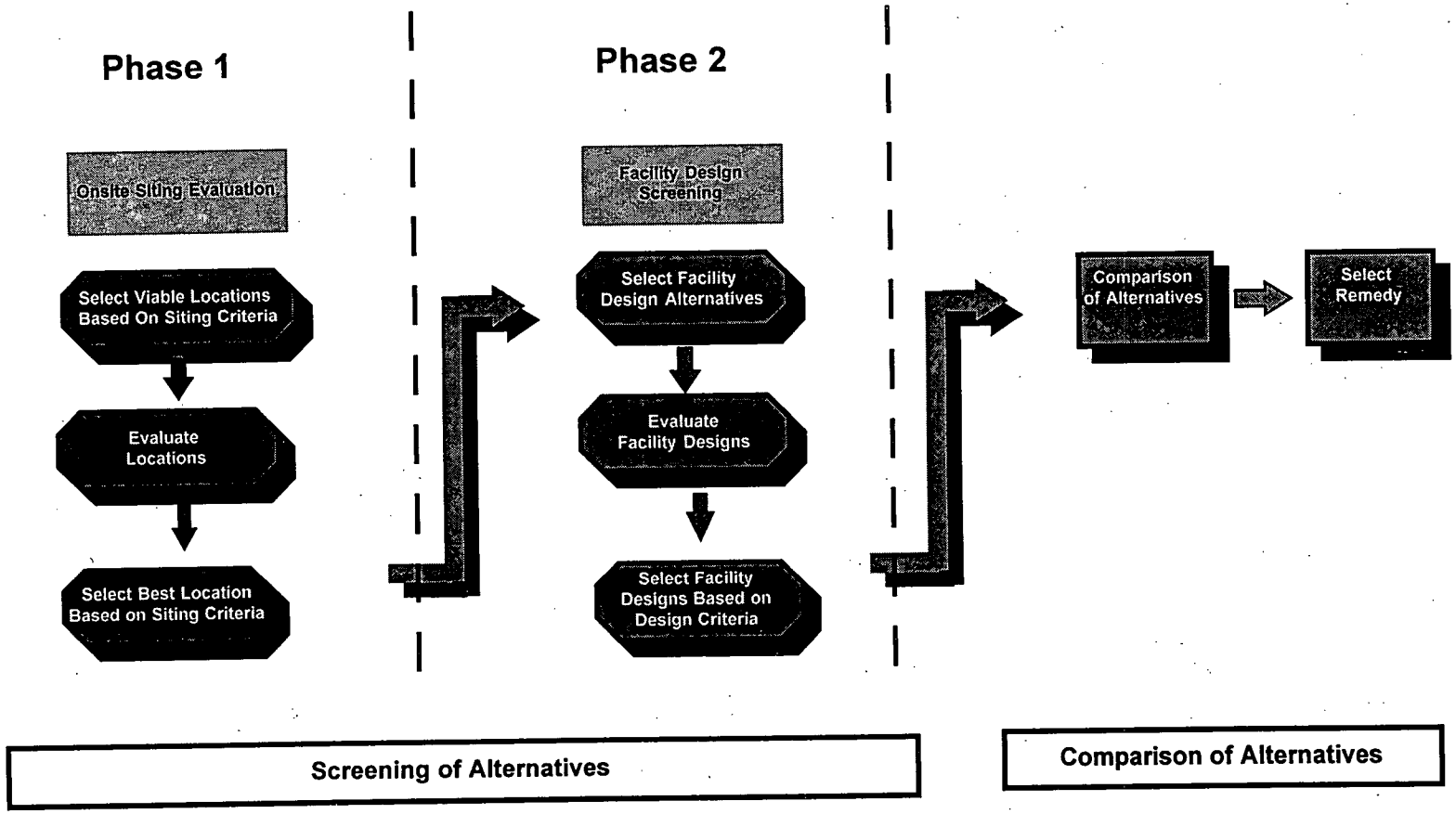
Figure 5-1 Decision Process For Remediation Waste Management



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- Other Stakeholder concerns include the general acceptance of the RWSF by the general public and the Municipal or County governments.

2. Develop a methodology for comparative analysis of the different sites: A basic assumption was that the entire Site, both within the buffer zone and the Industrial Area, would be included in the evaluation. A series of GIS (Geographical Information System) maps were produced to assist in this evaluation. These maps, which included key elements cited in the criteria, were evaluated for being beneficial or adverse to the siting of a RWSF.

   The initial evaluation of the sites reduced the number of potentially useable locations to seven, with four in the buffer zone and three in the Industrial Area.

   Potential Industrial Area sites identified were:

   - Industrial Area-West (IA-West), an area on the west side of the Industrial Area;
   - industrial Area-East (IA-East), an area on the east side of the Industrial Area; and
   - Solar Ponds, an area adjacent and east of the Solar Pond in the northeast section of the Industrial Area.

   The potential buffer zone sites identified were:

   - The New Sanitary Landfill (NSL);
   - An area encompassing the East Spray Fields (ESF);
   - An area in the southeast quadrant (SE Quad) of the buffer zone; and
   - An area in the southwest quadrant (SW Quad) of the buffer zone.

3. Evaluate the criteria subjectively and assign a relative weighting factor to each of the criteria: For a more detailed description of the methodology see Appendix C, Section C.2.2, Methodology.

   The methodology that was applied began by developing a relative weighting factor (%) based subjectively on the importance of each of the six categories of criteria as shown under Table 5.2 below.

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Next, the categories were divided into 38 specific issues. Each of the issues was subjectively assigned a value between 0 and 3, with a 3 being a more important issue, 1 being less important, and a 0 being a potential fatal flaw.

The next step was to develop a matrix using the 7 locations versus the 38 issues (see Appendix C, Table C-2). A score was assigned relative to the other sites and the criteria being evaluated. A score of 0 for any of the 38 issues would signify a fatal flaw and the site would be withdrawn from further consideration in the evaluation.

Table 5-2 Methodology Weighting Factors

Category	Criteria	Weighting Factor (%)	Number of Specific Issues	Total Number of Points Assigned
1	Corrective Action Management Unit (CAMU)	15	7	19
2	Public Protection (Geotechnical and Hydrological Criteria)	20	12	28
3	Site Special Issues	20	8	15
4	Cost Criteria	15	2	6
5	Regulatory Support	15	5	13
6	Other Stakeholder Concerns	15	4	9
	*** Total**	**100**	**38**	**90**

* A weighted average was arrived at for each of the categories and the values were summed.

4. Recommend an onsite location based on the above criteria and methodology: The location receiving the highest score was the recommended onsite location for a RWSF (see Appendix C, Section C.2.3, Table C-5). The location recommended for a RWSF is the area in the northeast corner of the Industrial Area adjacent and east of the Solar Ponds (see Figure 5-2).

5.2 PHASE 2 - SCREENING OF ONSITE DESIGN OPTIONS

The objective of Phase 2 was to select and evaluate different design options for an onsite RWSF. A list of innovative RWSF designs was developed. This list was compiled from literature and input from the Citizen's Advisory Board (CAB), current Site practices, and designs in use at other facilities in the United States and Europe. These design options are either actual facilities in use or under consideration elsewhere (see Appendix E, Remediation Waste Storage Facility Design Alternatives).

The following design options were proposed for the screening process:

- Pyramid Design - Bulk waste is enclosed in a rectangular pyramid constructed out of granite blocks; design proposed at a meeting of the CAB by a member of the public;

- Metal Buildings - Waste is enclosed in cargo containers placed inside engineered metal buildings on concrete slabs; this is RFETS' current practice to store LLW;

- Slab on Grade - Waste is stored in cargo containers placed on an abovegrade concrete slab; This is current practice at some DOE/DOD sites;

- Hardened Concrete Vault - Waste in cargo containers is placed in an abovegrade freestanding concrete structure with liners and a leachate collection system; this is a current practice at the DOE Savannah River Site for LLW & LLMW;

- Abovegrade Concrete Lined Cell with bulk placement - Bulk waste is placed in modules in concrete lined cell. Under the cell is a liner and a leachate collection system;

- Abovegrade Concrete Lined Cell in Cargo Containers - Waste in cargo containers is placed in modules in concrete lined cell. Under the cell is a liner and a leachate collection system;

- Abovegrade Storage Cell - Earthen structure similar to a RCRA cell except facility would be constructed Abovegrade with berms and a liner/leachate collection system; design as proposed is similar to current practice around the nation to meet RCRA-Subtitle C, requirements;

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- Silo Design - Bulk waste would be place in concrete cylinders which sit on top of a concrete pad. Under the pad is a liner/leachate collection system; this design was proposed in an interim report by the Idaho National Engineering Laboratory (INEL) (EG&G, 1994);

- Entombment - Waste would be placed in 55 gallon drums and then sealed with grout in concrete boxes which would be stored in a hardened concrete vault. This design was proposed in an interim report by the INEL (EG&G, 1994);

- Waste Pile - Bulk waste is compacted into a rectangular pile with all sides covered with a geomembrane. A liner system would be place under the pile. This design is based on the Interim Remedial Action for Basin F, Rocky Mountain Arsenal

- No Action (i.e., no CAMU designated Remediation Waste Storage Facility) - Remediation waste would have to be treated and shipped to an offsite disposal facility as soon as it is recovered. This alternative was included as required by CERCLA and NEPA.

The initial conceptual design screen, summarized in Table 5-3, which used the same criteria as the Siting Study, narrows the 11 design alternatives to four final design alternatives. Table 5-4 is a comparison of the 11 design alternatives with respect to cost.

~~Based on this alternative analysis four final design alternatives were selected~~ they include:

As a summary by design alternative, the following results explain the rationale of screening each alternative for the selection of the final four design alternatives.

Above Ground Conc. Lined Cell

The Abovegrade Concrete Lined Cell is similar to RCRA Subtitle "C" landfills except that the facility would be built at grade. This facility also incorporates the concept of long-term waste management with protection to the public and the environment by constructing a double liner system with a leachate collection system. The total footprint of this facility is larger than the other options because of the side berms required for construction of the cell. This feature makes the cost higher than the Concrete Lined Cell bulk storage option. Retrievability is more difficult than a concrete lined cell or options utilizing containers. This design was selected because it is a known, proven design that meets RFCA requirements, provides the necessary protection, and is one of the less costly designs evaluated.

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The Abovegrade Concrete Lined Cell with bulk placement combines features of several alternatives. As a long-term RWSF it provides protection to the public and the environment because of the RCRA double liner system and a leachate collection system that allows for early detection of leaks. This facility would consist of a concrete lined cell with integral walls to separate the remedial waste, which would segregate the waste and provide for retrievability. The waste could be managed in both bulk and containerized forms. The cost for this option was the most reasonable compared to all other options because it offered flexibility

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in waste handling, had a smaller facility footprint, and still offered the necessary protectiveness. The modular design further enhances flexibility as well as enhances waste segregation and retrieval abilities. This design was selected because it meets the substantive criteria, provides the necessary protection and is cost effective.

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Table 5-3 Summary of Facility Design Screen

Facility Design	CAMU Criteria	Public Protection (Geotechnical and Hydrological Criteria)
Pyramid Design	Not effective because of schedule concerns for expediting cleanup and higher costs. Hard to monitor. Reliability is not proven.	Structure could experience differential settlement and breach the barrier. Rigid structure not as elastic as other alternatives.
Silo Design	Minimizes land area by consolidation of waste to one location.	Design provides barriers and leachate collection to protect groundwater and surface water.
Metal Buildings	Intended as a short-term storage option with periodic maintenance. Costs are high due to bulk containers. Large area footprint because of number of buildings required.	Short-term storage. For up to 30 years it would provide adequate protection to environment. Protective barrier is the building shell and containers.
Slab on Grade	This alternative is a short-term storage option. Waste would be more exposed. Land area would be minimized. Retrieval would be more difficult.	Exposes containers to the weather elements, has a greater risk of releases to surface water or groundwater. No barriers.
Hardened Concrete Vault	Not cost-effective because of storage containers and rigid structure. Good retrievability with a larger footprint because of accessible aisles.	Provides multiple barriers to limit release of contaminants with a leachate collection system. Enclosed concrete structure and containers provide additional protection.
Abovegrade Concrete Lined Cell with Bulk Placement	A good mix of cost-effectiveness and protectiveness. Supports expediting cleanup activities because of modular design with integral separation walls for retrievability.	Provides numerous barriers to limit release of contaminants with a leachate collection system.
Abovegrade Concrete Lined Cell In Cargo Containers	Good retrievability but higher costs than Concrete Lined Cell because of waste containers.	Provides numerous barriers to limit release of contaminants with a leachate collection system. Containers provide additional protection.
Abovegrade Storage Cell	Provides good support for remedial activities, minimizes risk of future releases.	Liners and leachate collection system provides reliability, and protection to groundwater.
Waste Pile	Retrieval is difficult, similar to Abovegrade Storage Cell.	Short term Storage. No protective barriers or leachate collection.
Entombment	Good protection to environment and public. Larger footprint because of smaller containers for storage of wastes.	Provides additional barriers other than the multiple liners and leachate detection (i.e., concrete canisters and drums).
No Action	Individual remedial actions will require handling the waste separately by storing with ultimate offsite disposal.	Individual remedial actions will require handling the waste separately by storing with ultimate offsite disposal.

Table 5-3 (continued)

Facility Design	Site Special Issues	Cost Criteria
Pyramid Design	Does not provide an expeditious construction schedule because of logistics in acquiring the granite blocks. Does not support Site Vision.	This design fell in the middle of the range for total life-cycle costs.
Silo Design	Supports Site Vision and RFCA, relatively small footprint.	Cost-effective, third lowest total life-cycle cost due to small footprint .
Metal Buildings	Large footprint because of multiple facilities. Simple design allows quick construction.	Total cost is high due to cost of containers and multiple buildings.
Slab on Grade	Simple design allows quick construction. A short-term storage solution.	Total cost is high due to cost of containers.
Hardened Concrete Vault	Meets this criteria better than most designs, smaller footprint reduces impacts.	This option fell in the upper end of the cost range because of containers and free- standing rigid structure.
Abovegrade Concrete Lined Cell with Bulk Placement	Supports Site Vision and RFCA, small footprint, less impact to other Site programs. Flexible, modular type facility.	Low construction, site preparation, and closure costs yielded the second lowest total life-cycle cost of any of the designs.
Concrete Lined Cell In Cargo Containers	Supports Site Vision and RFCA, less impact to other projects.	This option fell in the middle of the cost range because of the cost of containers.
Abovegrade Storage Cell	Large footprint could cause additional impacts, supports Site Vision and RFCA.	Low total life-cycle cost in spite of high construction costs.
Waste Pile	Short term solution, consolidates wastes to one location, small footprint. Does not support RFCA or necessary requirements	The lowest life cycle costs due to a lack of protective features.
Entombment	The largest footprint of all alternatives. Construction would be very time- consuming and costly.	The most expensive design, highest life-cycle costs because of the double containment (drums and concrete bins).
No Action	Requires offsite disposal which could delay shipments and increase interim storage.	Total life-cycle costs were in the high end of the range because the offsite disposal cost.

Table 5-3 (continued)

Facility Design	Regulatory Support	Other Stakeholder Concerns
Pyramid Design	Design is not state of the art. No barrier systems or leachate detection other than the solid granite walls.	Questionable design/technology. Availability of materials in a timely fashion is uncertain.
Silo Design	Limited flexibility for future uses. Consolidation of waste in one footprint.	Design is not widely used. Protects environment and public. Retrieval would be more difficult.
Metal Buildings	Large footprint, , Poor consolidation of wastes since multiple buildings are required	Excellent retrievability. Proven technology and easy to implement quickly.
Slab on Grade	Small footprint for consolidation of wastes. Not a state of the art facility.	Excellent retrievability. Provides only minimal barriers for protection of environment. Proven technology and easy to implement quickly.
Hardened Concrete Vault	Long-term waste management. Protects environment and public.	Waste is retrievable, but not as retrievable as other designs. Proven technology but it would take more time and effort to construct.
Abovegrade Concrete Lined Cell with Bulk Placement	Long-term waste management that consolidates waste into modular/flexible facility.	Provides good protection to the environment and public health. Good retrievability because of integral dividing walls.
Concrete Lined Cell In Cargo Containers	Long-term waste management that provides good protection to public and environment. Retrievability is a little better because of accessibility to containers.	Provides good protection to the environment and public. Waste is more retrievable because of containerization.
Abovegrade Storage Cell	Provides good protection to the public and environment. Consolidates wastes into one location.	Proven technology because of past performance. Retrievability is achievable but fair because waste is in bulk quantities.
Waste Pile	Short-term solution. Provides good protection to public and environment. Not designed to meet RCRA considerations.	Retrievability is achievable but much more difficult than other designs due to a lack of segregation.
Entombment	Provides enhanced protection to the public and environment by the additional containers. Footprint is enlarged because of unusable/wasted space.	Retrievability is good because waste is segregated in concrete bins and drums. Longer construction schedule because of the complexity and number of drums to handle.
No Action	Increased interim storage until the individual remedial actions can ship waste offsite.	Requires offsite disposal. It would require interim storage and would delay some cleanup activities.

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Table 5-4 Comparison of Design Alternative Costs (Cost in thousands of dollars)

Alternative	Abovegrade Waste Cell	Pyramid	Concrete Lined Cell Bulk Placement	Concrete Lined Cell w/Containers	Hardened Concrete Vault
Total Life-Cycle Cost [1]	$118,800	$140,300	$77,320	$165,650	$181,630
Cost of Construction					
Design	$2,200	$2,200	$1,600	$1,600	$2,200
Pre-Construction	$400	$400	$150	$150	$400
Construction	$41,700	$57,900	$18,600	$18,600	$26,000
Total Cost of Construction	$44,300	$60,500	$20,350	$20,350	$28,600
Cost of Site Preparation	$8,800	$14,500	$1,970	$1,970	$6,100
Cost of Closure					
Interim Cap	$5,300	N/A	$5,300	$5,300	$5,300
Interim Closure Care & Monitoring	$13,900	$13,900	$13,000	$10,400	$10,400
Total Cost of Closure	$19,200	$13,900	$18,300	$15,700	$15,700

Table 5-4 (cont.) Comparison of Design Alternative Costs (Cost in thousands of dollars

Alternative	Silo Design	Slab on Grade	Metal Buildings	Entombment	Waste Pile	No Action
Total Life-Cycle Cost [1]	$107,300	$141,600	$161,400	$525,000	$36,669	$215,900
Cost of Construction						
Design	$2,000	$300	$2,300	N/A [2]	N/A [2]	N/A [2]
Pre-Construction	$400	$200	$1,300	N/A [2]	N/A [2]	N/A [2]
Construction	$30,400	$3,800	$17,900	N/A [2]	N/A [2]	N/A [2]
Total Cost of Const.	$32,800	$4,300	$21,500	N/A [2]	N/A [2]	N/A [2]
Cost of Site Preparation	$6,100	$6,100	$2,800	N/A [2]	N/A [2]	N/A [2]
Cost of Closure						
Interim Cap	$5,300	N/A	N/A	N/A [2]	N/A [2]	N/A [2]
Interim Closure Care & Monitoring	$13,900	$8,500	$10,400	N/A [2]	N/A [2]	N/A [2]
Total Cost of Closure	$19,200	$8,500	$10,400	N/A [2]	N/A [2]	N/A [2]

Footnotes:
1. Total life-cycle costs also include costs for containers, permitting, operations, contingency, etc. More detailed estimates are presented in Appendix E.
2. Costs for these alternatives were not broken down because of the following:
   - The Entombment costs were based on a projected total cost that did not address specific costs.
   - The Waste Pile costs were based on actual costs from Rocky Mountain Arsenal Cleanup in Colorado
   - These costs were not applicable for The No Action alternative.

The Abovegrade Concrete Lined Cell in cargo containers is similar to the aforementioned Concrete Lined Cell with bulk placement except that all remedial waste would be stored in cargo containers rather than bulk. A slightly higher degree of protection for the public and the environment is met because the containers act as an additional barrier. The retrievability is enhanced because of the containers, however, the cost is significantly higher than bulk placement. The design was screened out because the ability to put the waste in containers could not justify the additional cost.

The Hardened Concrete Vault alternative is a free standing, totally enclosed concrete structure intended for long-term waste management. Remedial waste would be stored in cargo containers which would be considered a fairly good retrievable option with built in aisles. Protection to the public and the environment is good because of the RCRA double liner system and leachate collection. The cost is high relative to other designs because of the cost of containers and free-standing rigid structure. The ability to monitor the facility is good because of the leachate detection system. This design was not considered as viable as other designs because of its high relative cost and the time and effort it would take to design and construct such a facility would impact remedial activities.

The Silo Design incorporates the concept of long-term waste management by storing remediation wastes in totally enclosed 5,000 cy concrete silos. As in some of the other alternatives, this facility would incorporate a double liner barrier with a leachate detection system. An extra level of protection for the environment and the public is provided because of the concrete silos. The remediation waste is retrievable because of the multiple silos, and the cost is lower than most of the other designs. This design was eliminated because the ability to retrieve waste is not as good as most of the other designs and it offered about the same level of protectiveness as the concrete lined cell but still would cost more.
Slab on Grade is similar to the Metal Buildings alternative from the standpoint of becoming a short-term (i.e., 25-30 yrs.) waste management option. The remedial waste would be placed in stored cargo containers which are stacked on a slab on grade. The slab on grade is open to the environment and would not have any protective liners or barriers underneath. Liners were not deemed necessary because the cargo containers could be inspected and leakage could be detected early on. It is possible to add a liner but the costs would increase. This option would have a high degree of retrievability because of the accessibility to cargo containers. Again, the maximum life cycle of this alternative is approximately 25 to 30 years before the remedial waste was redispositioned. The cost for this option was high because of the additional cost for containers. The alternative was screened out because it could not offer the protectiveness of other designs and yet was more expensive.

Metal Buildings were more expensive than other alternatives because of the cargo containers and the number of buildings. This alternative has no liner system for protection of the environment other than the containers and the building structure which provides adequate

protection for the life of the facility (25 to 30 years). A liner system was not needed because the containers could be inspected for leaks. A liner system could be added but would increase the total cost of the facility. Although this design supports the intended cycle of the 10 Year Plan, the protectiveness of this design is less than the concrete-lined cell designs and the economies of scale achieved through bulk storage are absent. The facility footprint would be larger than other options because of the required large central corridor for routine access and monitoring. The retrievability of this option is good because of the accessibility to cargo containers. This alternative was not screened out because it is an established design and offers good retrieval and inspection capabilities.

The Entombment alternative protects the public and the environment because of the multiple barrier systems. Again, this facility would incorporate a double liner system with a leachate detection system. This design option stores remediation waste into 55-gal drums which are then stacked as a cluster of eight in concrete bins. The enclosed concrete bins are then stacked within the cell liner. Because of the multiple container/barrier system, the cost for this alternative is the most expensive. The footprint for this facility is larger because of the wasted space within each concrete bin. The retrievability is good for this alternative as well. This alternative was screened out because its cost, large footprint, and the additional time and effort to construct the facility could not be justified by its level of protectiveness.

The Pyramid Design was not as favorable as the other design alternatives because of several concerns. Schedule concerns for expediting the remedial actions would be dependent on acquiring the large volume of granite stone and construction. Monitoring and retrieving the remedial waste would be difficult in this structure due to accessibility. The downgradient wells would be the only indication of a contaminated plume. A liner system could be added to this design but would increase the total cost and the cost is already one of the highest of any of the alternatives examined.. The remedial waste is not segregated but is stored in a bulk capacity. The facility is a totally enclosed rigid structure and would require stringent design standards to prevent differential settlement which could crack mortar joints and ultimately breach the barrier. From this standpoint, long-term maintenance would be required. This alternative was screened out because of cost, concerns about settling, the availability of materials, and concerns about the facilities ability to contain and monitor the waste.

The Waste Pile alternative is a short-term waste management solution. The remediation waste is enclosed with a surrounding geomembrane . The facility footprint would generally be smaller than the other alternatives because the waste is stored as bulk. The retrievability is achievable but at a lesser degree and is measured similar to the Abovegrade Waste Cell. Logistics of daily operations would be difficult because the waste pile would be open to the environment. The protectiveness of this design is poor. The design does not support the active management of waste as envisioned in the 10 Year Plan nor does it meet the basic requirements for a CAMU described in RFCA. This alternative was screened out because of poor protectiveness, an inability to support cleanup operations and an inability to meet 6 CCR 1007-3 Part 264, Subpart N as required by RFCA.

The No Action Alternative is carried throughout the screening process because of the requirements of NEPA and CERCLA as a baseline. The No Action Alternative essentially means the remediation waste is prepared for offsite disposal and no CAMU designation is obtained . If the No Action Alternative was followed through, and no long-term onsite RWSF was planned for, then the individual remedial actions would have to handle their wastes at the time of generation. This would result in an early expenditure of funds to meet treatment, transportation, and disposal costs which would limit the funds available for actual cleanup activities in support of site closure.

The four selected alternatives that reached the final screening were as follows:

- Abovegrade Storage Cell;
- Abovegrade Concrete Lined Cell with bulk placement;
- Metal Buildings; and
- No Action Alternative.

Several factors affected the selection of these alternatives for the final comparison which are explained below.

The Abovegrade Storage Cell is similar to the standard hazardous waste landfill built to RCRA Subtitle "C" standards. This facility would be built above the existing grade to prevent groundwater infiltration. This design, as well as the Concrete Lined Cell are proven technology. As with the Concrete Lined Cell, the liners and leachate collection system provide the ability to detect leaks and recover contaminants prior to entering the environment. This facility offers flexibility, retrievability and still remains one of the least expensive over the long term. In addition, this design supports the RFCA in terms of design requirements, and supports the 10 Year Plan by providing the necessary flexibility.

The abovegrade Concrete Lined Cell with bulk placement (Concrete Lined Cell) was selected for the final comparison for several reasons. The concrete cell adds another layer of protectiveness to groundwater from the leachate generated during placement and storage operations. This design is flexible and allows for modular installation that will optimize the sizing of the cells and timing of the installation as waste is generated. This design will also expedite risk reduction activities under the Site Vision because of the flexibility. The first module will be sized for 25,000 to 33,000 cu yd of waste, and therefore, can be installed more quickly. Subsequent cells would be added as needed up to a total capacity of approximately 100,000 cu yd. A fair degree of retrievability is maintained because a combination of containers and bulk storage is utilized. This allows the flexibility to utilize the facility for either short-term or long-term storage.

X

The Metal Buildings alternative was selected for the final screening because it would allow for interim storage of the waste until the final disposition is determined. Storage of waste will allow remediation to proceed in a timely fashion. The waste would be stored in cargo containers and would be fully monitorable and recoverable. It was, therefore, believed that public perception and acceptance of this alternative would be high despite the higher cost and shorter useful life.

The No Action Alternative was selected for the final screening because it must be assessed to meet NEPA values and 10 CFR 1021.321(c) requirements.

The final design alternative comparison used the RFCA criteria, as discussed in Section 6, to select the best alternative.

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Jennifer's Comments

6.0 COMPARISON OF ALTERNATIVES

Based on the analysis presented in this decision document, bulk placement of the remediation waste in the Concrete Lined Cell at the Site east of the Solar Pond is the remedy selected for management of remediation waste. The abovegrade Concrete Lined Cell with Bulk Placement was selected from the four final alternatives screened in Section 5.0:

- Abovegrade Storage Cell;
- Abovegrade Concrete Lined Cell with bulk placement;
- Metal Buildings; and
- No Action Alternative.

These four design alternatives were compared using the seven RFCA criteria from Paragraph 109(a)(DOE, 1996a) to select the best Alternative for remediation waste management at the Site. The seven RFCA criteria are as follows:

1) Worker Safety;
2) Protection of Public Health and the Environment;
3) Transportation;
4) Facility Design, Containment and Monitoring;
5) Institutional Controls;
6) Cost; and
7) Community Acceptance.

Two other criteria have been included that address NEPA values:

- Short-Term Effectiveness; and
- Long-Term Effectiveness and Permanence.

A summary of the final comparison of Alternatives is given in Table 6-1. Statements concerning public acceptance serve as placeholders and will be modified based on public input as the review cycle progresses.

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CAMU designation

Table 6-1 Summary of the Final Alternative Comparison for Remediation a Waste Storage Facility

Final Design Alternative	~~RFCA Criteria~~ Worker Safety	Protection of Public Health and the Environment	Transportation	Facility Design, Containment and Monitoring	Institutional Controls
Abovegrade Storage Cell	Risks to workers are similar for all Alternatives considered. Spraying of water during construction will reduce exposure to dust. Location is in a low traffic area.	RCRA double liner system provides groundwater protection. Leakage would be detected in the liner system	Centralized location minimizes transportation requirements onsite. Design and location should have minimal impact on existing traffic patterns.	Liner system provides additional containment plus the ability to detect leaching. Air monitoring could be performed in conjunction with existing RFETS monitoring.	The RFCA ~~acts as an Institutional control~~ requires continued maintenance of the facility. Since the use of the facility is for short-term storage, controls beyond those inherent in RFCA are not necessary.
Concrete Lined Cell with Bulk Placement	Risks to workers is similar for all Alternatives considered. Spraying of water during construction will reduce exposure to dust. Location is in a low traffic area.	RCRA double liner system provides groundwater protection. Concrete walls and floor provide additional protection. Leakage can be detected and collected prior to reaching liner system.	Centralized location minimizes transportation requirements onsite. Design and location should have minimal impact on existing traffic patterns.	Leachate would be detected and collected in a cell collection system prior to reaching the subsurface liner. Air monitoring would be performed in conjunction with existing RFETS monitoring.	The RFCA acts as an Institutional control requiring continued maintenance of the facility. Since the use of the facility is for short-term storage, then controls beyond those inherent in RFCA are not necessary.
Metal Buildings	Risks to workers is similar for all Alternatives considered. Spraying of water during construction will reduce exposure to dust. Location is in a low traffic area.	Containerized waste and building reduces exposure to the worker and the public. Visual inspections allow leaks to be detected before release to the environment.	Centralized location minimizes transportation requirements onsite. Design and location should have minimal impact on existing traffic patterns.	No liner system would be present; however, waste would be in containers which would be more easily monitored visually. Air monitoring would be performed in conjunction with existing RFETS monitoring.	The RFCA acts as an Institutional control requiring continued maintenance of the facility. Since the use of the facility is for short-term storage, then controls beyond those inherent in RFCA are not necessary.
No Action Alternative	Some increased exposure could occur due to increased transportation requirements. Worker risk is similar to risk for storage Alternatives.	It is assumed that permitted offsite facilities are protective. Increased transportation risks will occur.	Upgrades to existing facilities could be needed to accommodate offsite shipments. Shipments would be transported through several major population centers by rail or truck .	Off-site facility would offer less containment in terms of design but more containment in terms of geologic setting. The off-site facility would have air and water monitoring capabilities.	Institutional controls would exist for offsite facilities.

Table 6-1 (continued)

Final Design Alternatives	Cost[1]	Community Acceptance	Short-Term Effectiveness	Long-Term Effectiveness and Permanence
Abovegrade Storage Cell	This Alternative has a high total cost of **$119M** and requires a large footprint for the total facility.	Monitoring and retrieving the waste is more difficult with this option.	Reduces waste handling requirements for accelerated actions and D&D projects. Focuses resources on risk reduction.	Provides sufficient permanence for an interim solution. Utilizes natural nondegradable materials in cap and liner design to support long-term use.
Concrete Lined Cell With Bulk Placement	This Alternative has a total life-cycle cost of **$77M**. The cost benefit outweighs other Alternatives and allows more resources to be applied to risk reduction rather than waste management. Option offers an ability to monitor and retrieve waste at a relatively low cost.	This Alternative offers monitoring and retrievability of the remediation waste but physical inspection is not to the degree that metal buildings would offer.	Reduces waste handling requirements for accelerated actions and D&D projects. Modular design allows for rapid construction. Focuses resources on risk reduction.	Provides sufficient permanence for an interim solution. Utilizes natural nondegradable materials in cap and liner design to support long-term use.
Metal Buildings	This Alternative has a life-cycle cost of **$161M.** The high cost is the result of the container costs.	This Alternative combines easy monitoring and retrievability with offsite disposal. Visual leak inspection is possible. Protectiveness is less than other onsite options.	Additional packaging requirements needed to containerized waste. Rapid construction will speed up availability of facility. Focuses resources on risk reduction.	Provides sufficient permanence for an interim solution The buildings themselves are not effective for the long-term due to high maintenance.
No Action Alternative	This Alternative has a life-cycle cost of **$216M**. This cost is driven by the cost for containers, waste treatment, and offsite disposal costs.	Waste would be sent offsite. Waste would be transported near population centers.	Readily available to support on going projects. Additional effort needed for packaging, transportation, and documentation requirements.	All offsite disposal facilities under consideration have been designed for long-term use.

1. Cost estimates, except the No Action Alternative, do not include offsite shipment and disposal which is deferred until closure of the RWSF.

Intro
The following section discusses

What about worker safety during handling of the material

Worker Safety - Each of the Alternatives poses risks to workers. All of the Alternatives will be labor intensive to implement but will not pose any unusual risks. Air monitoring, spraying to minimize dust, and the use of a daily cover will protect plant workers from airborne contaminants during construction and operations. Once constructed, the onsite Alternatives will pose minimal risk to RFETS' workers because engineered barriers will contain the remediation waste. In addition, the selected site is in an area of minimal traffic. Worker safety for the no-action Alternative at offsite location was not evaluated but was assumed to be comparable to the onsite Alternatives.

Protection of Human Health and the Environment - In terms of design, the Concrete-Lined Cell with bulk placement has the most protective design elements. A significant advantage is the leachate collection system in the concrete floor of the cell. Unlike the above-grade storage cell, contaminants could be detected and captured within the cell. In the above-grade storage cell design, the contaminants would be captured in the first or second layer of liners. The metal building Alternative could also contain the leakage in the structure of the facility, itself; however, once the leakage is out of the buildings, contaminants would escape into the environment since there is not a liner system. In contrast, the Concrete Lined Cell has a double liner system.

Acc. to RFCA they all should have liners

The no-action Alternative would immediately have to rely on an offsite facility to provide protection. A permitted offsite disposal facility is assumed to afford adequate protectiveness once the waste is placed. Additional risk to human health and the environment would occur as a result of increased handling requirements and transportation. In addition, substantially more treatment, handling, transportation, and disposal costs would be incurred for each IHSS or cleanup action. These additional costs would limit the amount of risk reduction per dollar that could be accomplished. This, in turn, would result in more contaminant sources remaining exposed in the environment and could actually increase the risk to human health and the environment.

Not! ~~according~~ it would extend the time frame

All of the Alternatives offer protection from erosion. Likewise, there is little difference among the Alternatives in terms of biological impacts since these impacts are expected to be minimal.

Transportation - The central location of the RWSF will minimize onsite transportation of remediation waste. In addition, the location is in a low traffic area. However, eventual shipment offsite will require additional transportation either by truck or by rail. Offsite shipments would pass through at least two major population centers; there is only one facility currently available to accept low-level and mixed low-level wastes and that would probably be utilized and the routes to this facility are limited. It is possible that under the three onsite storage alternatives that remediation waste could be shipped to Alternative offsite facilities thereby reducing transportation risks. For all of the alternatives, upgrades to RFETS shipping and transportation facilities would be necessary.

will

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What about the facility design? CLC most robust more permanent more difficult to construct

Facility Design, Containment and Monitoring - All of the onsite Alternatives have engineered features to provide additional containment and monitoring. The Concrete Lined Cell with bulk placement has the best physical containment because both the cells and the liners have a leachate collection system. The metal building Alternative offers the ability to visually monitor the waste, plus the waste would be in containers and easily retrieved for shipment. The Abovegrade Storage Cell does not offer the same degree of monitoring or containment as the two other onsite options.

Institutional Controls - The selected location in the Solar Ponds Area combined with the RFCA acts as an institutional control since the DOE must comply with paragraph 278 of the RFCA which would require continued maintenance of a containment system in the event that the property is leased or the title is conveyed to another party. Because the RWSF will only be operational as long as operations are continued in the Industrial area, additional institutional controls beyond the existing controls are deemed not necessary. For the no-action Alternative, institutional controls of some form would likely exist; however, DOE and CDPHE involvement in those controls could be minimal.

Cost - Based on near-term costs, the concrete-lined cell was the least expensive ($77,300,000). The no-action Alternative was more expensive ($215,900,000) than the other Alternatives specifically because of the cost of treatment and disposal. This cost is likely to be deferred for the other Alternatives until the waste material is removed from storage. The Abovegrade Storage Cell was more expensive ($118,800,000) than the concrete-lined cell because its footprint was bigger which would require more site preparation and fill material. The cost of the metal buildings ($161,400,000) is also greater than the cost of the concrete-lined cell because of the cost to purchase containers and, again, because of the additional costs incurred by having a larger footprint.

The costs for each Alternative are listed in Table 6-1. A more complete breakdown of costs are in the Alternative descriptions in Appendix E and in the backup for the facility design screen in Appendix F. None of the cost estimates included offsite disposal which was assumed to be deferred until the waste would be removed from storage.

Community Acceptance - The no-action Alternative would best meet the desires of some segments of the local community since this Alternative would remove the waste from the area the earliest; however, other segments of the community might desire storage to allow more time to develop offsite options for transportation, treatment or disposal. The local communities desire to remove the waste must be balanced with the desires of more distant communities that are near waste disposal sites or are on the highways or railways over which the waste must be transported. Because only temporary storage of the waste is being proposed, ultimately there must be some community impact with any of the options. Of the three onsite options, the metal buildings would likely be the most acceptable option to the public since this Alternative offers the ability to inspect the waste in containers and to easily retrieve the containers for offsite shipment. Furthermore, since metal buildings have a limited useful life,

the community might find this a more acceptable Alternative since it would have a limited ability to provide long-term storage. All of the alternatives have the ability to monitor and retrieve the stored waste.

Short-Term Effectiveness - Because only temporary storage is being considered, the relative importance of the criterion is elevated. Particular emphasis needs to be placed on supporting an accelerated cleanup of RFETS as described by the TYP and the RFCA. One of the main advantages of the onsite alternatives is the ability to defer the cost of offsite disposal. Use of the RWSF would allow the immediate cleanup of high risk IHSSs as well as the D&D of more buildings in a shorter time frame. ~~The RWSF could also impact the plant mortgage by allowing more mortgage reduction activities to occur and thereby reducing the mortgage sooner.~~ D&D removal & IHSS do not help mortgage reduction signif.

The other issue of short-term effectiveness is logistics. Until a facility is available to handle large volumes of remediation waste, short-term effectiveness at RFETS is limited. Once the RWSF is built, dealing with the remediation waste would be easier than shipment to an offsite facility because packaging, sampling, documentation, and transportation issues would be much easier to address. An Abovegrade Storage Cell and the Concrete Lined Cell would allow bulk waste to be placed in the facility without additional containerization, and onsite transportation requirements would be minimal.

Because of convenience and initial cost, the Abovegrade Storage Cell and the Concrete-Lined Cell would best support the implementation of D&D and Environmental Restoration actions. The metal building Alternative would require some additional packaging effort and the no-action Alternative would require additional preliminary efforts to both package and transport the waste; however; all of the alternatives would require these actions for eventual offsite shipment.

Long-Term Effectiveness and Permanence - Since at the closure of the RWSF, all of the waste is going offsite for disposal, ultimately, the long-term ability of any Alternative is dependent on the offsite disposal facility selected. However, the relative permanence and long-term effectiveness of the selected Alternative is important because they are generally indicative of the facilities protectiveness. Also, permanence allows the flexibility for long-term storage should there be a need.

Of the four alternatives, the Concrete-Lined Cell with bulk waste placement would have the greatest degree of long-term effectiveness and permanence based on the extra protection offered by the 12-inch thick concrete walls and 18-inch thick floor. The internal concrete structure adds both an additional barrier to leakage as well as internal structural support for the facility.

The no-action Alternative and the Abovegrade Storage Cell also offer good long-term effectiveness and permanence. The Abovegrade Storage Cell offers about the same degree

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of permanence as the concrete-lined cell because it would utilize a similar liner system and a contoured, impervious interim cap. However, the Abovegrade Storage Cell would not have the additional protection of the concrete infrastructure of the concrete-lined cell. The metal building Alternative offers the least amount of long-term effectiveness and permanence. Since the facility is only intended for temporary storage this translates into only limited flexibility.

The Concrete-Lined Cell was selected because of the following criteria:

- It is protective of the environment and human health. The engineered features provide additional protection that the other alternatives do not have such as a multiple layer interim cap and an 18-inch concrete floor with its own leachate collection system.

- It provides more flexibility in storage options since it can accommodate either bulk storage or containers. It offers the retrievability needed for short-term storage combined with the protectiveness of a more permanent facility.

- It best supports environmental restoration and D&D activities since bulk waste could go from treatment or excavation right into the facility. The circumvention of the transportation requirements and packaging requirements would allow these activities to become more efficient and cost-effective. In the near-term, it costs less than the no-action Alternative and, therefore, which frees up funding for additional mortgage reduction activities and accelerated environmental actions. It is the least costly of the onsite alternatives.

- This facility would be installed in a modular fashion so that additional cells could be built adjacent to the original cell if needed. The use of modules would allow for some modules to be filled while others are constructed. This creates flexibility for future waste management decisions while not committing funds until necessary. This modular design conforms well to the 10 Year Plan and the RFCA as well as plans for the future use of the Site.

Jennifer's Copy

What is this?

7.0 SELECTED REMEDY

7.1

7.1 REMEDY DESCRIPTION

This section describes the selected alternative. ~~and~~

This section describes the conceptual design of the selected alternative and gives more detail of how the alternative meets the objectives of the IM/IRA, the RFCA, and CAMU criteria. The basis for the decision to select the specific alternative is described in Section 7.2, with a discussion of how the selected alternative meets the objectives of this IM/IRA that were outlined in Section 1. A Risk Evaluation is provided in Section 7.3 which discusses studies that were performed to provide assurance that the RWSF will meet the siting criteria, design requirements, and monitoring requirements included in RFCA and in the CAMU rule. Section 7.4 discusses technical and administrative controls for the CAMU that will meet the requirements identified in RFCA paragraph 80. Discussion of how NEPA values were addressed throughout the document is included in Section 7.5. Conceptual waste acceptance criteria (WAC) are described in Section 7.6. Section 7.7 discusses operational controls and plans that will control the activities and waste operations of the RWSF.

what criteria DOE, Part II?

The selected alternative, the Concrete Lined Cell, will consist of a series of modular cells, each sized for approximately 33,000 cu yd of waste and having a total capacity of up to 100,000 cu yd, as appropriate, to meet storage needs. The concrete-lined cell will be located immediately east of the Solar Ponds in the northeast quadrant of the Protected Area. (See Figure 7-1). This facility would be placed abovegrade with the lowest point of the leak detection system also being abovegrade. The RWSF will be designed with a double composite liner system with modular concrete cells. (See Figures 7-2 and 7-3.) An impervious interim cover will isolate wastes from infiltration and erosion. An example of a type of impervious interim cover is included in Figure 7-3. The liner will comply with RCRA Subtitle "C" requirements as defined in 6 CCR 1007-3, Part 264. For the purpose of costing, the conceptual design currently incorporates the following features:

- self-supporting reinforced concrete structure;
- facility size will be 500 ft long by 360 ft wide and 14 ft deep (approximately 4.13 acres);
- the facility will consist of up to three modules, each 500 ft long by 120 ft wide further sectioned/divided into compartments for waste segregation by bulk or cargo containers;
- a reinforced concrete slab with cast-in-place drain channels and sumps to collect leachate;
- external and internal reinforced concrete walls with integral waterstops;
- a composite double liner and leachate detection/collection system;
- an operational cover to enclose the cell/module during operations for fugitive dust controls and to reduce the generation of leachate;
- an impermeable interim cover system which would slope at a 3% grade; and
- five monitoring wells for groundwater monitoring.

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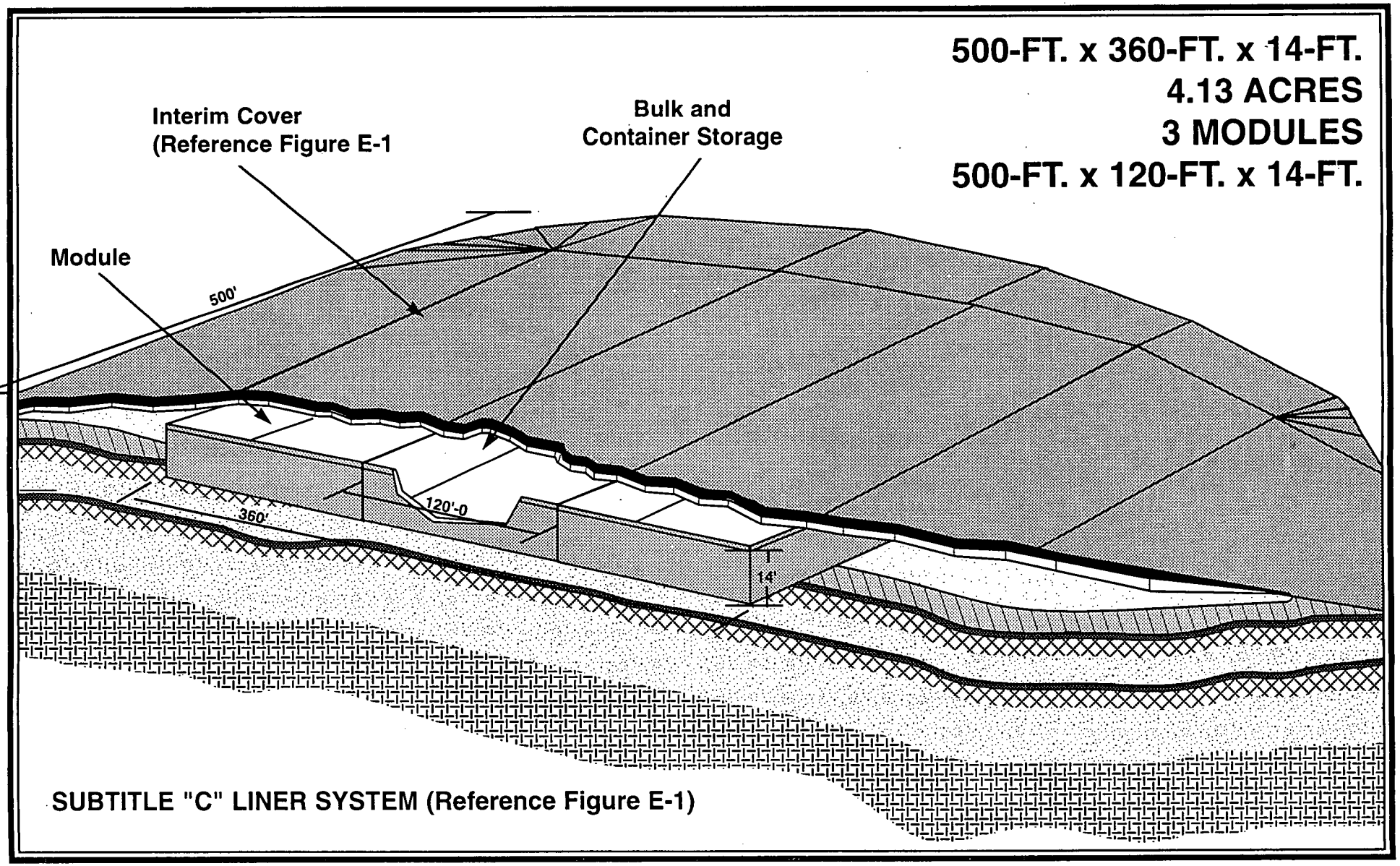

Figure 7-2

CONCRETE-LINED CELL WITH BULK WASTE PLACEMENT

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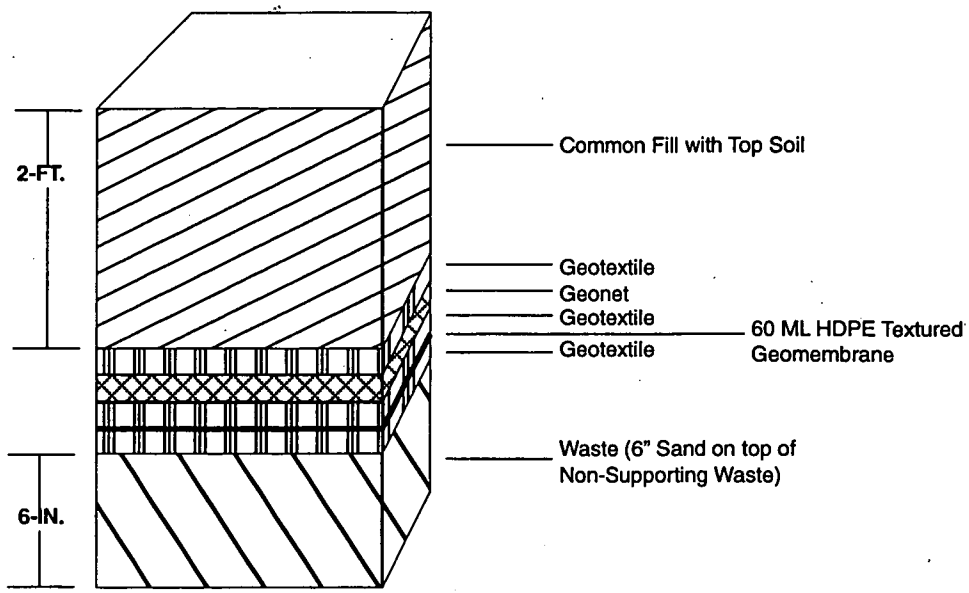
INTERIM CELL COVER



CELL LINER

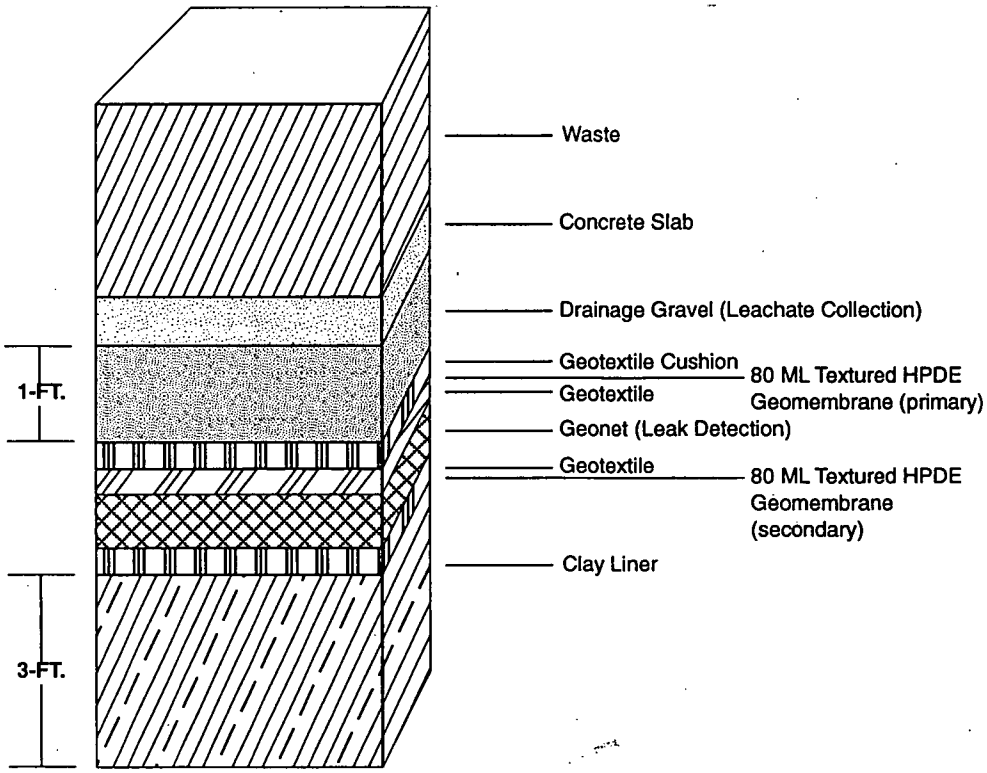


Figure 7-3

ON-SITE FACILITY CROSS SECTION

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The leachate transfer and storage system would be provided to manage leachate that is collected in the RWSF. Leachate will be transferred from the RWSF to a treatment system, as necessary.

Groundwater monitoring will be done in accordance with all applicable rules and regulations, including, but not limited to, CAMU requirements in 6 CCR 1007-3, Section 264, Subpart S and applicable requirements in 6 CCR 1007-3, Subpart F. A groundwater monitoring plan will be prepared in accordance with 6 CCR 1007-3, Subpart F.

During operations, an operational enclosure sprung structure will cover the cell/module to minimize fugitive dust and reduce the infiltration and generation of leachate until the interim cover has been established. Waste will be placed in the facility in bulk or in containers. Additionally, this facility will allow for the options of placing waste in cargo containers or segregating wastes.

Once a module/cell has reached capacity with remediation wastes, an interim cover will be constructed and the temporary sprung structure will be removed. The interim cover will be approximately two feet thick and consist of vegetative cover, drainage layer, and an impervious geosynthetic membrane (e.g., HDPE). The cover will be sloped 3% - 5% to promote drainage.

7.2 DECISION BASIS

A concrete-lined cell in the Solar Ponds Area was selected and justified based on the screening criteria and the final comparison criteria presented in Sections 5 and 6 of this Decision Document. To further support that selection, Section 7.2.1 is an evaluation of the selected remedy in terms of the original objectives of this document as presented in Section 1.0. In order to demonstrate compliance to RFCA, Section 7.2.2 demonstrates how the criteria in paragraphs 80 and 109a of RFCA were considered in the analysis of alternatives and, specifically, how the selected remedy addresses these criteria. Finally, in Section 7.2.3, the basic benefits of the selected remedy are stated to summarize the decision basis.

No it doesn't

7.2.1 Objectives

As stated in Section 1.1.1, there are four main objectives of this IM/IRA. The selected remedy meets those objectives in the following manner:

1) In support of the RFCA and the TYP, the management of low-level, low-level mixed and hazardous remediation waste must ensure the safety of the public, RFETS workers, and the environment through reliable, effective, protective, and cost-effective management of remediation wastes at the RFETS.

4/4/6

The selected remedy addresses this objective through the following safety features:

- all work including construction, filling operations, handling, and transportation will be done under an approved health and safety plan (HASP);
- the remediation waste that would be placed in this facility will generally have very low levels of radionuclides;
- work will be performed under the oversight of industrial hygienists, occupational safety professionals, and radiological engineers;
- workers will be required to undergo extensive training based on the specific hazards of their job;
- a wide range of dust suppression measures will be taken during construction, transportation, handling, and filling operations to ensure that fugitive emissions of vapors or particulates are not generated. Dust control activities during handling, transportation, construction, and placement could include an operational cover, dust suppresion sprays, high wind shutdowns, or other precautions.
- various types of monitoring would be performed to ensure not only the safety of the public and Site workers but also protection of the environment. This would potentially include air monitoring for particulates and contaminants, radiological monitoring, ground water monitoring, and surface water monitoring; and
- once a module or cell is filled, an interim protective cover would be placed over it.

The facility, itself, has numerous design features added to ensure protection of human health and the environment. Some of these protective measure are as follows:

- Leakage will be detectable within the facility, therefore, leachate can be collected prior to reaching the first liner;
- An impervious interim cover will reduce infiltration-related leaching and soil erosion;
- An 18-in. thick reinforced concrete slab floor;
- Waste separation could be done through the use of compartments built into the modular design;
- 12-in. thick reinforced concrete walls;
- Two leachate collection systems, one system will be built into the floor of the facility; the second system will be built into the liner system;
- A multiple-layer liner system that utilizes both synthetic and natural materials; and
- A groundwater monitoring system.

2) A means of consolidating remediation waste in one location is needed to support near-term risk reduction goals while addressing long-term liability and safety issues.

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The location and design were selected to allow large quantities of remediation waste to be consolidated at a single location. Not only does the location and design allow the physical consolidation of the waste but it also allows waste management activities such as operations, monitoring activities, and inspection to be consolidated as well. The use of a modular design allows the RWSF to adjust to the influx of waste media as remedial activities proceed. Although the waste will be consolidated at a single location, the modular design has features that multiple facilities could offer such as:

- The ability to segregate and isolate differing waste types;
- Future modules could have specialized containment and monitoring features should the need arise; and
- The ability to accept either bulk or containerized waste.

3) The management of low-level, low-level mixed, and hazardous remediation waste must result in a cost-effective solution ~~that can be implemented under existing budgetary constraints.~~ e

If storage is needed, the Concrete Lined Cell is the most cost-effective of the alternatives considered that could meet RFCA criteria. (The waste pile could not meet the 6 CCR 1007-3, Part 264, Subpart N requirements that were required by RFCA because it did not have a liner system.) Table 7-1 gives the total life cycle costs for all of the design alternatives considered.

b/c we did not design it or it is impossible to have b/c Rqmt under RFCA

Take out

Table 7-1 Life Cycle Costs for Design Alternatives

Alternative	Total Life Cycle Cost
Abovegrade Landfill	$118,800,000
Pyramid	$140,300,000
Concrete Lined Cell with bulk placement	**$77,320,000**
Concrete Lined Cell with containers	$165,650,000
Hardened Concrete Vault	$181,630,000
Silo Design	$107,300,000
Slab on Grade	$141,600,000
Metal Buildings	$161,400,000
Entombment	$525,000,000
Waste Pile	$36,669,000
No Action	$215,900,000

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Based on professional judgment, the cost differences between location alternatives were not as significant as cost differences between the design alternatives and the final alternatives.

In the near-term, it is also more cost-effective to store the waste onsite rather than ship it offsite for disposal (No Action); however, in the long term, if it is possible to ship the remediation waste offsite immediately then it is more cost-effective to do so. In terms of cost, the CAMU should still be an alternative to the TYP in case additional storage is needed.

4) The solution must be compatible with future land uses for the Site and the Site Vision.

The selection of a Concrete Lined Cell in the Solar Ponds Area is consistent with future land use, (DOE, 1995a) the Site Vision, (Kaiser-Hill, 1996b) and also the RFCA. The ways that the selected alternative supports the Site Vision and projected land uses are as follows:

- The RWFS is a temporary storage facility which is consistent with the Site Vision goal of dispositioning remedial waste in a safe manner.
- The site selected is in a contaminated portion of the Industrial Area of the plant and could potentially extend over several IHSSs. Future land use for this area is for limited industrial use. The area near the Solar Ponds is far enough away from any building that might be reused so as not to impact any future Site activities; and
- The design and centrally located site facilitates monitoring and maintenance. Monitoring can be performed in conjunction with monitoring activities already required for the industrial area. Existing air monitoring systems can also support monitoring for the RWSF.

7.2.2 Summary of Selection Basis

This does not tell me how we meet ARAR 109a rqmts

As part of the effort to define the design concept for the RWSF and in accordance with DOE Order 4010.1a, a Value Engineering Study was performed. In the value engineering analysis method, multiple alternative approaches of accomplishing the project functions are subjected to qualitative and quantitative techniques to determine the value of each. The alternative which represents the highest value is selected for further development.

Four categories of protective elements which were considered essential components of any acceptable design and which also represent the highest costs of implementability and operation of the facility were selected for inclusion in the Value Engineering Study.

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The categories were:

- protective barriers at the bottom of the facility (liners and/or other structures);
- protective barriers at the top of the facility (interim cover and/or other structures);
- waste placement; and
- waste removal (exhumation at end of storage period).

Many combinations of construction and placement were identified that could accomplish the functions associated with the four categories. Application of the value engineering techniques identified a design incorporating a concrete structure, conventional liners, and an interim cover. Waste is placed in bulk (rather than in individual containers) to represent the highest value. The results of the Value Engineering Study independently validated selection of the Concrete Lined Cell with bulk storage attained through the alternatives analysis process.
To support the selection of a Concrete Lined Cell at the Solar Ponds Area, the following advantages are cited:

- The modular design offers the greatest degree of flexibility including the following attributes:

  — a wide variety of waste types can be accepted and kept segregated;

  — debris could be placed in the facility without additional characterization, compaction, or size reduction;

  — the facility can be expanded as needed to meet the needs of cleanup at RFETS as the cleanup progresses;

  — the RWSF can accept both bulk and containerized wastes; and

  — the RWSF can store waste for varying durations.

- The facility would have a high degree of protectiveness because of the concrete containment system, the additional liners in the subsurface liner system, and the interim cover. All of these features offer much greater protection than would be found in a typical storage facility;

- One major advantage is that the concrete containment system allows for the capture of contaminants before they reach the subsurface rather than depending on the liner system. Media below the facility would not be contaminated should leaching occur. The liner system would act only as additional back up barriers or as tertiary containment, rather than as the secondary containment system;

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- The facility is situated in an area where contamination is already present;
- The selected location has strong CDPHE support based on previous input; and
- The facility is centrally located to many of the IHSSs that need remediation.
- The RWSF will minimize indirect effects on the environment by being placed in the Industrial Area where existing infrastructure will support use of the facility.

The RWSF will minimize cumulative effects on the environment by being built on an existing facility in an areas previously contaminated, and thus will not add impacts by disturbing additional areas on the Site.

In selecting a remedy, emphasis was on flexibility and environmental protection. The selected remedy offers a environmental protection, durability, and the ability to safely contain remediation waste for whatever period of time is needed. It is a facility well suited to safely contain the remediation waste for long periods of time which would allow new technologies to be developed to treat or contain the waste or for alternative sites for offsite disposal to be developed. In the decision making process, a key factor to the decision was the potential that if the waste could not be removed in a reasonable time period, flexibility was needed to continue to safely store the waste. This facility can safely store the waste for any duration while still retaining protectiveness.

7.3 RISK EVALUATION

Then we should bring a summary of this in our disc. in Sect 2

A number of studies have been conducted to provide assurance that the recommended alternative will meet the established criteria for the RWSF. These analyses were conducted to support CAMU criteria for protection of public health and the environment as listed in 6-CCR-1007-3 Part 264.552 (c). The analysis of risk has been divided into the following three main exposure pathways:

- Offsite transport of contaminants through the groundwater to neighboring surface waters;
- Worker exposure to radionuclides during operations; and
- Offsite fugitive dust emissions.

The potential for vertical contaminant migration through underlying geologic strata into the Laramie-Fox Hills aquifer has previously been addressed and is considered to be an unrealistic scenario, (see RMRS, 1996). The most conservative calculations of volatile

organic contaminant transport indicate that travel times of at least 17,000 yr will be required for contaminants to migrate to the deep aquifer, which greatly exceeds the 1,000 yr time-frame considered in this document. The analyses performed in this report confirm the conclusions reached by the U.S. Geological Survey (Hurr, 1976) that plant operations will not impact this aquifer. More information on potential contaminant migration to the Laramie-Fox Hills aquifer is contained within the "White Paper Analysis of Vertical Contaminant Migration Potential" (RMRS, 1996).

Exposures from inadvertent intrusion into the RWSF after closure were also ruled out primarily because waste will be actively managed by inspections and monitoring throughout the life of the facility as per RFCA paragraph 80. In addition, it is assumed that as long as wastes remain on-site in the protected area (PA) and, the site is on the CERCLA National Priorities List (NPL), administrative controls will be required to limit access onto the site and five-year public health reviews will be required to ensure that the remedies used remain protective as long as waste remains onsite. It is also assumed that a fully integrated sitewide monitoring network will remain in effect to detect any releases from this action or any other as long as waste remains on site.

In addition to the pathways analyses referenced above, an analysis of technical and administrative controls is included. These controls are the administrative, design, operational, and post closure practices put in place to ensure releases are prevented or are prevented from impacting human health and the environment. Institutional controls can include deed restrictions, interagency agreements, and other controls.

7.3.1 Offsite transport of contaminants through the groundwater to neighboring surface waters

As with most waste management systems, potential accidental offsite releases to the public or the environment constitute the majority of risk. Siting criteria, design requirements, and facility monitoring requirements have all been established to mitigate the likelihood of a release event occurring. Several studies relative to the location of the RWSF, as well as the design itself, have been conducted to assess the likelihood of a release and the resulting level of contamination associated with such an event. One of the pathways considered was a release of contamination from the facility to groundwater and the subsequent transport of contamination to surface waters, where exposures to the environment or the public could occur. Three integrated studies were conducted to assess what, if any, risks might result from such a release. These are:

- Remediation Waste Storage Facility (RWSF) Particle Tracking Study;
- Leachate Composition Analysis; and
- Discharge Composition Analysis.

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The first two studies identified the primary parameters for an exposure to occur, travel times, and source concentrations of contaminants. The final study defined the overall estimated concentrations based upon infiltration through interim and long term cover designs. These studies are attached to the decision document as Appendix H and are summarized below.

7.3.1.1 Remediation Waste Storage Facility Particle Tracking Model

The particle tracking study used a site validated mathematical model to track contaminant flow through the groundwater beneath the RWSF and estimated travel times to neighboring surface waters. Travel times were based upon varying retardation factors for a particle in contaminant categories that include metals, organic compounds, and radionuclides. Retardation factors were based upon solubility, adsorption coefficients, and other factors that influence a contaminant's ability to flow freely within the groundwater. The retardation factors have either been obtained from literature values or from Site-specific values. Time frames considered for transport were 30 yr, 500 yr, 1,000 yr and 10,000 yr. The times used all exceed the estimated operational life of the storage facility since the intent of the facility is to support site closure within the 10 Year Plan time frames by providing a facility for storage only. Travel times did not assume any engineered barriers at the top or the base of the RWSF. These times are extremely conservative due to the assumption of no engineered barriers and represent a worse case scenario. In addition to the conservative travel times, the study makes no representation as to what levels of contaminants would reach neighboring surface waters within these time frames but is strictly limited to the travel time for a particle of material.

Metals and radionuclides have extremely high coefficients of adsorption, meaning that metals and radionuclides tend to adhere to clays within the surrounding soils and, therefore, exhibit limited movement. In addition, clay liner systems within the RWSF would further limit migration. The particle tracking models showed that migration would be limited for periods of nearly 1,000 years. Given the engineered barriers designed for the RWSF and the limited operational life cycle, discharges to surface waters are not expected. In addition, given the levels of metals and radionuclides associated with the estimated leachate composition and the estimated infiltration rates into the RWSF, no contaminant levels above stream standards are anticipated within the unit boundary.

Organic compounds present the predominant risk for completing the pathway to neighboring surface waters. The particle tracking model predicts that organics could conceivably reach surface waters within 100 yr without the engineered caps and liner systems designed for the RWSF. Organics levels however, are expected to be very low since thermal desorption technology is currently being used to treat soils and debris prior to disposition into a storage facility. Given the anticipated levels of organics within the leachate, the levels of organics

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What about RFCA Standards?

discharged to surface waters if a potential release occurred, would be significantly less than what is allowable to protect human health or the environment and would meet all State standards for water. The leak detection system of the liners would signal an alarm before a potential release to the groundwater or surface waters occurred. These results are detailed in the leachate composition analysis and waste composition analysis.

7.3.1.2 Leachate Composition Analysis

This analysis identified an estimated leachate composition that was statistically based upon actual analytical results for areas at RFETS which are considered possible candidate sites for which materials may be placed into the RWSF. Multiple waste streams were used to ensure that the analysis was based upon a representative sample of likely contaminants for RFETS. This analysis considered organics, metals, and radionuclide concentrations (see Table 1, Appendix H).

7.3.1.3 Discharge Composition Analysis

The maximum contaminant concentrations that may occur in groundwater from a potential release from the RWSF were calculated. These calculations were performed on the basis of estimated concentrations of contaminants from the leachate composition analysis and the estimated volumes of leachate anticipated to be generated as a result of moisture infiltration into the RWSF through the interim cover. Two cover scenarios were evaluated, a final closure cover, and a less extensive interim cover. The intent of this analysis was to provide a benchmark for estimating maximum potential values of contaminant discharge via groundwater into neighboring surface waters from the RWSF. This study assumed that no leachate collection was included in the RWSF design. However, both a leachate collection system and liner are designed to capture any discharges from the RWSF eliminating contaminant transport to the groundwater. The discharge composition analysis study would represent a worst case scenario where the leachate collection system would be inoperable. This does not assume a catastrophic breach however, only a failed collection system where leachate would be allowed to accumulate within the liner system and eventually discharge through the liners into the groundwater. Since active management of the system will occur, it is highly unlikely this scenario would exist for a time frame long enough to allow leachate to migrate through the liners. These flow rates were based upon infiltration rates calculated with the HELP model, an EPA approved model for evaluation of engineered barriers (EPA, 1985).

Based upon an estimated waste stream leachate analysis, no discharges to surface waters above action levels is anticipated for either cover scenario. A detailed table listing estimated discharge levels for specific contaminants is included in the study (see Table 3, Appendix H).

7.3.2 Worker Exposure to Radionuclides During Operations

A radiological dose assessment was conducted to assess the maximum radionuclide activities allowable in soils at the RWSF, based on annual exposure limits. The dose assessment used an upper annual exposure limit for a worker of 5,000 mrem/yr (10 CFR 834), and a lower limit of 100 mrem/yr (DOE Order 5400.5). The exposure scenario was for a RWSF operational worker and used site-specific exposure factors. (See Programmatic Risk-Based Preliminary Remediation Goals, Rev 2, DOE 1995).

The soil activity for each individual radionuclide necessary to give a 5,000 mrem annual does to a worker at the RWSF is 64,100 pci/g of americium-241, 74,900 pci/g of plutonium-349, and 1,020,000 pci/g of uranium-238. The activity of each radionuclide to deliver a 100 mrem annual dose is 1,280 pci/g for americium-239, 1,500 pci/g for plutonium-239, and 20,400 pci/g for uranium 238. These activities were calculated separately for each radionuclide. If all were present, the maximum concentration of each to deliver a given dose would be reduced. Actual activities of radionuclides in the RWSF will be much lower than those calculated for even the 100 mrem dose.

Soils and other materials from across the Site will be deposited in the RWSF. Average activities will be well below those calculated above for the 100 mrem annual dose, and are estimated to be below the Tier I Action Levels for radionuclides in surface soils (AM-239 = 215 pci/g, Pu-239 = 1,429 pCi/g, and U-238 = 506 pCi/g, DOE, 1996a). The average activities for soils from the 903 Pad area, which would be deposited in the RWSF, are 10 pCi/g for Am-241, 347 pCi/g for Pu-239/240, and 3 pCi/g for U-238. This indicates that wastes that will be deposited in the RWSF will not pose a radiological health threat to operations personnel. Waste acceptance criteria (WAC) for the facility will establish conservative limits on contaminant levels in deposited wastes, and significant health and safety monitoring will also be conducted.

7.3.3 Fugitive Dust Emissions

The fugitive dust emissions study estimated maximum-allowable activities in wastes deposited in the RWSF to deliver a known dose from airborne radionuclide contaminants, transported with dust particulates, to an offsite human receptor at the RFETS boundary, at 96th and Indiana Street. The study conservatively assumed a five-acre area, continuously exposed to wind erosion, with no effects from operational barriers such as cover on wastes or containers, and 1995 Site meteorological wind data. A fugitive dust emissions factor of 66.84 grams/m^2 was calculated using EPA procedures. A regulatory limit for exposure dose was assumed to be 10 mrem per year.

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As in the worker dose calculations reported above, the upper limit activities to deliver the maximum allowable dose (10 mrem/yr) was calculated for each radionuclide. The results estimate that if 100 percent of the dust load at 96th and Indiana was from the RWSF the activities of Am-241 or Pu-239/241 could be up to 220,000 pci/g. The actual contribution of dust from the RWSF would be much less than 100 percent and contributions from the Site would lower the allowable activity, based on air emissions at the RWSF. However, the RWSF WAC will establish administrative controls on maximum contaminant levels at the RWSF that will be well below the level of concern for air emissions.

The average levels of radionuclides in Site soils are much lower than activities necessary to pose a threat to human health of a residential receptor at the RFETS boundary. Average activities were not estimated for contaminated debris resulting from D&D actions. The WAC will need to ensure that levels of radionuclides in debris are controlled within acceptable limits by predisposal decontamination or packaging.

7.4 Technical and Administrative Controls

– Tie this into RFCA reqmts better

Technical and administative controls are implemented in order to ensure that human health and the environment are protected from areas where present or past activities preclude unrestricted access or use, controls are implemented. The technical and administrative controls meet the requirements in RFCA paragraph 80 for a CAMU. For the RWSF, controls can be grouped into four major elements:

- Engineering Controls
- Facility Monitoring
- Operational Controls
- Administrative Controls

different than Section 4.2 These 2 should match maybe Sec 4 Eng Controls – cap/liner Facility Mon. – leak detect/insp

Engineering Controls - There are specific engineering controls designed into the facility in order to support protection of human health and the environment throughout the operational life of the facility. These include:

- A double liner system designed to detect and collect any leachate generated during operations;
- Interim cover designs which eliminate infiltration to the greatest extent practicable; and
- An internal infrastructure designed to facilitate placement and retrieval of wastes;

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Facility Monitoring - In addition to a fully instrumented leak detection system, an extensive monitoring network will ensure no releases pass undetected from the unit boundary. This includes air monitoring stations, groundwater monitoring wells, and surface water monitoring stations. These requirements will also be integrated into the overall RFETS monitoring program to ensure that a comprehensive network is in place to help protect human health and the environment. CDPHE will require groundwater monitoring that will meet rqmts in Subpart B — which include

Operational controls. Operational controls are put in place to ensure that waste management operations are conducted in such a way as to minimize the risk of release from the facility or exposure to personnel. These include:

- An agency-approved waste acceptance criteria specifying a safety envelope for chemical and physical waste parameters including appropriate treatment requirements.
- An operational health and safety plan approved by the agencies designed to provide operational constraints for personnel protection, weather conditions, decontamination procedures, training requirements, emergency response, and health and safety monitoring.
- Standard operating procedures that establish clear repeatable guideline for conduct of operations.
- Numerous quality assurance procedures from construction quality assurance to procedural audits all designed to ensure the facility and operations meet designated performance standards.
- Closure plans that define how the facility will be decommissioned after the life of the operations and what performance standards need to be met upon closure.

- Contingency and spill response plans will define how the facility responds to a release of waste or constituents from the RWSF.

Administrative controls. Administrative controls are defined to ensure that risk of exposure during construction, operations, and closure are minimized. These include:

- Land use restrictions as defined by future land used plans identified in the RFCA.
- Security plans define site restriction requirements throughout the life of the project.
- Clean up standards which define the level of clean up necessary to certify closure.

In summary, numerous technical and administrative controls will be in place to ensure that all aspects of this effort are conducted in such a way that risks to human health and the environment are minimal.

Did we address Nesta's comments?

7.5 NEPA VALUES

The proposed RWSF will be authorized using a single, integrated Decision Document that will be signed by the DOE, and the State of Colorado, when approved. The Decision Document and review process will satisfy the documentation and procedural requirements of the RFCA. The National Environmental Policy Act (NEPA) process has been integrated into the RFCA documentation and procedure, especially public involvement and decision-making, to reduce duplication and paperwork, and streamline the combined NEPA/CERCLA process. In accordance with the DOE Secretarial Policy issued in June 1994, integrated CERCLA/RCRA documents for environmental clean up activities are to incorporate NEPA values to the extent practical. This policy is intended to minimize the cost and time for document preparation and review while meeting the requirements of both acts.

The analyses required by NEPA are integrated throughout the Decision Document, with a summary of the analyses provided in Appendix I. Based on the analyses, the decision-making process requires no further documentation to complete the NEPA process.

7.6 CONCEPTUAL WASTE ACCEPTANCE CRITERIA

Waste acceptance criteria (WAC) will be developed for the RWSF to ensure that remediation wastes comply with applicable regulatory and site requirements. The WAC will set levels for those criteria that can be quantified. The WAC will undergo review and approval by regulators as part of the detailed Title II design review process. The following objectives would be achieved in compliance with the WAC:

1. Remedial wastes are effectively isolated from potential natural environmental pathways to protect the public health and the environment.

2. RWSF operating personnel and generators ensure continuous protection to the public health and the environment.

3. Characterization data of the remediation waste is documented.

The RWSF would receive remediation wastes from the Site Accelerated Actions and D&D cleanup activities which include the following waste types: RCRA; TSCA; LLW; and/or LLMW. The majority of remediation waste would be handled in large bulk volumes, such as roll off containers or tandem dump trucks, rather than small containerization, such as drums or crates.

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7.6.1 Physical and Chemical Compatibility Criteria

The WAC will provide physical and chemical limitations and requirements of the remediation waste and for the proper management. Process knowledge and/or chemical and radiological analyses will become the tools to document accurate characterization of the remedial waste. The following areas represent physical and chemical criteria for remedial waste compliance:

General Requirements

1. Waste in monolithic or particulate form will be accepted for disposal.

2. Waste will contain no free liquids.

3. Lack of free liquids shall be demonstrated by EPA Test Method 9095 (Paint Filter Test) or by EPA Test Method 9096. If the generator determines that the waste form is not conducive to either test method, then documentation must be provided to substantiate the claim that no free liquids are present.

4. Gaseous waste will not be accepted. Compressed gases as defined by Title 49, CFR 173.300, including unpunctured aerosol cans, will not be accepted.

5. Aerosol cans will have punctures. Expended gas cylinders must have the valve mechanism removed and shall meet the requirements of Section 3.2.4 for debris.

6. Pyrophoric waste will not be accepted.

7. Sanitary waste will not be accepted.

8. Personnel protective equipment will be accepted.

Physical Requirements

1. Physical properties of monolithic bulk wastes (e.g. maximum size range, specific weight, moisture content)

2. Physical properties of wastes classified as debris (e.g. maximum size range, specific weight, biodegradable)

3. Conditions for filled and emptied containers (6 CCR 1007-3 Subpart N 264.315)

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4. Prohibitions of containerized gases, free liquids, pyrophorics, and sanitary wastes (6 CCR 1007-3 Subpart N 264.312, 313, and 314)

5. Management of personal protective equipment (e.g. radiological screen of PPE after usage; followed by disposal)

Chemical Requirements

1. Chemical Analyses, acceptable analytical methods, and detection ranges.

2. Prohibited constituents and chemical characteristics including reactive or ignitable substances (e.g. pyrophoric uranium. See 6 CCR 1007-3 Subpart N 264.312.)

3. Chemical compatibilities (6 CCR 1007-3 Subpart N 264.313).

4. pH limitations

5. Composition of waste

7.6.2 Health and Safety - Radioactive Dose Criteria

Tie this into RFCA?

The WAC will address the radiological limitations and requirements for the waste to meet the CAMU goals and objectives. The RWSF has been categorized as less than a Category 3 Facility and designated as a Radiological Non-nuclear Facility based on a hazard categorization analysis for preliminary threshold quantity of plutonium and other radioactive isotopes (Kaiser-Hill, 1996a). All projects at RFETS are designated under two areas, safety class or non-safety class (NSC). The safety class is further defined by categories such as Category 1 and 2, with Category 1 being the higher risk. Under the non-safety class, Categories 3 and 4 exist. The RWSF was designated as less than a Category 3 Facility which, by definition, is a non-safety class in accordance with the Conduct of Engineering Manual (COEM) Volume 2, Classification of Systems, Components, and Parts; 2-D03-COEM-DES-223 Revision 1. This categorization analysis was based on sampling data from some of the more radioactive IHSSs, such as the Solar Ponds, the 903 Pad, and Lip Area, and the original Process Waste Lines. To be conservative, the highest activity concentration was used. This categorization is the lowest level of risk categorization. The facility will not receive transuranic (TRU) waste. Radiological requirements specified by the WAC include the following:

1. Radiochemical analyses for characterization

2. Threshold limits of radionuclides for the RWSF

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7.7 REMEDIATION WASTE STORAGE FACILITY OPERATIONS

Tie into section 4 as well

The RWSF will be operated and maintained under a number of administrative requirements to ensure compliance with applicable regulations. Administrative controls will be administered for activities of waste operations in the following areas: When will this happen

1. WAC documents and forms - These are required to demonstrate compliance with the RWSF WAC.

2. Operating procedures - Procedures for handling and placement of waste, facility maintenance and documentation to ensure safe and efficient operation of the RWSF. Discuss timing

3. Training plans - A plan to administer required training for operating personnel in procedures, safety, and quality assurance.

4. Health & Safety plans - The health and safety requirements for operating personnel to conduct operations in a safe manner.

5. Emergency procedures and plans - The procedures and requirements for operating personnel to enact in the event of an emergency; also known as contingency plans.

6. Limiting operating conditions - Identification of abnormal events which would require operations to temporarily stop activities (e.g. excessive wind velocities, and other weather conditions) to ensure safety to the public, the workers, and the environment.

7. Administrative procedures and plans - Additional procedures and plans to ensure compliance with regulations, DOE orders, and Site rules and policies.

8. Control of fugitive dust emissions - Plan to reduce dust emissions and monitor results to protect the public and workers.

9. Closure Plan - This includes the requirements, procedures, and performance standards used to close the Facility after the end of its operational life. This will be developed in accordance with the applicable state regulations that govern closure of this type of facility including 6 CCR 1007-3 Subpart G.

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Additional requirements addressed in the WAC or Facility Operations Plan for compliance are areas addressing administrative controls. The following requirements will ensure the RWSF to be operated in a safe manner:

- Recordkeeping and documentation;
- Waste information from process knowledge and/or sampling and analysis data for waste characterization;
- Quality assurance/quality control (QA/QC) certification program and verification;
- Status reports and waste forecasts;
- Shipment notification; and
- Packaging and labeling requirements.

Any General Concl. PK

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Need Intro

This section provides a schedule for the CAMU process. It includes the design process outlined in RFCA & then presents the duration for design & construction of the RWSF if it is to be constructed

8.0 SCHEDULE

This Gantt chart presents project task information as both text and graphics. Information about each task is listed in the Gantt table on the left side of the figure. The Gantt bar chart displays task durations and start and finish dates on a time scale. The relative positions of the task bars show which tasks start and finish before each other and which task overlap other tasks.

In paragraph 109 of RFCA, subparagraphs (b) and (c) durations for the CAMU designation process are given as such:

b. Within 45 days of receipt of DOE's draft IM/IRA, CDPHE shall determine whether the IM/RA meets or fails to meet the criteria in subparagraph (a). If CDPHE determines that the draft fails to meet the criteria, the draft shall, at the end of a 45-day review, explain with specificity the necessary modifications and allow the DOE to resubmit within 30 days, or to invoke dispute resolution within 14 days. If the CDPHE determines that the application meets the criteria described in subparagraph (a), the CDPHE shall issue the draft IM/IRA for public comment for a period of 60 days.

c. Within 30 days of the close to the public comment period, the CDPHE shall review the comments received and modify the draft, if appropriate. The agency shall also prepare a response to significant public comments at this time. At the end of this 30-day period, if the CDPHE still agrees that the IM/IRA, as modified, meets the regulatory criteria for designation and the criteria in paragraph 80, the CDPHE shall designate the storage CAMU. If the CDPHE has determined that the IM/IRA does not meet these same criteria, the CDPHE shall state the changes that DOE must make to receive approval."

Once the CAMU designation is complete, design and construction of the RWSF will be dependent on the need for a contingency to the TYP. Construciton of the facility, including design, is estimated to take a little more than two years. Placement of remediation waste in the facility is dependent on the progress of D&D and remediation activities. The schedule for eventual shipment of the waste offsite has not been determined. The TYP assumes that all low-level mixed waste would be disposed offsite by the year 2007.

The schedule for implementation of this Decision Document is provided as a Gantt Chart in Figure 8-1.

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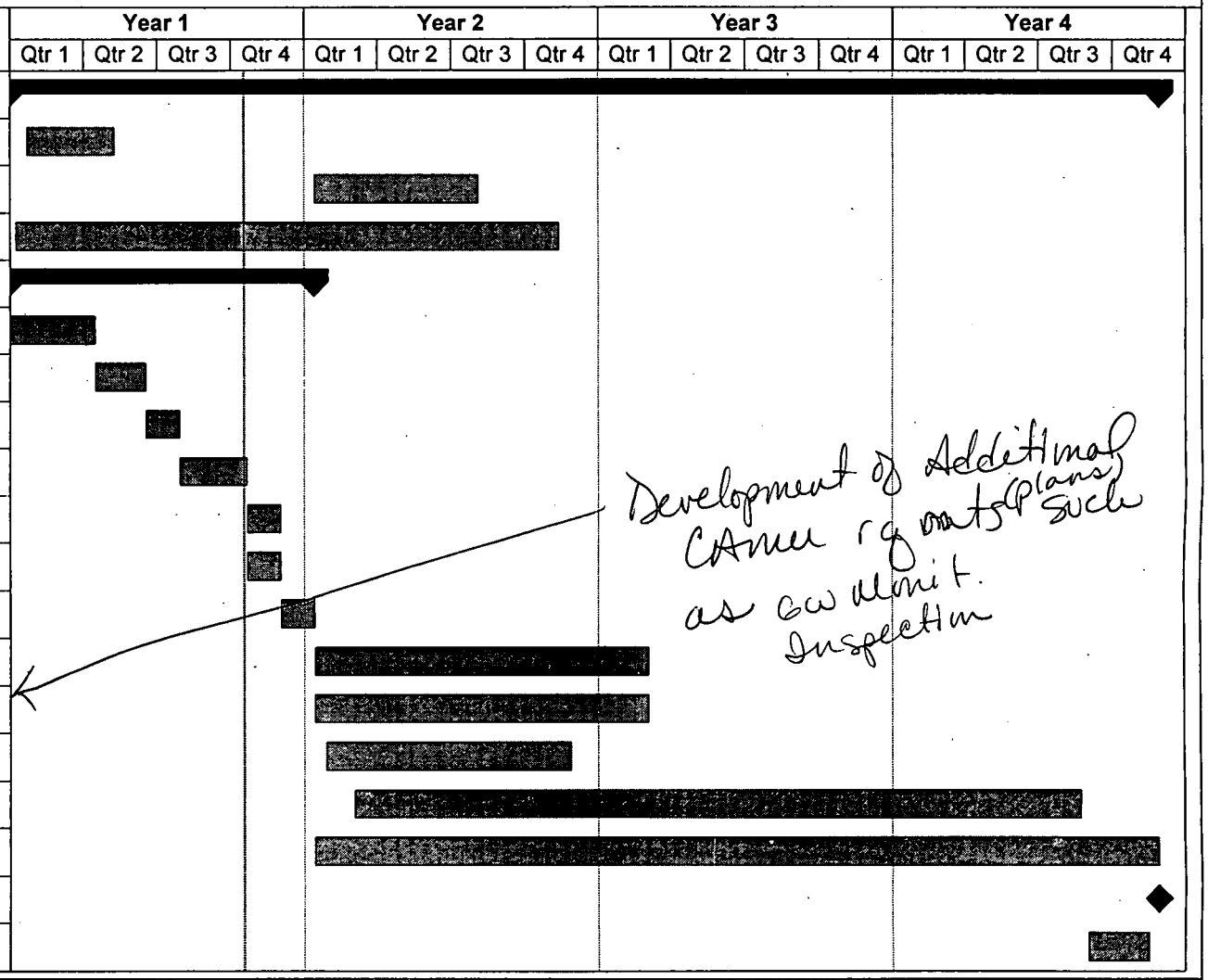
FIGURE 8-1: PROPOSED REMEDIATION WASTE STORAGE FACILITY SCHEDULE

Task Description	Dur
RWSF - DESIGN AND CONSTRUCITON	1021d
GEOTECHNICAL INVESTIGATION	78d
DEVELOP WASTE ACCEPTANCE CRITERIA	145d
PREPARE CONCEPTUAL DESIGN	482d
DECISION DOCUMENT	271d
PREPARE DECISION DOCUMENT (DD)	76d
CDPHE REVIEW DD	45d
MODIFY DD BASED ON CDPHE COMMENTS	30d
PUBLIC COMMENT PERIOD ON THE DD	60d
MODIFY DD BASED ON PUBLIC COMMENT	30d
PREPARE RESPONSIVENESS SUMMARY	30d
FINAL APPROVAL OF DD	30d
PREPARE DETAILED DESIGN	297d
PRECONSTRUCION PLAN PREPERATION	297d
PREPARE SITE FOR CONSTRUCTION	218d
CONSTRUCTION OF PREFERED ALTERNATIVE	645d
OPERATIONAL PROCEDURES & TESTING	750d
BEGIN OPERATIONS	0d
PROJECT CLOSE-OUT	55d



PROPOSED REMEDIATION WASTE STORAGE FACILITY SCHEDULE

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress

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Jennifer ahead

6.0 SCHEDULE

The attached Gantt chart, Figure 6-1, presents project task information as both text and graphics. Information about each task is listed in the Gantt table on the left side of the figure. The Gantt bar chart displays task durations and start and finish dates on a timescale. The relative positions of the task bars show which tasks start and finish before each other and which task overlap other tasks.

In Paragraph 109 of RFCA, subparagraphs (b) and (c) durations for the CAMU designation process are given as such:

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>
> c. Within 30 days of the close of the public comment period, CDPHE shall review the comments received and modify the draft if appropriate. The agency shall also prepare a response to significant public comments at this time. At the end of this 30 day period, if CDPHE still agrees that the IM/IRA as modified meets the regulatory criteria for designation and the criteria in paragraph 80, CDPHE shall designate the storage CAMU. If CDPHE has determined that the IM/IRA does not meet these same criteria, it shall state the changes that DOE must make to receive approval.

I don't know if we need this. This was added based on a R. Boyd comment.

Once the CAMU designation is complete, design & construction of the facility would occur only as a contingency action and would take a little more than two years. The facility would then be tested and opened for use. Placement of remediation waste in the facility would be dependent on the progress of D&D and remediation activities. The schedule for eventual shipment of the waste offsite has not been determined; nonetheless the Ten Year Plan assumes that all low level mixed waste would be disposed of by the year 2007.

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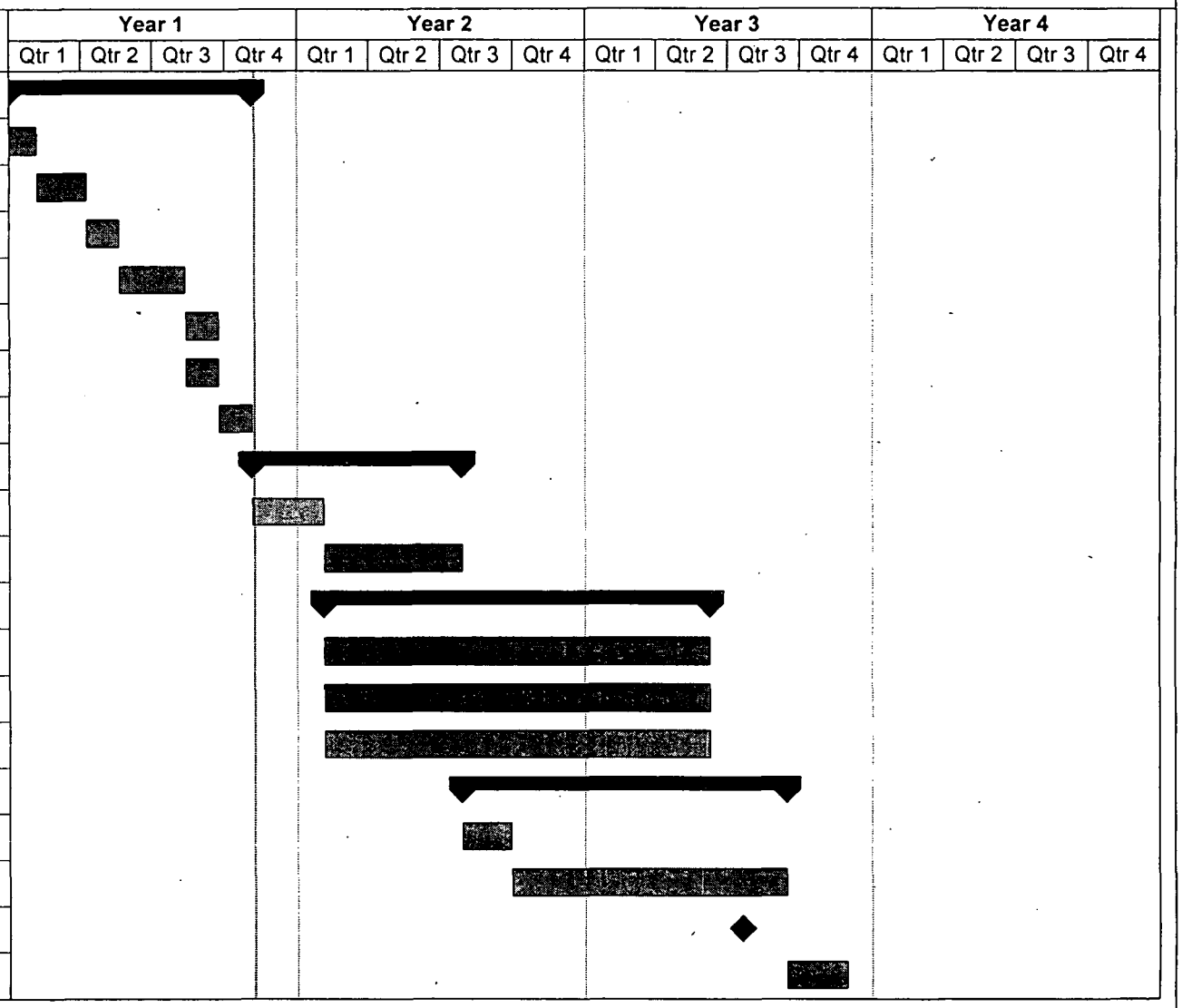
FIGURE 6-1: PROPOSED CONTAINERIZED STORAGE FACILITY SCHEDULE

Task Description	Dur
DECISION DOCUMENT	221d
PREPARE DECISION DOCUMENT (DD)	26d
CDPHE REVIEW DD	45d
MODIFY DD BASED ON CDPHE COMMENTS	30d
PUBLIC COMMENT PERIOD ON THE DD	60d
MODIFY DD BASED ON PUBLIC COMMENT	30d
PREPARE RESPONSIVENESS SUMMARY	30d
FINAL APPROVAL OF DD	30d
DESIGN	190d
PREPARE CONCEPTUAL DESIGN	65d
PREPARE DETAILED DESIGN	125d
OPERATIONAL AND MONITORING PLAN DEVELOPMENT	350d
PREPARE OPERATIONAL DOCUMENTATION	350d
PREPARE MONITORING PLAN	350d
OPERATIONAL PROCEDURES & TESTING	350d
CONSTRUCTION	295d
PREPARE SITE FOR CONSTRUCTION	45d
CONSTRUCTION OF PREFERED ALTERNATIVE	250d
BEGIN OPERATIONS	0d
PROJECT CLOSE-OUT	55d



PROPOSED CONTAINERIZED STORAGE FACILITY SCHEDULE

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

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Chris Dayton

4.0 ANALYSIS OF ALTERNATIVES AND SELECTION BASIS

As part of the CAMU designation process, paragraph 109 of the RFCA requires that the IM/IRA present an analysis of alternatives showing that the DOE has considered the following:

1. Worker safety
2. Protection of public health and the environment
3. Transportation
4. Facility design, containment and monitoring
5. Institutional controls
6. Cost, and
7. Community acceptance.

A wide variety of alternatives could be considered ranging from No Action to highly engineered storage vaults. Four alternatives were selected to represent the spectrum of technologies available. These alternative serve as a contingency to the Ten Year Plan should waste volume, storage, or shipping assumptions in the Ten Year Plan prove invalid. These four alternatives are:

- No Action - Remediation waste would be treated and shipped to an offsite disposal facility as soon as it is recovered or it would remain in storage at the point of recovery until shipment would be possible.

- Slab on Grade - Waste is stored in cargo containers placed on abovegrade concrete slab; Secondary containment would be built into slab. The facility would have no roof or walls.

- Metal Buildings - Waste would be enclosed in cargo containers placed inside engineered metal buildings on concrete slabs; Secondary containment would be built into the floor slabs.

- Hardened Concrete Vault - Waste in cargo containers would be placed in an abovegrade freestanding concrete structure. The floor of this structure would serve as a secondary containment system. This is a current practice at the DOE Savannah River Site, for LLW & LLMW.

not defined ✓

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Except for the No Action alternative, all of the alternatives considered would have an underlying double liner with a leachate collection system to meet the requirements of 6 CCR 1007-3, Part 264, Subpart N, Landfills as required by paragraph 80 of RFCA. This would effectively give all of the alternatives tertiary containment since a secondary containment system would be incorporated into the floor or slab of these structures. All of the alternatives except No Action, would also provide loading and unloading capabilities for offsite transport. A summary of the analysis of alternatives using the seven RFCA criteria is presented in Table 4-1. The following text discusses each of the alternatives.

The No Action alternative, although the least costly, was rejected for the following reasons:

- Permitted storage capacity at RFETS would not support the waste volume estimated in the Ten Year Plan to be generated during closure of RFETS.
- Generating large volumes of remediation wastes and leaving large numbers of containers exposed to the elements and spread across RFETS for an unknown duration would create undesirable risks of exposure and not support the levels of protectiveness desired at RFETS.
- Schedule impacts resulting from an inability to ship waste would leave contaminant sources, including buildings, exposed to the environment for time frames longer than acceptable as described in the Ten Year Plan.
- Resources necessary for the additional waste management requirements under this scenario—such as additional treatment costs—would limit the amouint of risk reduction that could be achieved.

The Slab On Grade alternative was rejected for reasons similar to the No Action alternative. This design is not as protective of human health and the environment relative to other storage alternatives. This alternative would not protect the wastes from corrosion due to the weather or from dispersal by the wind if containers leaked. The uncertainties associated with offsite disposal resources that would drive the need for storage would also compound the problem of leaving containers exposed to the environment for an unknown duration. For

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these reasons, this alternative would not adequately address worker safety, protection of public health and the environment, or facility design, containment and monitoring criteria.

The Hardened Concrete Vault was rejected primarily due to cost. Although it adequately addressed worker safety, protection of public health and the environment and containment. For short-term storage, it would not provide any more protectiveness than the Metal Buildings. If the facility needed to be utilized for more than 30 years this facility might be a better alternative; however, since the facility is intended for short-term use only (as described in the Ten Year Plan strategy), the added durability of the Hardened Concrete Vault was not a factor in the selection process. The Hardened Concrete Vault also might not offer the flexibility needed for changing waste volumes or transportation requirements: specifically, once constructed the facility would be difficult to reconfigure. When the facility is no longer needed, its closure would be more complicated and costly than the other alternatives since this type of structure is more permanent by design.

Metal Buildings were selected as the best alternative for short-term storage (10-20 yr). Metal buildings would provide adequate protectiveness at a lower cost. Other advantages that Metal Buildings offer include:

- Containers would be protected from the elements and potential airborne dispersal should any of the containment units fail. Air monitoring could be incorporated into existing programs.
- The use of a modular building design allows flexibility in addressing changing storage requirements, i.e. buildings could be constructed as needed.
- The level of containment would be protective of workers, the public, and the environment. The combination of liners, leachate collection system, and secondary containment would provide protectiveness to surface water and ground water.
- Metal buildings would offer the same protection as more sophisticated designs, and at a lower cost. The use of pre-engineered buildings would reduce cost and expedite the schedule. Lower costs allows more resources to be directed towards risk reduction activities.

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- Use of Metal Buildings for the storage of waste is an established and implementable technology currently in use at RFETS.
- Container retrieval and shipment would be greatly facilitated by this alternative, as the containers would be received and stored ready for shipment.
- Closure of the facility would be less complicated and more cost effective than the hardened concrete vault.

Table 4-1 Summary of Analysis of Alternatives

	RFCA Criteria	RFCA Criteria	RFCA Criteria	RFCA Criteria
Final Design Alternatives	**Worker Safety**	**Protection of Public Health and the Environment**	**Transportation**	**Facility Design, Containment and Monitoring**
No Action	Waste would need to be immediately shipped in bulk to reduce exposure. Potential cleanup schedule may be impacted.	Visual inspections would allow leaks to be detected before release to the environment. Remediation waste would be stored uncovered prior to shipment. Exposed containers would eventually pose a serious risk to the environment. Lack of adequate storage could delay some remediation work.	The necessity of immediate shipping could limit transportation options. Loading and unloading could be hampered by the lack of a waste handling facility. Shipping could be required through several population centers.	Containment would be less if containers were unconsolidated across RFETS. Inspection costs would be more.
Slab on Grade	Exposure could result if waste leaked from containers. Construction of the facility poses minimal risk.	Visual inspections would allow leaks to be detected before release to the environment. RCRA double-liner system would provide groundwater protection. Containerized waste would be stored uncovered prior to shipment. Exposed containers could eventually pose a serious risk to the human health and the environment.	The Slab on Grade would facilitate transportation. Facility could double as a loading and unloading facility. Facility could be accessed from many different sides Facility would not be expected to have a detrimental impact to traffic flow. Shipping could be required through several population centers.	Containers would be exposed to the elements which could accelerate deterioration and leakage. The slab itself is a containment and collection system in addition to the liner/leachate collection system beneath it Exposed contaminants could be subject to airborne migration.
Metal Buildings	Waste would be isolated from workers. Construction of the facility poses minimal risk.	Visual inspections would allow leaks to be detected before release to the environment. RCRA double-liner system would provide groundwater protection.	The CSF would allow coordination of transportation and more transportation options for offsite shipment. CSF would double as a loading and unloading facility. Facility is not expected to have a detrimental impact to traffic flow. Shipping could be required through several population centers.	Secondary containment would be incorporated into the building design. Monitoring would be accomplished through visual inspection and secondary containment system. Liner/ leachate collection system would provide additional containment and monitoring capabilities.
Hardened Concrete Storage Vault	Waste would be isolated from workers. Construction of the facility poses minimal risk	Visual inspections would allow leaks to be detected before release to the environment. RCRA double-liner system would provide groundwater protection. Vault would provide better long-term protection than other alternatives.	Access to facility would be more limited. Facility would not be expected to have a detrimental impact to traffic flow. Shipping could be required through several population centers.	Secondary containment would be incorporated into the building design. Monitoring would be accomplished through visual inspection and secondary containment system. Liner/ leachate collection system would provide additional containment and monitoring capabilities.

Table 4-1 Summary of Analysis of Alternatives (continued)

	RFCA Criteria	RFCA Criteria	RFCA Criteria
	Institutional Controls	**Cost**	**Community Acceptance**
No Action	The current RFETS site access limitations and RFCA would be institutional controls for waste stored at remedial action ~~and D&D~~ sites prior to shipment off site. Each site with waste stored pending shipment would require regularly scheduled inspections. Once shipped, institutional controls would exist offsite; The nature of those institutional controls would be dependent on the selected disposal facility.	Least expensive of alternatives. Some cost savings could be realized by not constructing a storage unit. Although significant near-term and shipment cost and schedule impacts would reduce amount of risk reduction conducted which is not supportive of Ten Year Plan Strategy. Although some risk reduction activities would be delayed leaving contaminant sources uncontrolled longer. Some of these savings would be offset by costs associated with immediate treatment. Some type of staging/shipping facility would likely be necessary to support this alternative.	Waste containers would continue to be exposed to the environment prior to shipment.
Slab on Grade	The RFCA would be an institutional control requiring continued maintenance, inspection and monitoring of the facility. Since the use of the facility is for short-term storage, controls beyond existing controls are not necessary.	Least expensive storage facility to construct and operate. Cost savings come at the expense of protectiveness due to lack of an enclosed facility. Final disposal costs still apply.	This alternative provides less protective measures to the public than the other two facilities evaluated. The Slab on Grade supports the overall RFETS strategy of offsite shipment. It is easy to retrieve waste and transport it.
Metal Buildings	The RFCA would be an institutional control requiring continued maintenance, inspection and monitoring of the facility. Since the use of the facility is for short-term storage, controls beyond existing controls are not necessary.	Metal Buildings were in the mid-range cost for the storage facilities evaluated. Final disposal costs still apply.	The CSF provides better monitoring and retrieval capabilities. The CSF supports the overall RFETS strategy of offsite shipment. It is easy to retrieve waste and transport it.
Hardened Concrete Storage Vault	The RFCA would be an institutional control requiring continued maintenance, inspection and monitoring of the facility. Since the use of the facility is for short-term storage, controls beyond existing controls are not necessary.	Most expensive of the storage facility alternatives to construct due to expense of constructing hardened concrete shell. Less resources would be available for risk reduction. Final disposal costs still apply.	This alternative is protective. Facility is more permanent than other facilities considered but still can support Ten Year Plan goals. Waste is more difficult to retrieve. Closure of this alternative would be more difficult.

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Table 4-1 Summary of Analysis of Alternatives (continued)

Final Design Alternatives	NEPA EVALUATION	NEPA EVALUATION
	SHORT-TERM EFFECTIVENESS	LONG-TERN EFFECTIVENESS
No Action	Readily available to support on-going projects. Additional effort would be needed for inspecting waste left at cleanup sites until shipment. The limited ability to store large quantities of waste on site could limit risk reduction activities in the short term.	All offsite disposal facilities under consideration have been designed for long-term use. The No Action alternative would not be effective if it causes delay of source term removals.
Slab on Grade	Rapid construction due to modular design would accelerate the availability of the facility. Un-enclosed transport containers could be subject to weather damage. Run-on and run-off would be controlled. Slab drainage and leachate collection system could be impacted by heavy rains. This alternative would not be suitable for volumes over 100,000 cu yd.	Not designed as a long-term facility. No long-term protection. All offsite disposal facilities under consideration have been designed for long-term use.
Metal Buildings	Rapid construction due to modular design would accelerate the availability of the facility. This alternative would not be suitable for volumes over 100,000 cu yd.	Not designed as a long-term facility. All offsite disposal facilities under consideration have been designed for long-term use.
Hardened Concrete Storage Vault	Rapid construction due to modular design would accelerate the availability of the facility. Containerized waste storage inside a concrete vault would not be suitable for volumes over 100,000 cu yd.	Designed as a long-term, permanent facility with cap and liner design to support long-term waste placement.

6.0 SCHEDULE

The attached Gantt chart, Figure 6-1, presents project task information as both text and graphics. Information about each task is listed in the Gantt table on the left side of the figure. The Gantt bar chart displays task durations and start and finish dates on a timescale. The relative positions of the task bars show which tasks start and finish before each other and which task overlap other tasks.

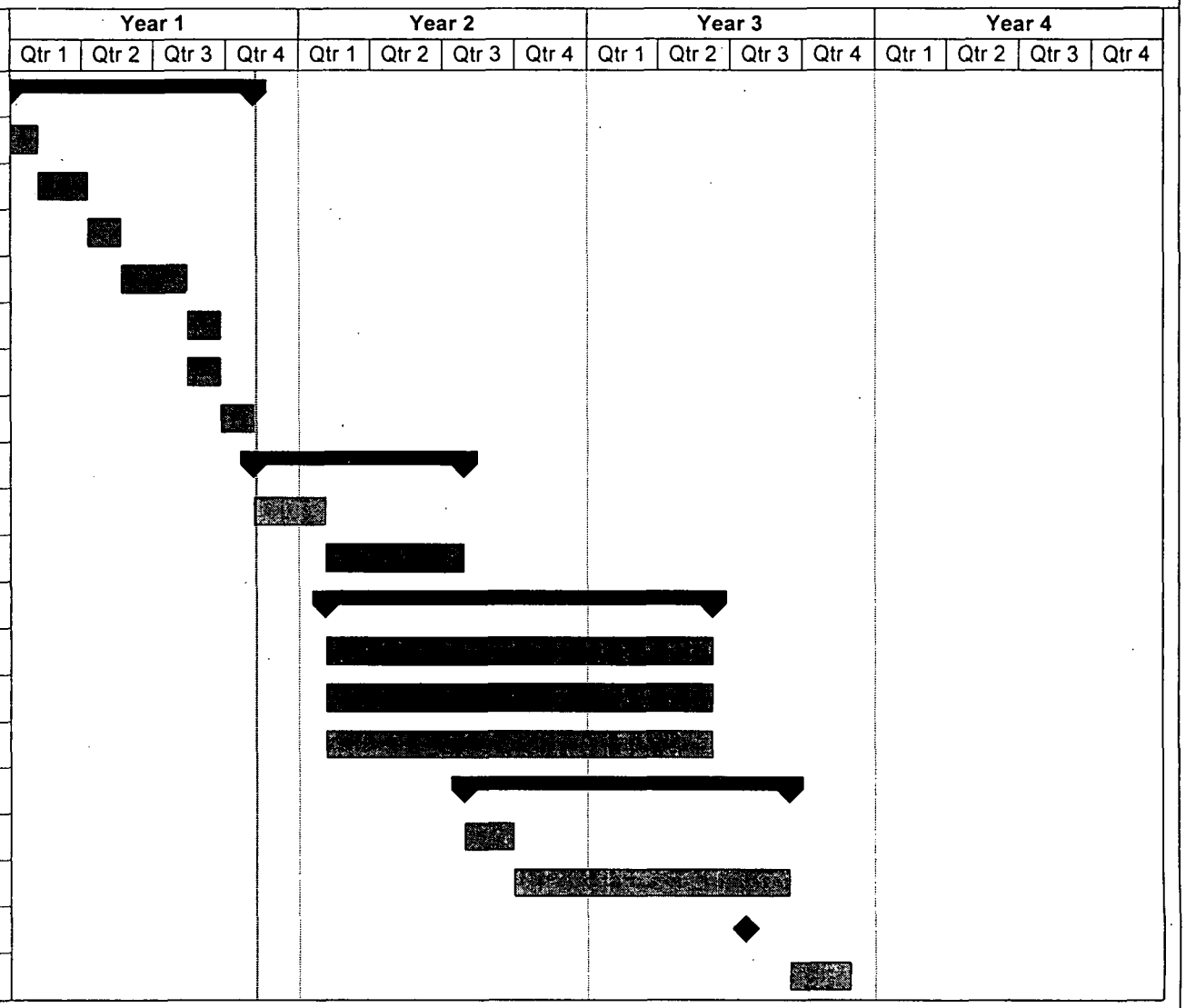
In Paragraph 109 of RFCA, subparagraphs (b) and (c) durations for the CAMU designation process are given as such:

> b. Within 45 days of receipt of DOE's draft IM/IRA, CDPHE shall determine that IM/?IRA meets of fails to meet the criteria in subparagraph (a). IF CDPHE determines that the draft fails to meet the criteria, it shall, at the end of its 45 day review, explain with specificity the necessary modifications and allow Doe to resubmit within 30 days or to invoke dispute resolution within 14 days. If CDPHE determines that the application meets the criteria described in subparagraph (a) , it shall issue the draft IM/IRA for public comment for a period of 60 days.
>
> c. Within 30 days of the close of the public comment period, CDPHE shall review the comments received and modify the draft if appropriate. The agency shall also prepare a response to significant public comments at this time. At the end of this 30 day period, if CDPHE still agrees that the IM/IRA as modified meets the regulatory criteria for designation and the criteria in paragraph 80, CDPHE shall designate the storage CAMU. If CDPHE has determined that the IM/IRA does not meet these same criteria, it shall state the changes that DOE must make to receive approval.

Once the CAMU designation is complete, design construction of the facility would occur only as a contingency action and would take a little more than two years. The facility would then be tested and opened for use. Placement of remediation waste in the facility would be dependent on the progress of ~~D&D and~~ remediation activities. The schedule for eventual shipment of the waste offsite has not been determined; nonetheless the Ten Year Plan assumes that all low level mixed waste would be disposed of by the year 2007.

FIGURE 6-1: PROPOSED CONTAINERIZED STORAGE FACILITY SCHEDULE

Task Description	Dur
DECISION DOCUMENT	221d
PREPARE DECISION DOCUMENT (DD)	26d
CDPHE REVIEW DD	45d
MODIFY DD BASED ON CDPHE COMMENTS	30d
PUBLIC COMMENT PERIOD ON THE DD	60d
MODIFY DD BASED ON PUBLIC COMMENT	30d
PREPARE RESPONSIVENESS SUMMARY	30d
FINAL APPROVAL OF DD	30d
DESIGN	190d
PREPARE CONCEPTUAL DESIGN	65d
PREPARE DETAILED DESIGN	125d
OPERATIONAL AND MONITORING PLAN DEVELOPMENT	350d
PREPARE OPERATIONAL DOCUMENTATION	350d
PREPARE MONITORING PLAN	350d
OPERATIONAL PROCEDURES & TESTING	350d
CONSTRUCTION	295d
PREPARE SITE FOR CONSTRUCTION	45d
CONSTRUCTION OF PREFERED ALTERNATIVE	250d
BEGIN OPERATIONS	0d
PROJECT CLOSE-OUT	55d



PROPOSED CONTAINERIZED STORAGE FACILITY SCHEDULE

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

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7.0 REFERENCES

DOE, 1996a, *Final Rocky Flats Cleanup Agreement*, July 19.

DOE, 1996b, *Draft Ten Year Plan*, July 30.

Kaiser-Hill, 1996a, Hazard Categorization Analysis for Waste Management Facility, January.

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5.0 FACILITY DESCRIPTION

already defined

This section describes the conceptual design of the Containerized Storage Facility (CSF) which has been proposed for the management of remediation wastes. The CSF has been proposed to be located in the southwest corner of the Industrial Area (Figure 5-1). The CSF would be composed of a series of engineered metal buildings, as shown on Figure 5-2, which would be constructed to serve as a staging facility in the receiving, storage, and ultimate shipment of remediation waste. The proposed location benefits from minimal site preparation costs, verses alternate locations, and the presence of an adjacent rail spur for offsite shipment. A footprint of 6.8 acres would include up to four modular buildings which could ultimately store 5,000, 20-cu-yd-capacity cargo containers each, for a total capacity of up to 100,000 cu yds. The modular design would allow the final configuration and storage capacity to be flexible in order to meet changing waste-storage requirements. The Metal Buildings would be constructed on reinforced concrete foundations with a double liner and leachate collection system under each building foundation. The double liner and leachate collection system, (see Figure 5-3) would comply with RCRA Subtitle C requirements as defined in 6 CCR 1007-3, Part 264 Subpart N. The remediation waste would be effectively isolated from the environment by the following three barrier systems:

- Containers;
- Structural concrete floor slab with integral leachate collection system; and
- Double liner system (e.g. primary barrier HDPE geomembrane and secondary barrier combined HDPE geomembrane and clay liner) with leachate detection and collection system.

The CSF would have a design life of twenty years (e.g. 10 years operation under the Ten Year Plan (Ten Year Plan) and operation for an additional 10 years as a contingency) at which time it assumed the remediation waste would have been transported to an offsite facility for disposal.

maybe also treatment

5.1 RFCA DESIGN CONSIDERATIONS

RFCA paragraph 80 describes requirements that have been incorporated into the conceptual design such as leachate detection and collection. Details of how these requirements will be

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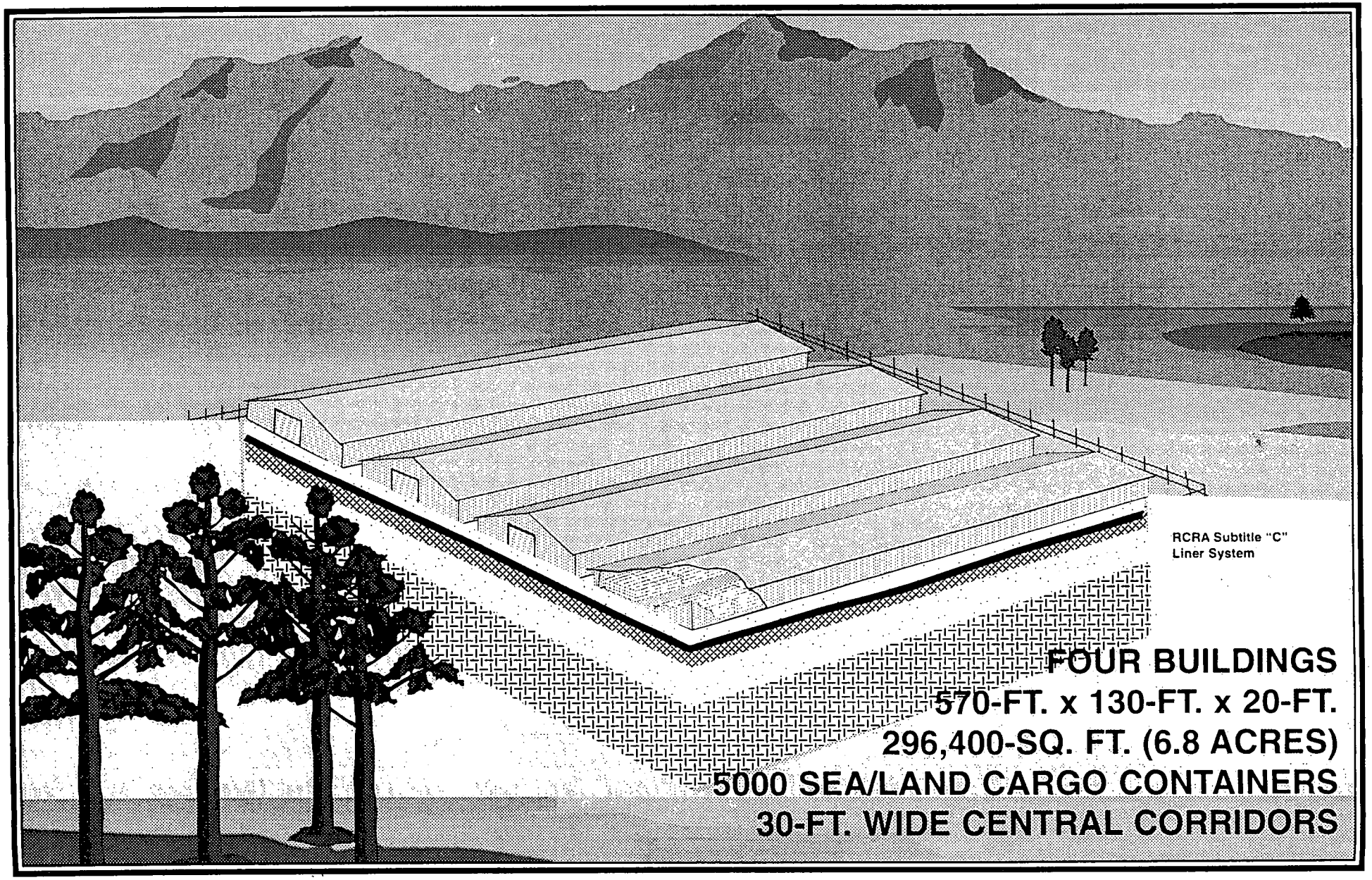

Figure 5-2

CONTAINERIZED STORAGE FACILITY

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CONTAINERIZED STORAGE FACILITY LINER

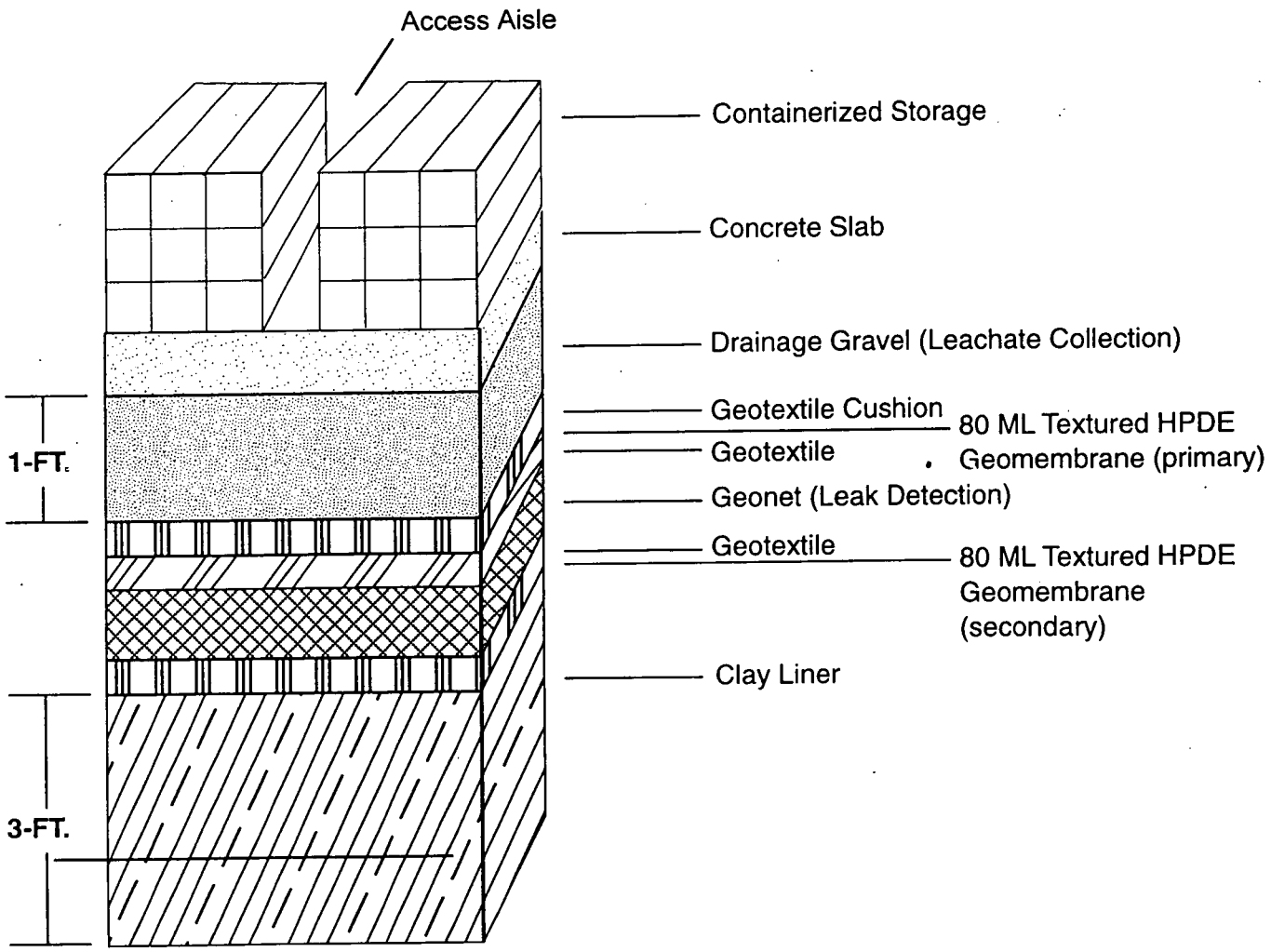

Figure 5-3

CONTAINERIZED STORAGE FACILITY CROSS SECTION

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met will be submitted during the design phase. Incorporated as part of the proposal alternative are the following:

- Detection and monitoring/inspection (part of the alternatives analysis and facility operational plans);
- Cap/liner in compliance with 6 CCR 1007-3 Par 264, Subpart N; and
- Ground water monitoring system to be developed as part of the design/construction.

Also, the following would be developed as part of the design/construction:

- Operating and design requirements (to be included as design submittals and operational plans);
- Requirements for responding to releases of wastes or constutuents from the units; and
- Waste treatment requirements (to be provided in the WAC)

The following features were used to develop a conceptual cost estimate (see Table 5-1):

- Four metal buildings, each 570 ft. long by 130 ft. wide and 20 ft. eave height;
- Each building would be constructed, when required, dependent upon waste volumes;
- Buildings would be constructed over a reinforced concrete floor;
- A maximum total of 5000 - 20 cu yd cargo containers for the entire four building CSF;
- Cargo containers would be stacked three high in the buildings;
- Each building would have a thirty foot wide central corridor and personnel access aisles for routine monitoring and inspection;
- A twenty-year design life;
- Cargo containers;

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- Double liner system and leachate collection system ; and
- Groundwater monitoring wells (six total maximum) would be installed both up gradient and down gradient and would be operated through the life cycle of the CSF (20 years).

TABLE 5-1 SUMMARY OF COSTS FOR THE CSF

TASK DESCRIPTION	ESTIMATED COST
Containers	$68,177,000
Site Preparation	$1,209,000
Engineering Design / Project & Const. Mgmt.	$3,685,000
Construction	
A. Four Metal Buildings	$9,307,000
B. Double Liner System	$3,236,000
C. Leachate Collection/Detection System	$386,000
Total Cost [1]	**$86,000,000**

Any escalation costs?

Notes:
1. A 25% contingency cost is included in the estimate

The leachate collection and retrieval system would collect any potential leachate and it would be transferred to a facility for treatment.

5.2 WASTE CHARACTERISTICS AND CONCEPTUAL WASTE ACCEPTANCE CRITERIA

The following sections describe the waste and associated acceptance criteria for the CSF. Section 5.2.1 gives a brief identification of the waste characteristics which could be received at the CSF. Section 5.2.2 gives estimates of the waste volumes and section 5.2.3 briefly explains what the Waste Acceptance Criteria (WAC) would address for the CSF.

5.2.1 Remediation Waste Characterization

This section describes the general waste types characteristics which may be placed in the CSF. Identification of waste characteristics, sources and projected volumes for the CSF clarify and substantiate the need for a contingency to existing waste storage. Only remediation waste would be considered for management in this facility.

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Remediation waste is defined as follows by RFCA, part 5, line 26, item (bf):

> (1) solid, hazardous, and mixed wastes; (2) all media and debris that contain hazardous substances, listed hazardous or mixed wastes or that exhibit a hazardous characteristic; and (3) all hazardous substances generated from activities regulated under this Agreement as RFCA corrective actions or CERCLA response actions, including decommissioning. Remediation waste does not include wastes generated from other activities. Nothing in this definition confers RCRA or CHWA authority over source, special nuclear, or byproduct material as those terms are defined in the Atomic Energy Act.

In addition, low-level waste, as defined by RFCA, is radioactive waste that is not high-level waste, spent nuclear fuel, by-product material, or transuranic waste (although it may contain small amounts of transuranic elements). The majority of the low-level waste managed at the CSF would have an average radionuclide activity much less than ten nanocuries per gram (nCi/g) based on the Hazard Categorization Analysis (Kaiser Hill, 1996).

Remediation waste types for the CSF are expected to include the following:

- Contaminated soil collected from remedial actions, usually treated to remove volatile organics
- Treated and untreated sludge and sediments
- Toxic Substance Control Act (TSCA) waste (such as asbestos and PCBs)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions
- IDM from past and future characterization activities, such as wells, and borings, if the IDM is characterized as hazardous, low-level, or low-level mixed remediation waste
- ~~D&D~~ Decom. waste which has been characterized as hazardous, low-level, or low-level mixed waste. ~~D&D~~ Decom. waste includes building rubble, equipment, and utilities removed from the building prior to demolition.

No, Look at RFCA Defn. of Decomm.

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5.2.2 Remediation Waste Volume

Waste volume estimates were based on planned risk reduction activities. A preliminary estimate of remediation waste volumes the may require storage prior to ultimate disposal is presented in Table 5-2 below. The total volume of remediation waste is estimated to be 101,800 m^3 or 133,000 cu yd which would be placed in the CSF. These estimates were based on current information and coincide with the Ten Year Plan waste volumes. These volume estimates are not intended to limit the size of the facility, but serve as a tool to create alternatives for the decision making process.

Table 5-2 Remediation Waste Volumes for the Containerized Storage Facility

Remediation Waste Types	Total Estimated Volume (m^3)	Total Estimated Volume (yd^3)	Volume Ranges (m^3)
Low-Level Waste	40,716	53,293	32,573 m^3 to 81,432 m^3
Low-Level Mixed Waste	53,438	79,945	48,863 m^3 to 122,156 m^3
Total	94,000	133,238	81,435 m^3 to 203,588 m^3

TSCA, HAZ

Notes:
1. These waste volumes are estimated within a range of -50% to +100%.

The actual volume of soil defined by Tier 1 and Tier 2 cleanup levels in RFCA Action Levels and Stds. Framework could be larger or smaller because volume estimates were made with preliminary data from limited characterization.

5.2.3 Conceptual Waste Acceptance Criteria

The purpose of the CSF is to provide ER and D&D Decom. activities the services of a staging facility for the receiving, interim storage and ultimate shipping of remediation waste. Waste acceptance criteria (WAC) would be developed for the CSF to ensure remediation wastes comply with applicable regulatory and site requirements. The CSF would accept remediation waste in transportable containers which have accompanying documentation that meets the waste acceptance criteria of the anticipated target disposal facility. The WAC would be specific for the CSF and may not address specific requirements as required by other offsite disposal facilities which ultimately would receive the waste. For criteria which can be

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quantified, specific levels would be identified. The following objectives would be achieved in compliance with the WAC:

1. Remedial wastes are effectively isolated from potential natural environmental pathways to protect the public health and the environment.
2. Operating personnel of the CSF ensure continuous protection to the public health and the environment.
3. Remediation waste is routinely monitored and inspected. and
4. Characterization data of the remediation waste is documented to the extent necessary to support project specific waste management objectives and WAC requirements for the CSF.

As previously mentioned, the CSF would receive remediation waste from ER and ~~D&D~~ Decomm activities which would be handled as bulk wastes in customized cargo containers verses crates or drums. The CSF **is not** a handling facility and is not intended to repackage waste once received.

The WAC would provide physical and chemical limitations and requirements for the proper management of remediation waste. Process knowledge and/or chemical and radiological analyses would become the tools to document accurate characterization of the remedial waste.

5.2.3.1 Physical Requirements

A summarized list of physical requirements which the WAC would address are listed below:

- Physical properties of bulk wastes such as soils, sediments, and treated sludge (e.g. maximum size range, specific weight, moisture content)
- Physical properties of wastes classified as debris (e.g. maximum size range, specific weight, moisture content, non-biodegradable)
- No free liquids (e.g. 6 CCR 1007-3 Subpart N 264.314; EPA Paint Filter Test)
- Conditions for filled and emptied containers (6 CCR 1007-3 Subpart N 264.315) and
- Prohibitions of containerized gases, ignitable or reactive wastes (6 CCR 1007-3 Subpart N 264.312, 313)

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5.2.3.2 Chemical Requirements

A summarized list of chemical requirements which the WAC would address are listed below:

- Chemical analyses, acceptable analytical methods, and detection ranges;
- Prohibited constituents and chemical characteristics including reactive or ignitable substances (e.g. pyrophoric uranium; 6 CCR 1007-3 Subpart N 264.312);
- Chemical compatibility's (6 CCR 1007-3 Subpart N 264.313);
- pH limitations; and
- Composition of wastes.

5.2.3.3 Health and Safety Issues

The primary concerns of Health and Safety for the CSF are itemized as follows:

- Operations involving heavy equipment (e.g. large forklifts/cranes) for the handling of containers;
- Health and Safety issues for the industrial worker;
- Threshold limits of radionuclides for the CSF; and
- The CSF would require operating and administrative procedures for the assurance of safe operations involving heavy equipment and protective measures for the industrial worker.

The WAC would address the following radiological requirements:

- Radiochemical analyses for characterization; and
- Threshold limits of radionuclides for the CSF.

The majority of low-level remediation waste to be managed at the CSF would have an average radionuclide activity less than ten nanocuries per gram (nCi/g) as mentioned previously under section 5.2.1. A preliminary hazard category analysis was performed for the CSF. The CSF

Do we want to comment that avg. conc. in pCi/g range?

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was categorized less than a Category 3 facility and designated as a Radiological Non-nuclear Facility based on preliminary threshold quantities of plutonium and other radioactive isotopes (Kaiser-Hill, 1996c). This categorization analysis was based on sampling data from some of the more radioactive IHSSs at RFETS (e.g. Solar Ponds, 903 Pad and Lip Area, and the Original Process Waste Lines). To be conservative in the hazard analysis, the highest activity concentrations were used from these IHSSs. The CSF would not receive transuranic waste (TRU).

5.3 Technical and Administrative Controls

Technical and administrative controls would be implemented in order to ensure that human health and the environment would be protected from areas where present or past activities preclude unrestricted access or use, controls are implemented. The technical and administrative controls would be met the requirements in RFCA paragraph 80 for a CAMU. Discussion of controls for the CSF is grouped into four major elements:

- Engineering Controls (e.g. double liner system, leachate collection/detection system, interim cover)
- Facility Monitoring (e.g. groundwater monitoring plan)
- Operational Controls (e.g. waste acceptance criteria, inspection, H&S plan, contingency/spill response plan)
- Administrative Controls (e.g limited access; institutional controls)

make into sentences

Engineering controls - There would be specific engineering controls designed into the facility in order to support protection of human health and the environment throughout the operational life of the facility. The following engineering controls of the CSF would comply with 6 CCR 1007-3, Part 264, Subpart N, 264301 - Design and operating requirements: 264.302 - Action leakage rate; 264.303 - Monitoring and inspection; and 264.304 - Response actions:

- Double liner system (e.g. primary barrier - geosynthetic layer; secondary barrier - composite layer consisting of clay layer overlain by geosynthetic)

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- Leachate collection/removal system (e.g. two systems; the first system is an integral collection/removal system constructed in the floor slab with sumps and piping; the second system is the coarse sand drainage layer above the primary barrier with integral collection pipes, pumps and sumps)
- Leak detection system (e.g. geonet layer between the primary and secondary barriers)
- An internal infrastructure designed to facilitate retrieval of wastes

fix bullets

Facility Monitoring - In addition to the monitoring and inspection per 264.303 for the double liner system and a fully instrumented leak detection system, an extensive monitoring network would ensure no releases pass undetected from the unit boundary. This would include both air and surface water monitoring stations and groundwater monitoring wells upgradient and downgradient of the CSF which would require a groundwater monitoring plan. These requirements would also be integrated into the overall RFETS monitoring program to ensure that a comprehensive network was in place to help protect human health and the environment.

Operational Controls - Operational controls would be put in place to ensure that waste management operations were conducted in such a way as to minimize the risk of release from the facility or exposure to personnel:

- An agency-approved waste acceptance criteria specifying a safety envelope for chemical and physical waste parameters including appropriate treatment requirements
- An operational health and safety plan approved by the agencies designed to provide operational constraints for personnel protection, weather conditions, decontamination procedures, training requirements, emergency response, and health and safety monitoring
- Standard operating procedures that establish clear repeatable guidelines for conduct of operations, including packaging and transporting of waste from D&D or IHSS remediation locations to the CSF
- Numerous quality assurance procedures from construction quality assurance, as cited earlier per Subpart 264.303 (a) monitoring and inspection, to procedural audits all designed to ensure the facility and operations meet designated performance standards

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- Closure plans that define how the facility would be decommissioned after the life of the operations and the performance standards for closure per Subpart 264.310 and 264.552 (e)

- Contingency/spill response plans per Subpart 264.304 would define how the facility responds to a release of waste or constituents from the CSF.

Administrative Controls - Administrative controls are defined to ensure that risk of exposure during construction, operations, and closure are minimized. These may include:

- Appropriate institutional controls (e.g. warning signs, fences, deed restrictions)

- Security plans which define site restriction requirements throughout the life of the project

- Cleanup standards which define the level of cleanup necessary to certify closure

In summary, numerous technical and administrative controls would be in place to insure that all aspects of this effort were conducted in such a way that risks to human health and the environment would be minimal.

5.4 NEPA VALUES

The proposed CSF would be authorized using a single, integrated Decision Document that would be signed by the DOE, and the State of Colorado, when approved. The Decision Document and review process would satisfy the documentation and procedural requirements of the RFCA. The National Environmental Policy Act (NEPA) process was integrated into the RFCA documentation and procedure, especially public involvement and decision-making, to reduce duplication and paperwork, and streamline the combined NEPA/CERCLA process. In accordance with the DOE Secretarial Policy issued in June 1994, integrated CERCLA/RCRA documents for environmental clean up activities are to incorporate NEPA values to the extent practical. This policy is intended to minimize the cost and time for document preparation and review while meeting the requirements of both acts.

The CSF would be anticipated to minimize cumulative effects on the environment by being placed in the Western Industrial Area because of the following:

- The proposed area in the industrial area has been already disturbed and consolidation of waste is achieved;
- Existing infrastructure already exists which would support the CSF; and
- The proposed area was selected based on a detailed siting study which screened out sensitive areas (e.g. areas populating the endangered species Prebles Jumping Mouse, steep slopes, wetlands, etc., were avoided)

The analyses required by NEPA were integrated throughout the Decision Doc. Based on the analyses, the decision-making process requires no further documentation to complete the NEPA process.

5.5 REMEDIATION WASTE STORAGE FACILITY OPERATIONS

The CSF would be operated and maintained under a number of administrative requirements, as previously mentioned in section 5.3 "Technical and Administrative Controls," to ensure compliance with paragraph 80 of RFCA. Administrative controls would be administered for activities of waste operations in the following areas:

fix bullets

1. WAC documents and forms - These would be required to demonstrate compliance with the RWSF WAC and paragraph 80 of RFCA requirements previously mentioned in section 2.2
2. Operating procedures - Procedures for handling and placement of waste, facility maintenance and documentation to ensure safe and efficient operation of CSF
3. Training Plans - A plan to administer required training for operating personnel in procedures, safety, and quality assurance
4. Health & Safety plans - The health and safety requirements for operating personnel to conduct operations in a safe manner
5. Contingency/spill response plans would define, per Subpart 264.03, how the facility would respond to a release of waste or constituents from the CSF

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6. Limiting operating conditions - Identification of abnormal events which would require operations to temporarily stop activities (e.g. excessive wind velocities, and other weather conditions) to ensure safety to the public, the workers, and the environment

7. Administrative procedure and plans - Additional procedures and plans to ensure compliance with RFCA, DOE orders, and RFETS rules and policies

8. Control of fugitive dust emissions - Facility Monitoring plan as cited in section 5.3 to reduce dust emissions and monitor results to protect the public and worker

9. Closure Plan - This would include the requirements and performance standards for closure per Subpart 264.310 and 264.552 (e) to close the facility after the end of its operational life

Additional requirements addressed in the WAC or Facility Operations Plan for compliance would be areas addressing administrative controls. The following requirements would ensure the RWSF to be operated in a safe manner:

- Recordkeeping and documentation;
- Waste information from process knowledge and/or sampling and analysis data for waste characterization;
- Quality assurance/quality control (QA/QC) certification program and verification;
- Status reports and waste forecasts; and
- Shipment notification.

Packaging and labeling requirements

5.4.3 CLOSURE REQUIREMENTS FOR THE CSF

Once the CSF has shipped offsite all remediation waste it would be subjected to closure requirements under RFCA Part 9 Subpart B paragraphs 97, 118, and 121. A closure plan would be submitted which described the following items to meet the closure performance goals of 264.111:

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- A description of how the CSF would be closed to meet the closure performance standards;
- A description of how final closure would be conducted;
- An estimate of the maximum inventory of remediation waste managed within the CSF;
- A detailed description of the steps required to decontaminate all hazardous waste residues, containment system components, equipment, structures, and soils for final closure;
- A description of how other activities ensure the closure performance standards are satisfied (e.g. ground-water monitoring, leachate collection, run-on and run-off controls); and
- A schedule for final closure.

5.5 CONCLUSION

The CSF is proposed as a contingency to the existing Ten Year Plan. This IM/IRA Decision Document is the tool to designate the proposed IA-West area as a CAMU for storage of remediation waste as a contingency to the Ten Year Plan. The Decision Document identifies and explains, in a detailed study and analysis, the best location onsite for the selected remedy—Metal Buildings. In the event remediation waste could not be shipped offsite as originally anticipated under the Ten Year Plan, the DOE would have the option of implementing the CAMU as their contingency for interim storage of remediation waste pending shipment.

Advantages
Can do offsite
treatment and
disposal

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4.0 IDENTIFICATION OF SUBSTANTIVE CRITERIA

Paragraph 80 of RFCA provides: "(I)f the application meets the appropriate substantive criteria CDPHE will issue a CAMU designation." Likewise, the CAMU rule, promulgated pursuant to the CHWA, states that "(t)he Department shall specify, in the permit or order, requirements for CAMUs..." (See 6 CCR 1007-3, Part 264.552 [e).

4.1 CAMU Objectives

The designation of a Corrective Action Management Unit must be performed in accordance with the seven criteria enumerated in 6 CCR 1007-3, Part 264.552(c). The seven criteria are, by nature, high level objectives. For that reason, the seven criteria were adapted and used in Section 6.0 as the decision criteria for comparison and selection of an alternative. The seven CAMU objectives include:

1. The CAMU must facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

2. The waste management activities associated with the CAMU must not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents;

3. The CAMU may only include uncontaminated areas of the facility if including such areas is more protective;

4. Where remediation wastes will remain in place after closure the CAMU must be managed and contained so as to control, minimize or eliminate future releases to the extent necessary to protect human health and the environment;

5. The CAMU must expedite the timing of remedial actions;

6. The CAMU must enable the use, when appropriate, of treatment technologies to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste.

7. The CAMU must be placed on the minimal area necessary to provide a reliable, effective, protective, and cost effective remedy.

4.2 RFCA Requirements

Paragraph 80 of RFCA provides:

> ...that the design criteria for the facility described in this paragraph shall be the same whether the facility is for the retrievable, monitored storage of remediation wastes or for the disposal of remediation wastes. Specifically, the facility described in this paragraph must ensure retrievability of wastes and protection of human health and the environment through a combination of requirements that include, but are not limited to: detection and monitoring/inspection requirements; operating and design requirements, including cap/liner system that meets the requirements as set forth in 6 CCR 1007-3, Part 264, Subpart N; a groundwater monitoring system; and requirements for responding to releases of wastes or constituents from the units. In addition, where necessary for protection of human health and the environment, waste treatment will be required."

In response to RFCA paragraph 80, the following design and operating requirements will be addressed and implemented:

- leak detection;
- inspections;
- a cap that meets RCRA Subpart N requirements;
- a groundwater monitoring system;
- corrective action for releases; and
- a waste acceptance criteria, consistent with design and operation, that provides treatment of wastes where necessary.

The above requirements are discussed in Section 7 for the specific selected alternative, the Concrete Lined Cell. As part of the IM/IRA process, paragraph 109 of RFCA also directs consideration of seven topics, ~~including~~:

- worker safety;
- protection of human health and the environment;
- transportation;
- facility design, containment, and monitoring;
- institutional controls;
- cost; and
- community acceptance.

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4.3 CAMU Requirements

Additional requirements for designation are enumerated in Part 264.552(e) of the CAMU rule. The following are the additional requirements:

- specification of the area configuration, Part 264.552 (e) (1));
- specification of the design requirements (Part 264.532 (e) (2);
- specification of operation requirements (Part 264.552 (e) (2);
- specification of groundwater monitoring requirements (Part 264.552 (e) (3);
- specification of closure and post closure requirements (Part 264.552 (e) (2) that:
  - minimize the need for further maintenance and (Part 264.552 (e) (4) (iii) (A);
  - consider the CAMU design (Part 264.552 (e) (4) (iii) (A);
  - consider the potential for releases (Part 264.552 (e) (4) (iii) (C);
  - consider the physical and chemical characteristics of the waste (Part 2 64.552 (e) (4) (iii) (D);
  - consider hydrological and other environmental conditions at the facility that may influence the migration of any releases (Part 264.552 (e) (4) (iii) (E);
  - consider potential human or environmental exposures to releases (Part 264.552 (e) (4) (iii) (F)
  - requirements for excavation, removal, treatment, or containment of remediation wastes (Part 264.552 (e) (4) (ii) (A);
  - requirements for removal and decontamination of equipment, devices and structures used in remediation waste management activities within the CAMU (Part 264.55 (e) (4) (ii) (C);

Paragraph 80 of RFCA provides: "(I)f the application meets the appropriate substantive criteria CDPHE will issue a CAMU designation." Likewise, the CAMU rule, promulgated pursuant to the CHWA, states that: "(t)he Department shall specify, in the permit or order, requirements for CAMUs..." (See 6 CCR 1007-3 Part 264.552 (e).

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KAISER • HILL
COMPANY

INTEROFFICE MEMORANDUM

DATE: 10/23/96

TO: Tim O'Rourke/RMRS

FROM: Jennifer Uhland/Kaiser-Hill

SUBJECT: Review of Draft Corrective Action Management Unit IM/IRA Decision Document and Application Support Document

---

I have reviewed the CAMU decision document. I think that the document is in good shape and requires minor adjustments. Thanks to the whole team for the good work. My markups are in the text, however I wanted to summarize major comments by sections. They are listed below. In general we are still not there from a formatting standpoint, but I think that a good word processor/text editor will fix that problem. We can discuss these comments any time on Thursday. Do not incorporate into the document until after our meeting with DOE on Friday.

Executive Summary

1. Make this ES similar to Container Storage Facility Application
2. Explain that there are 2 CAMU applications and why
3. Slightly more detail regarding why this is a contingency (e.g. due to waste volume uncertainty and why there is uncertainty associated with the volumes)
4. Are we asking for a designation for 100,000 yd. or 400,000 yd.?

Section 1

1. Explain that there are 2 CAMU applications and why
2. Slightly more detail regarding why this is a contingency (e.g. due to waste volume uncertainty and why there is uncertainty associated with the volumes)
3. Are we asking for a designation for 100,000 yd. or 400,000 yd.? Depends plan UCD

Section 2 Minor comments see text

Section 3

1. Revise Table 3-1 to be consistent with the TYP

Section 4

1. Better Introduction
2. We probably should address requirements of 264.552 (a)(3)

Section 5

1. Noticeable formatting problem and call outs for Figures
2. 100 vs. 400 thousand yd. issue again

Section 6

1. Slightly tone down Butler Building discussions
2. Liners should not be a deciding factor b/c RFCA requires it.

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Section 7

1. Better link between Section 7.4 and 7.7 to the Section 4 requirements
2. Final Conclusion paragraph (I think the reader is left hanging)
3. Section 7.2.2 does not discuss what you say it will in the intro. to Section 7.2

Section 8 - minor comments see text

United States Government

facsimile

Department of Energy

Rocky Flats Field Office

Number of pages (not including cover page) 3

DATE:: 24 Oct 94

TO:: Regina Sarter
x4728

REPLY TO
ATTN OF: Timothy S. Howell
Office of Chief Counsel
Rocky Flats Field Office
U.S. Department of Energy
Post Office Box 928
Golden, Colorado 80402-0928

Voice transmission: (303) 966-2027
Facsimile transmission: (303) 966-3717

SUBJECT:: Review of draft CAMU application. Hard copy sent thru distribution.

Overall -- the decision document looks real good!

Tim

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DOE F 1325.8

United States Government **Department of Energy**

memorandum

Rocky Flats Field Office

DATE: October 24, 1996

REPLY TO ATTN OF: OCC:TSH

SUBJECT: Review and Comment on the Draft Corrective Action Management Unit Application application and Rocky Flats Cleanup Agreement Decision Document

TO: Regina Sarter, CD, RFFO

I have reviewed the draft Corrective Action Management Unit (CAMU) application and Rocky Flats Cleanup Agreement (RFCA) decision document. I offer the following comments and suggested modifications.

Missing Element in the Analysis:

1. As a whole, this decision document adequately incorporates most National Environmental Policy Act (NEPA) values. However, the document fails to adequately incorporate the NEPA value associated with irretrievable/irreversible commitment of resources. This decision document should address the irretrievable/irreversible commitment of resources (if any) associated with the siting, construction, and operation of a storage CAMU. A RFCA decision document, to be legally sufficient vis-à-vis the Secretary's NEPA policy, should include a short discussion and analysis regarding the anticipated degree of irretrievable/irreversible damage (if any) to natural resources which may result from the proposed remedy or other cleanup action. In addition, case law supports the notion that the inclusion of such a discussion under NEPA may very well reduce the Site's liability for natural resource damage claims under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

2. Ordinarily, this discussion and analysis need not be an exhaustive quantitative exercise. Nevertheless, the decision document should, at a minimum, include a qualitative discussion surrounding the degree of anticipated (if any) short term and long term damage or injury to natural resources. With respect to the CAMU decision document, there are several locations where the irretrievable/irreversible commitment of resources associated with the siting, construction, and operation of a storage CAMU could be discussed: (a) in the Executive Summary; (b) in Section 6 as part of the comparative analysis for each alternative; (c) in Section 7.5 regarding NEPA values; (d) Appendix B, B.7.3.2 and B.7.3.3; and (e) Appendix I.

no change

Attorney-Client Privilege

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General Comments:

1. Reference, Executive Summary, p. ES-1, ¶ 1: Note that on October 18, 1996 the RFCA parties approved the soil cleanup level associated with radionuclides. It may be appropriate to incorporate this decision in lieu of the present language. Recommend consulting Bob April, Acting Deputy Assistant Manager for Environmental Compliance.

2. Reference, p. ES-2, ¶ 2: Has the field office agreed to deferring that Colorado make a finding of fact as to whether the proposed CAMU meets the requirements for a disposal facility? Recommend consulting Bob April, Acting Deputy Assistant Manager for Environmental Compliance.

3. Reference, p. 1-1, ¶ 4, line 5: See comment 1 above.

4. Reference, p. 1-2, ¶ 1: See comment 2 above. Is it a true field office decision that all waste will be removed from the CAMU before closure? This statement appears to be a major policy shift from RFCA negotiations.

5. Reference, p. 1-3, Fig. 1-1: This map is misleading. The map should include a dot for the following cities: Superior; Louisville; Lafayette; Erie; Commerce City (note: delete the dot for Henderson since Henderson is not a city, but is a community area within Commerce City); Federal Heights; and Wheat Ridge.

6. Reference, p. 1-7, ¶ 1; p. 7-9, point 4); p. B-3, ¶ 3, line 6; p. C-22, C.2.4.2: The entire document needs a global change for the many references to "planned" or "projected" future land uses. At this point in the Site's land use planning it is appropriate to only use the phrase "reasonably foreseeable future land uses" since the NEPA process has not yet been completed vis-à-vis future land use determinations. Please note that RFCA does not make any land use decisions. The parties have only agreed to consider the "reasonably foreseeable future land uses" for the Site throughout the cleanup decision making process. Prior to making future land use determinations the NEPA process must first be completed.

7. Reference, p. 1-9, ¶ 3, line 10: Add the City of Superior.

8. Reference, p. 2-1, ¶ 4: Line 1: Delete phrase "From a logistical standpoint" since it adds little to the decision making process. Line 2/3: This language needs clarified so that it is clear that we are talking about the transportation of waste directly from a remedial area (e.g., individual hazardous substance site (IHSS)) since we may still have transportation issues associated with staging and packaging and other over-the-road shipping issues. This is especially true if we do as we say we will in p. 1-2, ¶ 2, that all waste will be removed from the CAMU.

9. Reference, p. 7-17, ¶ 3: In line 2 of ¶ 3 change the phrase "These include" to "These may include". In the first bullet, delete the existing language and replace with "Appropriate institutional controls (e.g., warning signs; fences; deed restrictions)."

Point of contact on this matter is the undersigned. If you have any questions, I may be reached at (303) 966-2027.

Timothy S. Howell
Environmental Counsel

cc:
B. April, EC, RFFO
S. Slaten, LD, RFFO
R. Tyler, CD, RFFO
J. Stover, LD, RFFO
R. DiSalvo, OOC, RFFO
K. Koch, OCC,RFFO
J. Dreger, OCC, RFFO

Attorney-Client Privilege

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Master copy

2.0 VERIFICATION OF CAMU DESIGNATION CRITERIA

The ability to designate the RWSF as a CAMU is dependent on compliance with the criteria found in 6 CCR 1007-3 264.552 (c), Corrective Active Management Units (CAMU). In order to demonstrate a need for a CAMU at RFETS, these seven criteria were made an integral part of the decision-making process. Each of the seven CAMU criteria listed below is followed by a description of how the selected RWSF remedy demonstrates compliance with the criterion.

as numbers 1 through 7

1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies.

The CAMU designation of the RWSF would be the cornerstone in successfully completing environmental restoration and D&D activities within the accelerated schedule for Site closure proposed in RFCA. The ability of the RWSF to provide readily accessible storage capabilities for large volumes of remediation waste, with generally low levels of contamination, facilitates reliable, effective, protective, and cost effective remedies by:

- Accelerating IHSS and will also impact D&D activities. closures by providing a facility for interim storage and/or treatment of contaminated material while simultaneously developing cost-effective offsite disposal capabilities. Currently, the logistics of offsite disposal limit schedules for closing IHSS. Designation of a CAMU will allow limited resources to be focused on supporting ~~near~~ short-term risk reduction. ← Current costs for offsite shipment, treatment, and disposal limit the amount of resources that can be focused on near-term risk reduction, including source removal and D&D
- Allowing RFETS to ~~maximize economies of scale~~ maximize funds / or minimize costs for treatment, storage, and disposal so that action levels for Site closure can be achieved.

The effectiveness of specific cleanup actions ~~will~~ would be enhanced by the availability of the RWSF. ~~This will~~ allow for a more aggressive remediation strategy. Source materials, including contaminated soils that might have been left in place for a number of years as a continuing source of contamination will be removed from the environment and placed in the RWSF.

~~From a logistical standpoint, the RWSF will offer individual site clean up actions a reliable, readily available facility that can accept large quantities and wide varieties of remediation waste.~~ The waste destined for the RWSF will ~~not have to~~ be transported offsite, so little ~~in the way of~~ staging and packaging for transportation will be necessary. ~~There will not be the questions~~ Issues of whether a shipment can be transported, whether the shipment will be returned, or whether the facility will be in operation when needed. The RWSF will accept only remediation waste (including D&D waste). ~~The flow~~ of waste into the facility, therefore, will not be impacted by waste ~~from~~ other generators.

Waste would be transported from the IHSS or D&D location and placed in the RWSF in bulk.

will not arise until final closure of the CAMU.

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~~Because of the modular, compartmentalized design of the RWSF, it will be able to accept a wide variety of remediation waste including D&D waste. The waste will not have to be homogeneous.~~ Changes in waste form can be accommodated so that operations will not be held up due to unanticipated conditions in the field. For example, if during remedial excavation of soils, a drum or block of concrete is uncovered, this material can be put into the RWSF without shutting down remedial or RWSF operations or requiring extensive paperwork. ~~Also, a wide variety of waste forms can be accepted so that even if the contaminants change, the RWSF can accommodate that change and the~~ environmental remediation project can proceed without much delay. This availability of immediate storage will facilitate the effectiveness of cleanup actions by allowing all of the contaminants and source materials to be removed at once and with minimal delay.

The RWSF CAMU offers more protectiveness than alternatives such as no action, cap-in-place, or several small storage facilities because it consolidates the remediation waste into an engineered barrier ~~protective of~~ that protects human health and the environment. The remediation waste can be physically removed from an IHSS or building and placed into the RWSF. Additional engineered protection can be provided for the same cost because it is a single large facility as opposed to numerous smaller facilities. Another benefit is that Remediation waste that might have been left capped in place or placed in several smaller storage facilities ~~will have the benefit of being~~ can now be centrally located and completely surrounded by multi-layered impermeable protection. In addition, the remediation waste will be monitored at a single location. Leachate The leachate generated by all the remediation waste will be isolated and recovered at this single location.

Insert ATTACHED 1,2,3,4

~~The design proposed was selected based on the ability of the RWSF to provide a low-cost storage alternative while achieving compliance with applicable design standards as well as ensuring protectiveness of human health and the environment. Even with multiple protective design features, the concrete lined cell was still the most cost effective of any design considered. The cost was kept low by utilizing bulk storage in modular compartments as opposed to containers, by keeping the waste onsite for the immediate future, and by using a design that minimizes the footprint and material costs. Another factor that lowered cost was the ability of the RWSF to accept a wide variety of waste forms. The ability to accept the waste from D&D activities represents significant cost savings that can be directly translated into money available for additional Site closure activities.~~ how?

~~Contaminated areas require more active management and, therefore, cost more to manage.~~ Sources that may impact other site activities and workers as well as potential exposures to offsite receptors can be removed from the environment sooner if the RWSF is available. This ~~supports the concept of~~ facilitates accelerated site closure by allowing previously contaminated areas to be cleaned up to interim cleanup levels agreed to in RFCA rather than closed with contamination above action levels in place. Once contaminant sources

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- The facility is situated in an area where contamination is already present;
- The selected location has strong CDPHE support based on previous input; and
- The facility is centrally located to many of the IHSSs that need remediation.
- The RWSF will minimize indirect effects on the environment by being placed in the Industrial Area where existing infrastructure will support use of the facility.

The RWSF will minimize cumulative effects on the environment by being built on an existing facility in an areas previously contaminated, and thus will not add impacts by disturbing additional areas on the Site.

In selecting a remedy, emphasis was on flexibility and environmental protection. The selected remedy offers a environmental protection, durability, and the ability to safely contain remediation waste for whatever period of time is needed. It is a facility well suited to safely contain the remediation waste for long periods of time which would allow new technologies to be developed to treat or contain the waste or for alternative sites for offsite disposal to be developed. In the decision making process, a key factor to the decision was the potential that if the waste could not be removed in a reasonable time period, flexibility was needed to continue to safely store the waste. This facility can safely store the waste for any duration while still retaining protectiveness.

~~7.3 RISK EVALUATION~~

Then we should bring a summary of this in our disc. in Sect 2

A number of studies have been conducted to provide assurance that the recommended alternative will meet the established criteria for the RWSF. ~~These analyses were conducted~~ to support CAMU criteria for protection of public health and the environment as listed in 6-CCR-1007-3 Part 264.552 (c). The analysis of risk ~~has been~~ was divided into the following three main exposure pathways:

Insert 1

The details of the risk evaluation are found in Section 7.

- Offsite transport of contaminants through the groundwater to neighboring surface waters;
- Worker exposure to radionuclides during operations; and
- Offsite fugitive dust emissions.

The potential for vertical contaminant migration through underlying geologic strata into the Laramie-Fox Hills aquifer has previously been addressed and is considered to be an unrealistic scenario, (see RMRS, 1996). The most conservative calculations of volatile

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CAMU criteria for protection of public health and the environment as listed in 6-CCR-1007-3 Part 264.552 (c). The analysis of risk has been divided into three main exposure pathways. These are:

- Offsite transport of contaminants through the groundwater to neighboring surface waters,
- Worker exposure to radionuclides during operations and,
- Offsite fugitive dust emissions.

Insert 2

Exposure to the public from infiltration through the underlying geologic strata into the lower Laramie sandstone/Fox Hills drinking water aquifer was considered and ruled out. To date, there are no indications that contaminants could travel through over 500 feet of claystones ~~into the Fox Hills~~ aquifer within the 1,000 year time frames considered. ~~The US~~ Geological Survey (Hurr, 1976) concluded ~~that plant operations would not impact this aquifer~~. More information on the hydrology of RFETS is available in the ~~Groundwater Geochemistry Report for RFETS, EG&G~~ Rocky Flats, Inc., January, 1995.

Insert 3

Exposures from inadvertent intrusion into the TSF after closure were also ruled out primarily because waste will be actively managed by inspections and monitoring throughout the life of the facility. In addition, ~~it is assumed that as long as wastes remain on-site in the protected area (PA) and, the site is~~ on the CERCLA National Priorities List (NPL), administrative controls will be required to limit access onto the site and 5 year public health reviews will be required to ensure that the remedies used remain protective as long as waste remains on-site. It is also assumed that a fully integrated sitewide monitoring network will remain in effect to detect any releases from this action or any other as long as waste remains on site.

In addition to the pathways analyses referenced above, an analysis of technical and administrative controls is included. These controls are the administrative, design, operational, and post closure practices put in place to ensure releases are prevented or are prevented from impacting human health and the environment. Institutional controls can include deed restrictions, interagency agreements, and other controls.

7.4.1 Off site transport of contaminants through the groundwater to neighboring surface waters

As with most waste management systems, accidental off site releases to the public or the environment constitutes the majority of risk. Siting criteria, design requirements, and facility monitoring requirements have all been established to mitigate the likelihood of a release event occurring. Several studies relative to the location of the TSF, as well as the design itself, have been conducted to assess the likelihood of a release and the resulting level of contamination associated with such an event. One of the pathways considered was a release of contamination from the facility to groundwater and the

Insert 4

~~(a)~~ fugitive dust emissions will be addressed by both administrative and engineering controls. Modeling calculations show that the ~~concentrations~~ activity levels in soils to be placed in the RMSF ~~is~~ are much lower than activities that would pose a threat to human health at the ~~the~~ plant boundary.

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are removed from the environment through ~~deactivation,~~ D&D, and environmental restoration activities, cost savings can be realized since these areas no longer require active landlord management. This early closure can result in ~~what is termed~~ "mortgage reduction". Savings achieved from reducing the mortgage through these cleanup activities can be applied to accelerate additional activities supporting Site closure.

ie, reduced costs of operating the RFETS

Treatment requirements which are not necessary to protect human health and the environment can be deferred under the flexibility of the CAMU regulations. This further allows finite resources to be focused on actual cleanup sooner rather than in the future.

2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents.

This criteria is meant to address risks that occurr during remediation which active waste handling and operation of the CAMU

Not only does the RWSF CAMU not create unacceptable risks but it eliminates risks that might be associated with alternative remedies. The RWSF CAMU minimizes risks to human health and the environment in the following ways:

~~Preamble to the CAMU Rule~~

- Remediation waste is removed from the environment and put into an effective and protective facility. No longer will it be exposed to natural transport phenomena that could spread the contamination.

(Federal Register Vol. 58 No. 29 Feb 16, 1993)

- Safety precautions will be taken during construction of the facility. All activities will be performed within the extreme safety and radiological protection standards that exist at the Site. Individuals with expertise specific to safety construction will ensure that all construction activities are carried out in a safe manner. Construction quality assurance efforts will ensure that the RWSF will meet all design criteria and performance standards for protectiveness.

- Initial transportation of the wastes will be performed in a controlled environment over short distances on non-public roads with minimal or controlled traffic. Operations will be closely monitored and safely controlled. Public exposure will be limited because the waste will not leave the plant site ~~until final closure of the Site rather than~~ ~~throughout the life of site closure~~ during remediation operations. Because the distances will be so short and the process will be tightly controlled, the risk of transportation accidents will also be minimized. Administrative and engineered controls will be used to ensure that ~~high~~ high winds do not mobilize the contamination during transport. These measures may include precautions such as covered loads, spraying water or other dust suppressants on the loads, high wind shut downs, and other appropriate precautions. ~~Final disposition of the wastes will be conducted once cleanup is complete, allowing resources to be more efficiently focused, economies of scale to be achieved, and support operations to be appropriately scaled.~~ during remediation

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If any remediation waste remains in place a final cap will be installed.

- Safety during filling of the facility will also be closely monitored and controlled. Precautions being considered include spraying the waste for dust suppression, keeping the waste covered, high wind shut downs, and appropriate personal protective equipment. All filling activities will be conducted under appropriate health and safety plans.

An interim operational cover will be installed to protect the waste from exposure to the elements during

Indirect effects and cumulative impacts of the Environmental Restoration program at the Site will be reduced by utilizing the centralized RWSF. Impacts to the environment will be minimized because the footprint of contaminated areas will be reduced to one facility compared to multiple IHSSs that now exist. ~~and the RWSF will be constructed and thus will not impact previously undisturbed areas of the Site.~~

built on a previously disturbed and contaminated area

3) The CAMU shall include uncontaminated areas of the facility, only if including such areas for the purposes of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.

requires justification for selecting a camu in an uncontaminated location, and

This CAMU criteria was a major influence upon the selection of the RWSF location east of the Solar Ponds. ~~This location is in a contaminated area of the Site~~. The proposed RWSF location east of the Solar Ponds overlaps with the following areas of contamination:

The location selected is in an area previously affected by waste management activities ~~a contaminated area of the site~~ and thus meets this criteria.

Federal Register, Feb 16, 1993 Cont 1993

- **IHSS 165 - The Triangle Area** This IHSS was part of the former OU 6. Drums containing plutonium-bearing wastes were stored in this area. The drums leaked and contaminated the soil. In 1973, 200 cubic yards of soil were removed from this site.

- **IHSS 176 - Swinerton and Walberg Contractor Storage Yard** This IHSS was part of the former OU 10. Water spray from the Solar Ponds blew into this area. Also, leaking drums containing waste oils and volatile organic compounds were stored here. Volatile organic compounds were detected during the soil gas survey characterization of this site.

- **HSS 101 - Solar Ponds Area** These are former OU 4 solar evaporation ponds which were used for storage and evaporation of liquid low-level radioactive waste. All of the sludge has been removed from the Solar Ponds but the liners are still in place. The proposed CAMU location overlaps the eastern edge of the ponds. Additional facilities may be placed on the ponds themselves if expansion of the RWSF is needed and designated in the future. Placement of the facility at this location is expected to facilitate ~~cleanup~~ remediation operations at the Solar Ponds.

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- **Building 964** - This building housed low-level waste storage. It was also exposed to the water spray coming from the solar ponds.

Although this area is contaminated, it is not expected that placement of the RWSF in this area will hamper any cleanup operations. Likewise, the levels of contaminants that would be found at the RWSF construction site are not expected to hamper its construction or operation.

4) Areas within that CAMU, where remediation wastes remain in place after closure of the CAMU, shall be managed and contained so as to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment.

This criterion is not applicable. At this time, the intended use of this facility is for monitored, retrievable waste storage.

See criteria 1 and 2 above.

5) The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). ~~The Department shall designate a CAMU in accordance with the following:~~

(1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

(2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to hazardous wastes or hazardous constituents.

Once constructed, the facility will expedite remedial activities. Waste will be transported directly from excavation or treatment into the RWSF. Planning documents for cleanups will be simplified since the waste management methodology will be established. It will be possible to establish work crews that could clean up IHSSs in an almost assembly-line fashion, moving from IHSS to IHSS with the necessary equipment while trucks transport the remediation waste to the RWSF. Concurrent to these activities, new modules to the RWSF could be constructed so that there would be sufficient capacity available to accept the waste. Crews could be simultaneously performing ~~deactivation followed by~~ D&D and environmental restoration, moving from building to building, and transporting these waste materials to the RWSF.

Without the RWSF, cleanup and D&D activities may be limited ~~to~~ by the rate at which wastes can be shipped off site

6) The CAMU shall enable the use, when appropriate, of treatment technologies (including innovative technologies) to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste that will remain in place after closure.

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The selected remedy supports the ability to treat waste before or after placement. Wastes could be treated in-place prior to excavation, after excavation, or because the RWSF design supports retrievability, the waste could be retrieved and treated. ~~It could even be possible to apply some types of innovative technologies in the facility itself since the waste will be completely contained.~~

The CAMU ~~will~~ could also support treatment technologies by acting as a centralized location for remediation waste treatment. This will also allow economies of scale to be achieved so that technologies not cost-effective for small quantities of wastes might be more applied to large volumes.

replace w/ attached

Temporary or permanent staging areas near the facility could be set up, and mobile or permanent treatment equipment could be bought in. These treatment technologies could include soil washing, solidification, thermal desorption or more innovative technologies identified in the future.

See criteria 1 and 2 above.

7) The CAMU shall minimize the land area of the facility upon which remediation wastes will remain in place after closure of the CAMU unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). ~~The Department shall designate a CAMU in accordance with the following:~~

(1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

(2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to hazardous wastes or hazardous constituents.

This criterion is supported by the fact that multiple source areas at RFETS that might have previously been closed in place now have the option of closure to the action levels agreed to in the RFCA. The CAMU will support a bias towards removal rather than isolating sources in place. This will facilitate release of areas at RFETS for future land use, as described in the RFETS Vision.

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5) The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). See criteria 1 and 2 above.

Once constructed, the facility will expedite remedial activities. Waste will be loaded into containers directly from excavation or treatment and transported to the CSF. Planning documents for cleanups will be simplified since the waste management methodology will be established. It will be possible to establish work crews that could clean up IHSSs in an almost assembly-line fashion, moving from IHSS to IHSS with the necessary equipment while trucks transport the remediation waste in roll-off type containers to the CSF. Concurrent to these activities, waste would be shipped offsite and, if necessary, new modules to the CSF could be constructed so that there would be sufficient capacity available to accept the waste. Crews could be simultaneously performing deactivation followed by D&D and environmental restoration, moving from building to building, and transporting these waste materials to the CSF.

6) The CAMU shall enable the use, when appropriate, of treatment technologies (including innovative technologies) to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste that will remain in place after closure.

Insert

Because the proposed ~~CSF~~ RWFS will be for storage of ~~containerized~~ waste only, it will not impact or be impacted by the use of treatment technologies. Treatment to enhance the long-effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste that will remain in place after closure is a key element of the ER program and of all cleanup actions at RFETS. At RFETS, most IHSS source removals will involve treatment to remove the hazardous component of mixed low level waste. Treated waste that meets the action levels in RFCA will be placed back in the IHSS and will remain in place after closure. This waste minimization and reduction of toxicity and mobility approach results in only shipping for offsite disposal wastes that are either above the RFCA action levels for radiological dose, or from which the hazardous component cannot be removed easily. D&D wastes are not anticipated to need treatment (other than sizing) prior to shipment for offsite disposal.

thermal desorption waste to the CAMU or for

If it were deemed cost-effective for a specific cleanup or treatment technology, temporary or permanent staging areas near the facility could be set up, and mobile or permanent treatment equipment could be bought in. However, this would not be performed as part of the CAMU, and is not part of the CAMU designation request.

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This section presents the substantive criteria that 6CCR Subpart 3 and RFCA require for a CAMU to be designated at the site

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4.0 IDENTIFICATION OF SUBSTANTIVE CRITERIA

Paragraph 80 of RFCA provides: "(I)f the application meets the appropriate substantive criteria CDPHE will issue a CAMU designation." Likewise, the CAMU rule, promulgated pursuant to the CHWA, states that "(t)he Department shall specify, in the permit or order, requirements for CAMUs..." (See 6 CCR 1007-3, Part 264.552 [e).

4.1 RCRA CAMU ~~Objectives~~ Criteria

The designation of a Corrective Action Management Unit must be performed in accordance with the seven criteria enumerated in 6 CCR 1007-3, Part 264.552(c). ~~The seven criteria are, by nature, high level objectives. For that reason, the seven criteria were adapted and used in Section 6.0 as the decision criteria for comparison and selection of an alternative~~. The seven CAMU ~~objectives~~ criteria include: were discussed in Section 2.0 of this document and

1. The CAMU must facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

2. The waste management activities associated with the CAMU must not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents;

3. The CAMU may only include uncontaminated areas of the facility if including such areas is more protective;

4. Where remediation wastes will remain in place after closure, the CAMU must be managed and contained so as to control, minimize or ~~eliminate~~ future releases to the extent necessary to protect human health and the environment;

5. The CAMU must expedite the timing of remedial actions;

6. The CAMU must enable the use, when appropriate, of treatment technologies to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste.

7. The CAMU must be placed on the minimal area necessary to provide a reliable, effective, protective, and cost effective remedy.

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Section 7.4 of this document discusses how the selected design ~~complies~~ addresses the RFCA Requirements.

4.2 RFCA Requirements

The requirements under RFCA for CAMU designation are presented in paragraphs 80 and 109 of RFCA:

Paragraph 80 of RFCA provides:

> ...that the design criteria for the facility described in this paragraph shall be the same whether the facility is for the retrievable, monitored storage of remediation wastes or for the disposal of remediation wastes. Specifically, the facility described in this paragraph must ensure retrievability of wastes and protection of human health and the environment through a combination of requirements that include, but are not limited to: detection and monitoring/inspection requirements; operating and design requirements, including cap/liner system that meets the requirements as set forth in 6 CCR 1007-3, Part 264, Subpart N; a groundwater monitoring system; and requirements for responding to releases of wastes or constituents from the units. In addition, where necessary for protection of human health and the environment, waste treatment will be required. If DOE proposes a CAMU, it is the expectation of the Parties that if the application meets the appropriate substantive criteria, CDPHE will issue a CAMU designation for storage or disposal in a timely fashion..."

Italics

In response to RFCA paragraph 80, the following design and operating requirements will be addressed and implemented:

- leak detection;
- inspections;
- a ~~cap~~ cap/liner system that meets RCRA Subpart N requirements;
- a groundwater monitoring system;
- corrective action for releases; and
- a waste acceptance criteria, consistent with design and operation, that provides treatment of wastes where necessary.

The above requirements are discussed in Section 7 for the specific selected alternative, the Concrete Lined Cell. In addition, As part of the IM/IRA process, paragraph 109 of RFCA also directs ~~consideration of seven topics, including:~~ DOE to present an analysis of alternatives showing that DOE has considered the following:

- worker safety;
- protection of human health and the environment;
- transportation;
- facility design, containment, and monitoring;
- institutional controls;
- cost; and
- community acceptance.

5/2

6CCR Subpart S, Part 264.552(a)(2) states:
"For the purposes of the application of the minimum technology requirements of 40 CFR part 264.5(h)(2), or of the minimum technology requirements of subparts K, L, M or N, or the groundwater protection requirements of subpart F and Application Support Document or the closure and post-closure requirements of subpart G of Part 264 or 265 of these regulations, consolidation or placement of remediation waste into or within a CAMU does not constitute creation of a regulated unit."

4.3 CAMU Requirements

Additional requirements for designation are enumerated in Part 264.552(e) of the CAMU rule. The following are the additional requirements:

- specification of the area configuration, Part 264.552 (e) (1);
- specification of the design requirements (Part 264.532 (e) (2);
- specification of operation requirements (Part 264.552 (e) (2);
- specification of groundwater monitoring requirements (Part 264.552 (e) (3);
- specification of closure and post closure requirements (Part 264.552 (e) (2) that:
  - minimize the need for further maintenance and (Part 264.552 (e) (4) (iii) (A);
  - consider the CAMU design (Part 264.552 (e) (4) (iii) (A);
  - consider the potential for releases (Part 264.552 (e) (4) (iii) (C);
  - consider the physical and chemical characteristics of the waste (Part 2 64.552 (e) (4) (iii) (D);
  - consider hydrological and other environmental conditions at the facility that may influence the migration of any releases (Part 264.552 (e) (4) (iii) (E);
  - consider potential human or environmental exposures to releases (Part 264.552 (e) (4) (iii) (F)
  - requirements for excavation, removal, treatment, or containment of remediation wastes (Part 264.552 (e) (4) (ii) (A);
  - requirements for removal and decontamination of equipment, devices and structures used in remediation waste management activities within the CAMU (Part 264.55 (e) (4) (ii) (C);

Paragraph 80 of RFCA provides: "(I)f the application meets the appropriate substantive criteria CDPHE will issue a CAMU designation." Likewise, the CAMU rule, promulgated pursuant to the CHWA, states that: "(t)he Department shall specify, in the permit or order, requirements for CAMUs..." (See 6 CCR 1007-3 Part 264.552 (e).

5/3

4.0 IDENTIFICATION OF SUBSTANTIVE CRITERIA

This section presents the substantive criteria that 6 CCR Subpost 5 and RFCA require for a CAMU to be designated at RFETS. Paragraph 80 of RFCA provides: "If the application meets the appropriate substantive criteria CDPHE will issue a CAMU designation." Likewise, the CAMU rule, promulgated pursuant to the CHWA, states that "The Department shall specify, in the permit or order, requirements for CAMUs..." (See 6 CCR 1007-3, Part 264.552 (c).

4.1 RFCA CAMU CRITERIA

The designation of a Corrective Action Management Unit must be performed in accordance with the seven criteria enumerated in 6 CCR 1007-3, Part 264.552(c). The seven CAMU criteria were discussed in section 2.0 of this document and include:

1. The CAMU must facilitate the implementation of reliable, effective, protective, and cost-effective remedies;
2. The waste management activities associated with the CAMU must not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents;
3. The CAMU may only include uncontaminated areas of the facility if including such areas is more protective;
4. Where remediation wastes will remain in place after closure the CAMU must be managed and contained so as to control, minimize or eliminate future releases to the extent necessary to protect human health and the environment;
5. The CAMU must expedite the timing of remedial actions;
6. The CAMU must enable the use, when appropriate, of treatment technologies to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste.
7. The CAMU must be placed on the minimal area necessary to provide a reliable, effective, protective, and cost effective remedy.

4.2 RFCA Requirements

The requirements under RFCA for CAMU designation are presented in paragraphs 80 and 109 of RFCA. Section 7.4 of this document discusses how the selected design addresses the RFCA requirements. Paragraph 80 of RFCA states:

> " that the design criteria for the facility described in this paragraph shall be the same whether the facility is for the retrievable, monitored storage of remediation wastes or for the disposal of remediation wastes. Specifically, the facility described in this paragraph must ensure retrieve of wastes and protection of human health and the environment through a

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Insert A

Continue to detect and to characterize the nature , extent, concentration, direction, and movement of existing releases of hazardous constituents in groundwater from sources located within th CAMU (Part 264.552 (e)(3)(i) and;

Detect and subsequently characterize releases of hazardous constituents to groundwater that may occur from areas of the CAMU in which remediation wastes will remain in place after closure of the CAMU (Part 264.552(e)(3)(ii).

Insert B.

Control, minimize, or eliminate, to the extent necessary to protect human health and the environemnt, for areas where remediaiton wastes remain in place, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground, to groundwater, to surface waters, or to the atmosphere (Part 264.552(4)(i)(B)

Insert C

Supparts B,C,D, and E (listed below) are addressed in Section 7 for the selected alternative as noted.

- Part 264, Subpart B General Facility Standards (Section 7.1, 7.2, 7.4, 7.7)
- Part 264, Subpart C Preparedness and Prevention (Sections 7.4, 7.7)
- Part 264, Subpart D, Contingency Plan and Emergency Procedures (Sections 7.4, 7.7)
- Part 264, Subpart E, Manifest System, Recordkeeping, and Reporting, (Sections 7.4, 7.7)

The specific details of how these requirements will be met must be described in the RWSF design and associated documents by DOE after a CAMU designation has been approved.

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combination of requirements that include, but are not limited to: detection and monitoring/inspection requirements; operating and design requirements, including cap/liner system that meets the requirements as set forth in 6 CCR 1007-3, Part 264, Subpart N; a groundwater monitoring system; and requirements for responding to releases of wastes or constituents from the units. In addition, where necessary for protection of human health and the environment, waste treatment will be required. If DOE proposes a CAMU, it is the expectation of the parties that if the application meets the appropriate substantive criteria, CDPHE will issue a CAMU designation for storage or disposal in a timely fashion. . . ."

In response to RFCA paragraph 80, the following design and operating requirements will be addressed and implemented:

- leak detection; (section 7-1, 7.4)
- inspections; (7.4)
- a cap/liner system that meets RCRA Subpart N requirements; (Section 7.1, 7.4)
- a groundwater monitoring system; (Section 7.1, 7.4)
- corrective action for releases; ~~and~~ (7.4)
- a waste acceptance criteria, consistent with design and operation, that provides treatment of wastes where necessary. (7.6)

The above requirements are discussed in Section 7 for the specific selected alternative, the Concrete Lined Cell.

In addition, as part of the ~~IM/RAE~~ IM/IRA process, paragraph 109 of RFCA also directs DOE to present an analysis of alternatives showing that DOE has considered the following:

- worker safety; (7.2.1, 7.3.2, 7.6)
- protection of human health and the environment; (7.2.1, 7.3, 7.4)
- transportation; (7.4)
- facility design, containment, and monitoring; (7.4, 7.1)
- institutional controls; (7.4,
- cost; ~~and~~ (7.2.1)
- community acceptance (Section 8.0 public comment)

4.3 CAMU Requirements

Six CC R Subpart S, Part 264.552 (a) (2) states:

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"For the purposes of the application of the minimum technology requirements of 40CFR Part 268.5 (h) (2); or of the minimum technology requirements of Subparts K, L, M, or N; or the groundwater protection requirements of Subpart F; or the closure and post-closure requirements of Subpart G of part 264 or 265 of these regulations; consolidation or placement of remediation waste into or within a CAMU does not constitute creation of a regulated unit."

Part 264.552 (a) (3) requires:

"Where the remediation wastes placed into a CAMU are hazardous wastes, the CAMU shall comply with Subparts B, C, D, and E of Part 264 or 265 of these regulations and, when such remediation wastes will remain in place after closure of the CAMU, the CAMU shall comply with the regulations for the siting of hazardous waste disposal sites, 6 CCR 1007-2, Part 2."

Insert C attached

Additional requirements for designation are enumerated in 6 CCR Part 264.552(e) of the CAMU rule. The following are the additional requirements after the designation of the CAMU (Compliance with these requirements is duscussed in section 7.7).

Insert A attached

- specification of the area configuration, Part 264.552 (e) (1));
- specification of the design requirements (Part 264.532 (e) (2);
- ~~specification~~ of operation and closure ~~requirements (Part 264.552 (e) (2)~~ sufficient to
- specification of groundwater monitoring requirements (Part 264.552 (e) (3);
- specification of closure and post closure requirements (Part 264.552 (e) (~~2~~ 4) that:
  - minimize the need for further maintenance ~~and~~ (Part 264.552 (e) (4) ~~(iii)~~ (A)
  - ~~consider the CAMU design (Part 264.552 (e) (4) (iii) (A)~~ (i)
  - consider the potential for releases (Part 264.552 (e) (4) (iii) (C)
  - consider the physical and chemical characteristics of the waste (Part 264.552 (e) (4) (iii) (D)
  - consider hydrological and other environmental conditions at the facility that may influence the migration of any releases (Part 264.552 (e) (4) (iii) (E)
  - consider potential human or environmental exposures to releases (264.552 (e) (4) (iii) (F)
  - requirements for excavation, removal, treatment, or containment of remediation wastes (Part 264.552 (e) (4) (ii) (A)
  - requirements for removal and decontamination of equipment, devices and structures used in remediation waste management activities within CAMU (Part 264.55 (e) (4) (ii) (C)

Insert B

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5.0 FACILITY DESCRIPTION

This section describes the conceptual design of the Containerized Storage Facility (CSF) which has been proposed for the management of remediation wastes. The CSF has been proposed to be located in the southwest corner of the Industrial Area (Figure 5-1). The CSF would be composed of a series of engineered metal buildings, as shown on Figure 5-2, which would be constructed to serve as a staging facility in the receiving, storage, and ultimate shipment of remediation waste. The proposed location benefits from minimal site preparation costs, verses alternate locations, and the presence of an adjacent rail spur for offsite shipment. A footprint of 6.8 acres would include up to four modular buildings which could ultimately store 5,000, 20-cu-yd-capacity cargo containers each, for a total capacity of up to 100,000 cu yds. The modular design would allow the final configuration and storage capacity to be flexible in order to meet changing waste-storage requirements. The Metal Buildings would be constructed on reinforced concrete foundations with a double liner and leachate collection system under each building foundation. The double liner and leachate collection system, (see Figure 5-3) would comply with RCRA Subtitle C requirements as defined in 6 CCR 1007-3, Part 264 Subpart N. The remediation waste would be effectively isolated from the environment by the following three barrier systems:

- Containers
- Structural concrete floor slab with integral leachate collection system
- Double liner system (e.g. primary barrier HDPE geomembrane and secondary barrier combined HDPE geomembrane and clay liner) with leachate detection and collection system

not spelled out previously?

The CSF would have a design life of twenty years (e.g. 10 years operation under the Ten Year Plan (~~Ten Year Plan~~) and operation for an additional 10 years as a contingency) at which time it is assumed the remediation waste would have been transported to an offsite facility for disposal.

does the TYP include this as a given or a contingency?

5.1 RFCA DESIGN CONSIDERATIONS

RFCA paragraph 80 describes requirements that have been incorporated into the conceptual design such as leachate detection and collection. Details of how these requirements will be

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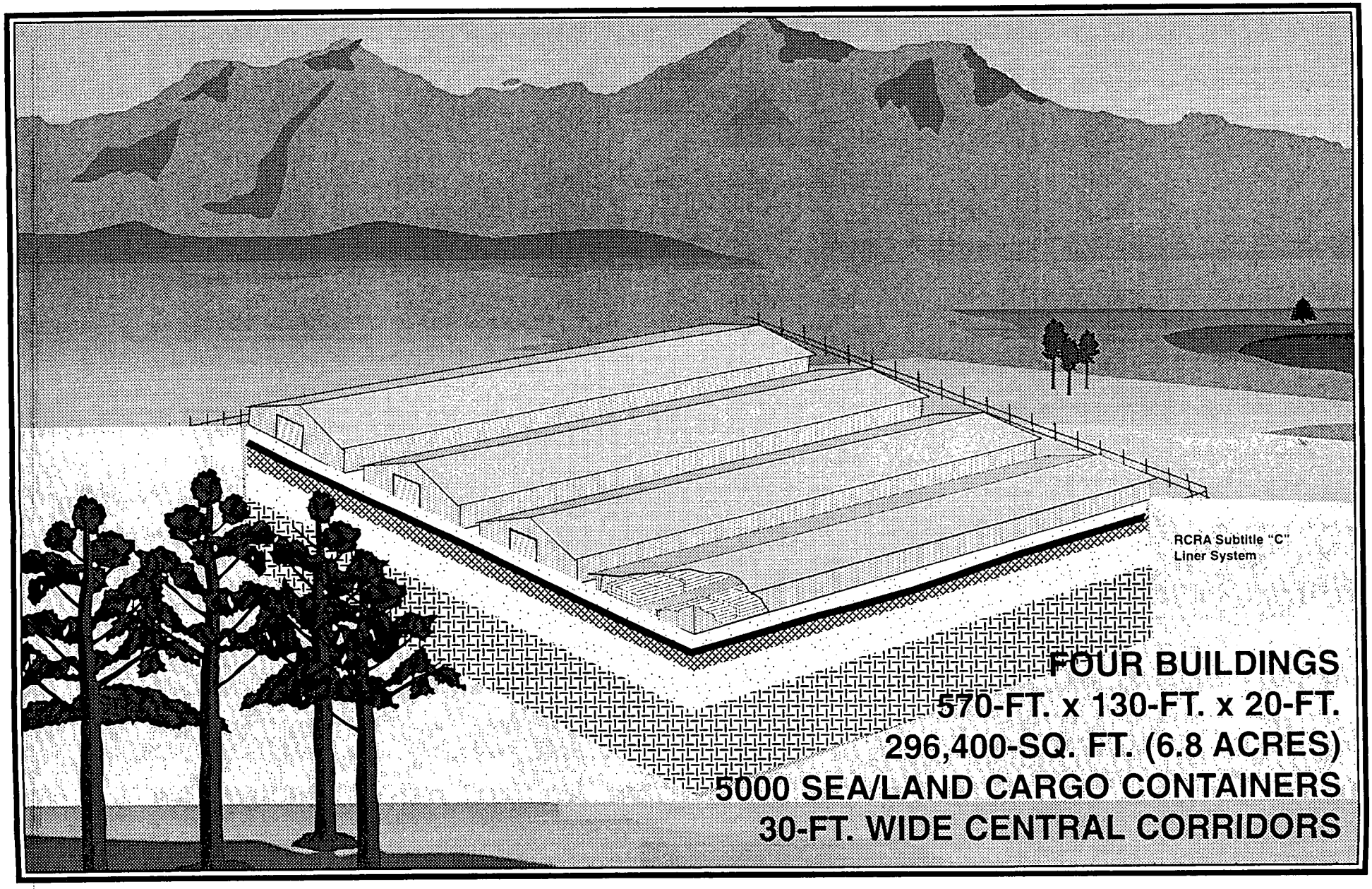

Figure 5-2

CONTAINERIZED STORAGE FACILITY

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met will be submitted during the design phase. Incorporated as part of the proposal alternative are the following:

- Detection and monitoring/inspection (part of the alternatives analysis and facility operational plans)
- Cap/liner in compliance with 6 CCR 1007-3 Par 264, Subpart N
- Ground water monitoring system to be developed as part of the design/construction

Also, the following would be developed as part of the design/construction:

- Operating and design requirements (to be included as design submittals and operational plans)
- Requirements for responding to releases of wastes or constutuents from the units
- Waste treatment requirements (to be provided in the WAC)

The following features were used to develop a conceptual cost estimate (see Table 5-1):

- Four metal buildings, each 570 ft. long by 130 ft. wide and 20 ft. eave height
- Each building would be constructed, when required, dependent upon waste volumes
- Buildings would be constructed over a reinforced concrete floor
- A maximum total of 5000 - 20 cu yd cargo containers for the entire four building CSF
- Cargo containers would be stacked three high in the buildings
- Each building would have a thirty foot wide central corridor and personnel access aisles for routine monitoring and inspection
- A twenty year design life
- Cargo containers

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CONTAINERIZED STORAGE FACILITY LINER

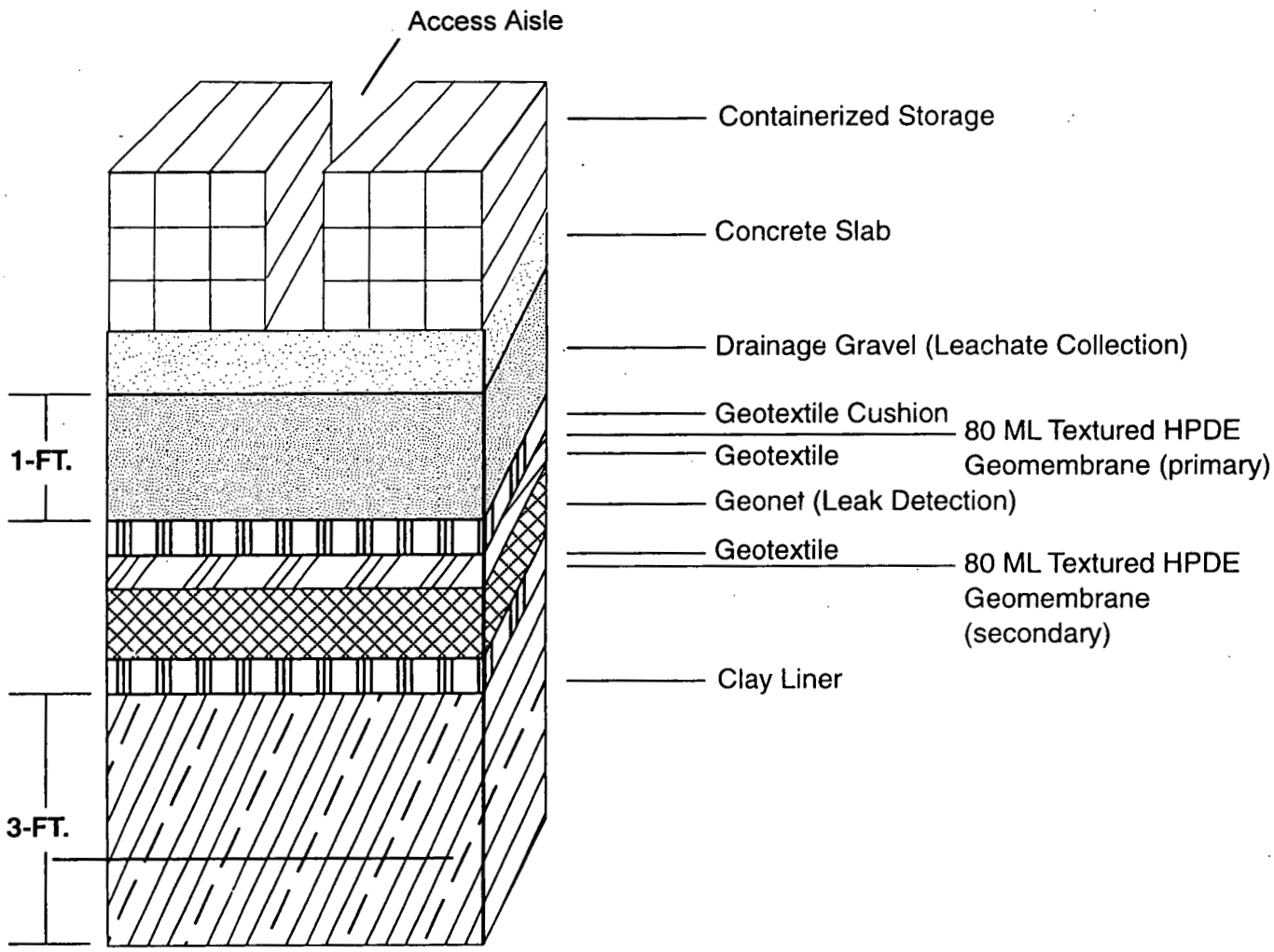

Figure 5-3

CONTAINERIZED STORAGE FACILITY CROSS SECTION

- Double liner system and leachate collection system
- Groundwater monitoring wells (six total maximum) would be installed both up gradient and down gradient and would be operated through the life cycle of the CSF (20 years)

TABLE 5-1 SUMMARY OF COSTS FOR THE CSF

TASK DESCRIPTION	ESTIMATED COST
Containers	$68,177,000
Site Preparation	$1,209,000
Engineering Design / Project & Const. Mgmt.	$3,685,000
Construction	
A. Four Metal Buildings	$9,307,000
B. Double Liner System	$3,236,000
C. Leachate Collection/Detection System	$386,000
Total Cost [1]	**$86,000,000**

Notes:
1. A 25% contingency cost is included in the estimate

The leachate collection and retrieval system would collect any potential leachate and it would be transferred to a facility for treatment.

5.2 WASTE CHARACTERISTICS AND CONCEPTUAL WASTE ACCEPTANCE CRITERIA

The following sections describe the waste and associated acceptance criteria for the CSF. Section 5.2.1 gives a brief identification of the waste characteristics which could be received at the CSF. Section 5.2.2 gives estimates of the waste volumes and section 5.2.3 briefly explains what the Waste Acceptance Criteria (WAC) would address for the CSF.

5.2.1 Remediation Waste Characterization

This section describes the general waste types characteristics which may be placed in the CSF. Identification of waste characteristics, sources and projected volumes for the CSF clarify and substantiate the need for a contingency to existing waste storage. Only remediation waste would be considered for management in this facility.

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Remediation waste is defined as follows by RFCA, part 5, line 26, item (bf):

> (1) solid, hazardous, and mixed wastes; (2) all media and debris that contain hazardous substances, listed hazardous or mixed wastes or that exhibit a hazardous characteristic; and (3) all hazardous substances generated from activities regulated under this Agreement as RFCA corrective actions or CERCLA response actions, including decommissioning. Remediation waste does not include wastes generated from other activities. Nothing in this definition confers RCRA or CHWA authority over source, special nuclear, or byproduct material as those terms are defined in the Atomic Energy Act.

In addition, low-level waste, as defined by RFCA, is radioactive waste that is not high-level waste, spent nuclear fuel, by-product material, or transuranic waste (although it may contain small amounts of transuranic elements). The majority of the low-level waste managed at the CSF would have an average radionuclide activity much less than ten nanocuries per gram (nCi/g) based on the Hazard Categorization Analysis (Kaiser Hill, 1996).

Remediation waste types for the CSF are expected to include the following:

- Contaminated soil collected from remedial actions, usually treated to remove volatile organics
- Treated and untreated sludge and sediments
- Toxic Substance Control Act (TSCA) waste (such as asbestos and PCBs)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions
- IDM from past and future characterization activities, such as wells, and borings, if the IDM is characterized as hazardous, low-level, or low-level mixed remediation waste
- D&D waste which has been characterized as hazardous, low-level, or mixed waste. D&D waste includes building rubble, equipment, and utilities removed from the building prior to demolition.

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5.2.2 Remediation Waste Volume

Waste volume estimates were based on planned risk reduction activities. A preliminary estimate of remediation waste volumes ~~the~~ that may require storage prior to ultimate disposal is presented in Table 5-2 below. The total volume of remediation waste is estimated to be 101,800 m^3 or 133,000 cu yd which would be placed in the CSF. These estimates were based on current information and coincide with the Ten Year Plan waste volumes. These volume estimates are not intended to limit the size of the facility, but serve as a tool to create alternatives for the decision making process.

Table 5-2 Remediation Waste Volumes for the Containerized Storage Facility

Remediation Waste Types	Total Estimated Volume (m^3)	Total Estimated Volume (yd^3)	Volume Ranges (m^3)
Low Level Waste	40,716	53,293	32,573 m^3 to 81,432 m^3
Low Level Mixed Waste	53,438	79,945	48,863 m^3 to 122,156 m^3
Total	94,000	133,238	81,435 m^3 to 203,588 m^3

Where referenced?

Notes:
1. These waste volumes are estimated within a range of -50% to +100%.

The actual volume of soil defined by Tier 1 and Tier 2 cleanup levels in RFCA could be larger or smaller because volume estimates were made with preliminary data from limited characterization.

5.2.3 Conceptual Waste Acceptance Criteria

The purpose of the CSF is to provide ER and D&D activities the services of a staging facility for the receiving, interim storage and ultimate shipping of remediation waste. Waste acceptance criteria (WAC) would be developed for the CSF to ensure remediation wastes comply with applicable regulatory and site requirements. The CSF would accept remediation waste in transportable containers which have accompanying documentation that meets the waste acceptance criteria of the anticipated target disposal facility. The WAC would be specific for the CSF and may not address specific requirements as required by other offsite disposal facilities which ultimately would receive the waste. For criteria which can be

quantified, specific levels would be identified. The following objectives would be achieved in compliance with the WAC:

1. Remedial wastes are effectively isolated from potential natural environmental pathways to protect the public health and the environment.
2. Operating personnel of the CSF ensure continuous protection to the public health and the environment.
3. Remediation waste is routinely monitored and inspected.
4. Characterization data of the remediation waste is documented to the extent necessary to support project specific waste management objectives and WAC requirements for the CSF.

As previously mentioned, the CSF would receive remediation waste from ER and D&D activities which would be handled as bulk wastes in customized cargo containers verses crates or drums. The CSF **is not** a handling facility and is not intended to repackage waste once received.

The WAC would provide physical and chemical limitations and requirements for the proper management of remediation waste. Process knowledge and/or chemical and radiological analyses would become the tools to document accurate characterization of the remedial waste.

5.2.3.1 Physical Requirements

A summarized list of physical requirements which the WAC would address are listed below:

- Physical properties of bulk wastes such as soils, sediments, and treated sludge (e.g. maximum size range, specific weight, moisture content)
- Physical properties of wastes classified as debris (e.g. maximum size range, specific weight, moisture content, non-biodegradable)
- No free liquids (e.g. 6 CCR 1007-3 Subpart N 264.314; EPA Paint Filter Test)
- Conditions for filled and emptied containers (6 CCR 1007-3 Subpart N 264.315)
- Prohibitions of containerized gases, ignitable or reactive wastes (6 CCR 1007-3 Subpart N 264.312, 313)

5.2.3.2 Chemical Requirements

A summarized list of chemical requirements which the WAC would address are listed below:

- Chemical analyses, acceptable analytical methods, and detection ranges.
- Prohibited constituents and chemical characteristics including reactive or ignitable substances (e.g. pyrophoric uranium; 6 CCR 1007-3 Subpart N 264.312)
- Chemical compatibility's (6 CCR 1007-3 Subpart N 264.313)
- pH limitations
- Composition of wastes

5.2.3.3 Health and Safety Issues

The primary concerns of Health and Safety for the CSF are itemized as follows:

- Operations involving heavy equipment (e.g. large forklifts/cranes) for the handling of containers
- Health and Safety issues for the industrial worker
- Threshold limits of radionuclides for the CSF
- The CSF would require operating and administrative procedures for the assurance of safe operations involving heavy equipment and protective measures for the industrial worker.

The WAC would address the following radiological requirements:

- Radiochemical analyses for characterization
- Threshold limits of radionuclides for the CSF

The majority of low level remediation waste to be managed at the CSF would have an average radionuclide activity less than ten nanocuries per gram (nCi/g) as mentioned previously under section 5.2.1. A preliminary hazard category analysis was performed for the CSF. The CSF

was categorized less than a Category 3 facility and designated as a Radiological Non-nuclear Facility based on preliminary threshold quantities of plutonium and other radioactive isotopes (Kaiser-Hill, 1996c). This categorization analysis was based on sampling data from some of the more radioactive IHSSs at RFETS (e.g. Solar Ponds, 903 Pad and Lip Area, and the Original Process Waste Lines). To be conservative in the hazard analysis, the highest activity concentrations were used from these IHSSs. The CSF would not receive transuranic waste (TRU).

5.3 Technical and Administrative Controls

Technical and administrative controls would be implemented in order to ensure that human health and the environment would be protected from areas where present or past activities preclude unrestricted access or use, ~~controls are implemented~~. The technical and administrative controls would ~~be met~~ meet the requirements in RFCA paragraph 80 for a CAMU. Discussion of controls for the CSF is grouped into four major elements:

1 • Engineering Controls (e.g. double liner system, leachate collection/detection system, interim cover)

2 • Facility Monitoring (e.g. groundwater monitoring plan)

3 • Operational Controls (e.g. waste acceptance criteria, inspection, H&S plan, contingency/spill response plan)

4 • Administrative Controls (e.g limited access, institutional controls)

1. Engineering controls - There would be specific engineering controls designed into the facility in order to support protection of human health and the environment throughout the operational life of the facility. The following engineering controls of the CSF would comply with 6 CCR 1007-3, Part 264, Subpart N, 264301 - Design and operating requirements: 264.302 - Action leakage rate; 264.303 - Monitoring and inspection; and 264.304 - Response actions:

- Double liner system (e.g. primary barrier - geosynthetic layer; secondary barrier - composite layer consisting of clay layer overlain by geosynthetic)

- Leachate collection/removal system (e.g. two systems; the first system is an integral collection/removal system constructed in the floor slab with sumps and piping; the second system is the coarse sand drainage layer above the primary barrier with integral collection pipes, pumps and sumps)

- Leak detection system (e.g. geonet layer between the primary and secondary barriers)

- An internal infrastructure designed to facilitate retrieval of wastes

2. Facility Monitoring - In addition to the monitoring and inspection per 264.303 for the double liner system and a fully instrumented leak detection system, an extensive monitoring network would ensure no releases pass undetected from the unit boundary. This would include both air and surface water monitoring stations and groundwater monitoring wells upgradient and downgradient of the CSF which would require a groundwater monitoring plan. These requirements would also be integrated into the overall RFETS monitoring program to ensure that a comprehensive network was in place to help protect human health and the environment.

3. Operational Controls - Operational controls would be put in place to ensure that waste management operations were conducted in such a way as to minimize the risk of release from the facility or exposure to personnel:

- An agency-approved waste acceptance criteria specifying a safety envelope for chemical and physical waste parameters including appropriate treatment requirements

- An operational health and safety plan approved by the agencies designed to provide operational constraints for personnel protection, weather conditions, decontamination procedures, training requirements, emergency response, and health and safety monitoring

- Standard operating procedures that establish clear repeatable guidelines for conduct of operations, including packaging and transporting of waste from D&D or IHSS remediation locations to the CSF

- Numerous quality assurance procedures from construction quality assurance, as cited earlier per Subpart 264.303 (a) monitoring and inspection, to procedural audits all designed to ensure the facility and operations meet designated performance standards

- Closure plans that define how the facility would be decommissioned after the life of the operations and the performance standards for closure per Subpart 264.310 and 264.552 (e)

- Contingency/spill response plans per Subpart 264.304 would define how the facility responds to a release of waste or constituents from the CSF.

Administrative Controls - Administrative controls are defined to ensure that risk of exposure during construction, operations, and closure are minimized. These may include:

- Appropriate institutional controls (e.g. warning signs, fences, deed restrictions)

- Security plans which define site restriction requirements throughout the life of the project

- Cleanup standards which define the level of cleanup necessary to certify closure

In summary, numerous technical and administrative controls would be in place to insure that all aspects of this effort were conducted in such a way that risks to human health and the environment would be minimal.

5.4 NEPA VALUES

The proposed CSF would be authorized using a single, integrated Decision Document that would be signed by the DOE, and the State of Colorado, when approved. The Decision Document and review process would satisfy the documentation and procedural requirements of the RFCA. The National Environmental Policy Act (NEPA) process was integrated into the RFCA documentation and procedure, especially public involvement and decision-making, to reduce duplication and paperwork, and streamline the combined NEPA/CERCLA process. In accordance with the DOE Secretarial Policy issued in June 1994, integrated CERCLA/RCRA documents for environmental clean up activities are to incorporate NEPA values to the extent practical. This policy is intended to minimize the cost and time for document preparation and review while meeting the requirements of both acts.

The CSF would be anticipated to minimize cumulative effects on the environment by being placed in the Western Industrial Area because of the following:

insert 5.4.1 "Anticipated Damages to Natural Resources" [see attached]

- The proposed area in the industrial area has been already disturbed and consolidation of waste is achieved

- Existing infrastructure already exists which would support the CSF

- The proposed area was selected based on a detailed siting study which screened out sensitive areas (e.g. areas ~~populating~~ populated by the ~~endangered~~ rare species Prebles Jumping Mouse, steep slopes, wetlands, etc., were avoided)

the habitat is what is most important. Can we say habitat? Do this analysis address Prebles habitat? w/ John Stater; DOE is SSA coordinator or Steve Nesta.

The analyses required by NEPA ~~were~~ STET integrated throughout the Decision Document. Based on the analyses, the decision-making process ~~requires~~ STET no further documentation to complete the NEPA process.

5.5 REMEDIATION WASTE STORAGE FACILITY OPERATIONS

The CSF would be operated and maintained under a number of administrative requirements, as previously mentioned in section 5.3 "Technical and Administrative Controls," to ensure compliance with paragraph 80 of RFCA. Administrative controls would be administered for activities of waste operations in the following areas:

1. WAC documents and forms - These would be required to demonstrate compliance with the RWSF WAC and paragraph 80 of RFCA requirements previously mentioned in section 2.2

2. Operating procedures - Procedures for handling and placement of waste, facility maintenance and documentation to ensure safe and efficient operation of CSF

3. Training Plans - A plan to administer required training for operating personnel in procedures, safety, and quality assurance

4. Health & Safety plans - The health and safety requirements for operating personnel to conduct operations in a safe manner

5. Contingency/spill response plans would define, per Subpart 264.03, how the facility would respond to a release of waste or constituents from the CSF

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6. Limiting operating conditions - Identification of abnormal events which would require operations to temporarily stop activities (e.g. excessive wind velocities, and other weather conditions) to ensure safety to the public, the workers, and the environment

7. Administrative procedure and plans - Additional procedures and plans to ensure compliance with RFCA, DOE orders, and RFETS rules and policies

8. Control of fugitive dust emissions - Facility Monitoring plan as cited in section 5.3 to reduce dust emissions and monitor results to protect the public and worker

9. Closure Plan - This would include the requirements and performance standards for closure per Subpart 264.310 and 264.552 (e) to close the facility after the end of its operational life

Additional requirements addressed in the WAC or Facility Operations Plan for compliance would be areas addressing administrative controls. The following requirements would ensure the RWSF to be operated in a safe manner:

- Recordkeeping and documentation
- Waste information from process knowledge and/or sampling and analysis data for waste characterization
- Quality assurance/quality control (QA/QC) certification program and verification;
- Status reports and waste forecasts
- Shipment notification

Packaging and labeling requirements

5.4.3 CLOSURE REQUIREMENTS FOR THE CSF

Once the CSF has shipped offsite all remediation waste it would be subjected to closure requirements under RFCA Part 9 Subpart B paragraphs 97, 118, and 121. A closure plan would be submitted which described the following items to meet the closure performance goals of 264.111:

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- A description of how the CSF would be closed to meet the closure performance standards
- A description of how final closure would be conducted
- An estimate of the maximum inventory of remediation waste managed within the CSF
- A detailed description of the steps required to decontaminate all hazardous waste residues, containment system components, equipment, structures, and soils for final closure
- A description of how other activities ensure the closure performance standards are satisfied (e.g. ground-water monitoring, leachate collection, run-on and run-off controls.
- A schedule for final closure.

5.5 CONCLUSION

The CSF is proposed as a contingency to the existing Ten Year Plan. This IM/IRA Decision Document is the tool to designate the proposed IA-West area as a CAMU for storage of remediation waste as a contingency to the Ten Year Plan. The Decision Document identifies and explains, in a detailed study and analysis, the best location onsite for the selected remedy—Metal Buildings. In the event remediation waste could not be shipped offsite as originally anticipated under the Ten Year Plan, the DOE would have the option of implementing the CAMU as their contingency for interim storage of remediation waste pending shipment.

In several areas, this Document suggests that approval of the CAMU would result in different methods of operation, suggesting that the CAMU is not actually viewed as a "contingency"

6.0 SCHEDULE

The attached Gantt chart, Figure 6-1, presents project task information as both text and graphics. Information about each task is listed in the Gantt table on the left side of the figure. The Gantt bar chart displays task durations and start and finish dates on a timescale. The relative positions of the task bars show which tasks start and finish before each other and which task overlap other tasks.

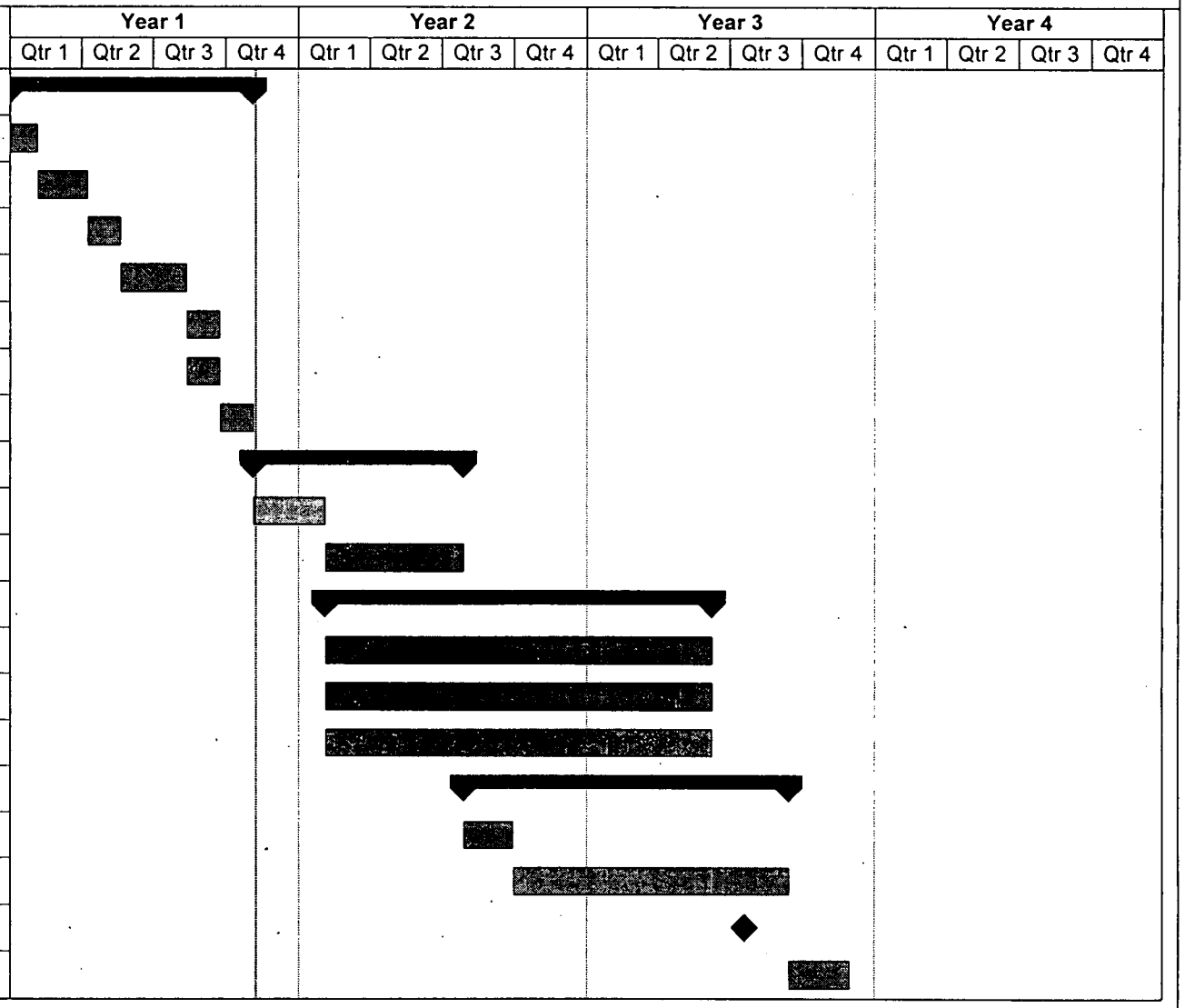
In Paragraph 109 of RFCA, subparagraphs (b) and (c) durations for the CAMU designation process are given as such:

> b. Within 45 days of receipt of DOE's draft IM/IRA, CDPHE shall determine that IM/?IRA meets of fails to meet the criteria in subparagraph (a). IF CDPHE determines that the draft fails to meet the criteria, it shall, at the end of its 45 day review, explain with specificity the necessary modifications and allow Doe to resubmit within 30 days or to invoke dispute resolution within 14 days. If CDPHE determines that the application meets the criteria described in subparagraph (a) , it shall issue the draft IM/IRA for public comment for a period of 60 days.
>
> c. Within 30 days of the close of the public comment period, CDPHE shall review the comments received and modify the draft if appropriate. The agency shall also prepare a response to significant public comments at this time. At the end of this 30 day period, if CDPHE still agrees that the IM/IRA as modified meets the regulatory criteria for designation and the criteria in paragraph 80, CDPHE shall designate the storage CAMU. If CDPHE has determined that the IM/IRA does not meet these same criteria, it shall state the changes that DOE must make to receive approval.

Once the CAMU designation is complete, design construction of the facility would occur only as a contingency action and would take a little more than two years. The facility would then be tested and opened for use. Placement of remediation waste in the facility would be dependent on the progress of D&D and remediation activities. The schedule for eventual shipment of the waste offsite has not been determined; nonetheless the Ten Year Plan assumes that all low level mixed waste would be disposed of by the year 2007.

FIGURE 6-1: PROPOSED CONTAINERIZED STORAGE FACILITY SCHEDULE

Task Description	Dur
DECISION DOCUMENT	221d
PREPARE DECISION DOCUMENT (DD)	26d
CDPHE REVIEW DD	45d
MODIFY DD BASED ON CDPHE COMMENTS	30d
PUBLIC COMMENT PERIOD ON THE DD	60d
MODIFY DD BASED ON PUBLIC COMMENT	30d
PREPARE RESPONSIVENESS SUMMARY	30d
FINAL APPROVAL OF DD	30d
DESIGN	190d
PREPARE CONCEPTUAL DESIGN	65d
PREPARE DETAILED DESIGN	125d
OPERATIONAL AND MONITORING PLAN DEVELOPMENT	350d
PREPARE OPERATIONAL DOCUMENTATION	350d
PREPARE MONITORING PLAN	350d
OPERATIONAL PROCEDURES & TESTING	350d
CONSTRUCTION	295d
PREPARE SITE FOR CONSTRUCTION	45d
CONSTRUCTION OF PREFERED ALTERNATIVE	250d
BEGIN OPERATIONS	0d
PROJECT CLOSE-OUT	55d



PROPOSED CONTAINERIZED STORAGE FACILITY SCHEDULE

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

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7.0 REFERENCES

DOE, 1996a, *Final Rocky Flats Cleanup Agreement*, July 16.

DOE, 1996b, *Draft Ten Year Plan*, July 30.

Kaiser-Hill, 1996a, Hazard Categorization Analysis for Waste Management Facility, January.

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Rick DiSalvo

5.0 FACILITY DESCRIPTION

This section describes the conceptual design of the Containerized Storage Facility (CSF) which has been proposed for the management of remediation wastes. The CSF has been proposed to be located in the southwest corner of the Industrial Area (Figure 5-1). The CSF would be composed of a series of engineered metal buildings, as shown on Figure 5-2, which would be constructed to serve as a staging facility in the receiving, storage, and ultimate shipment of remediation waste. The proposed location benefits from minimal site preparation costs, verses alternate locations, and the presence of an adjacent rail spur for offsite shipment. A footprint of 6.8 acres would include up to four modular buildings which could ultimately store 5,000, 20-cu-yd-capacity cargo containers each, for a total capacity of up to 100,000 cu yds. The modular design would allow the final configuration and storage capacity to be flexible in order to meet changing waste-storage requirements. The Metal Buildings would be constructed on reinforced concrete foundations with a double liner and leachate collection system under each building foundation. The double liner and leachate collection system, (see Figure 5-3) would comply with RCRA Subtitle C requirements as defined in 6 CCR 1007-3, Part 264 Subpart N. The remediation waste would be effectively isolated from the environment by the following three barrier systems:

- Containers
- Structural concrete floor slab with integral leachate collection system
- Double liner system (e.g. primary barrier HDPE geomembrane and secondary barrier combined HDPE geomembrane and clay liner) with leachate detection and collection system

The CSF would have a design life of twenty years (e.g. 10 years operation under the Ten Year Plan (Ten Year Plan) and operation for an additional 10 years as a contingency) at which time it assumed the remediation waste would have been transported to an offsite facility for disposal.

5.1 RFCA DESIGN CONSIDERATIONS

RFCA paragraph 80 describes requirements that have been incorporated into the conceptual design such as leachate detection and collection. Details of how these requirements will be

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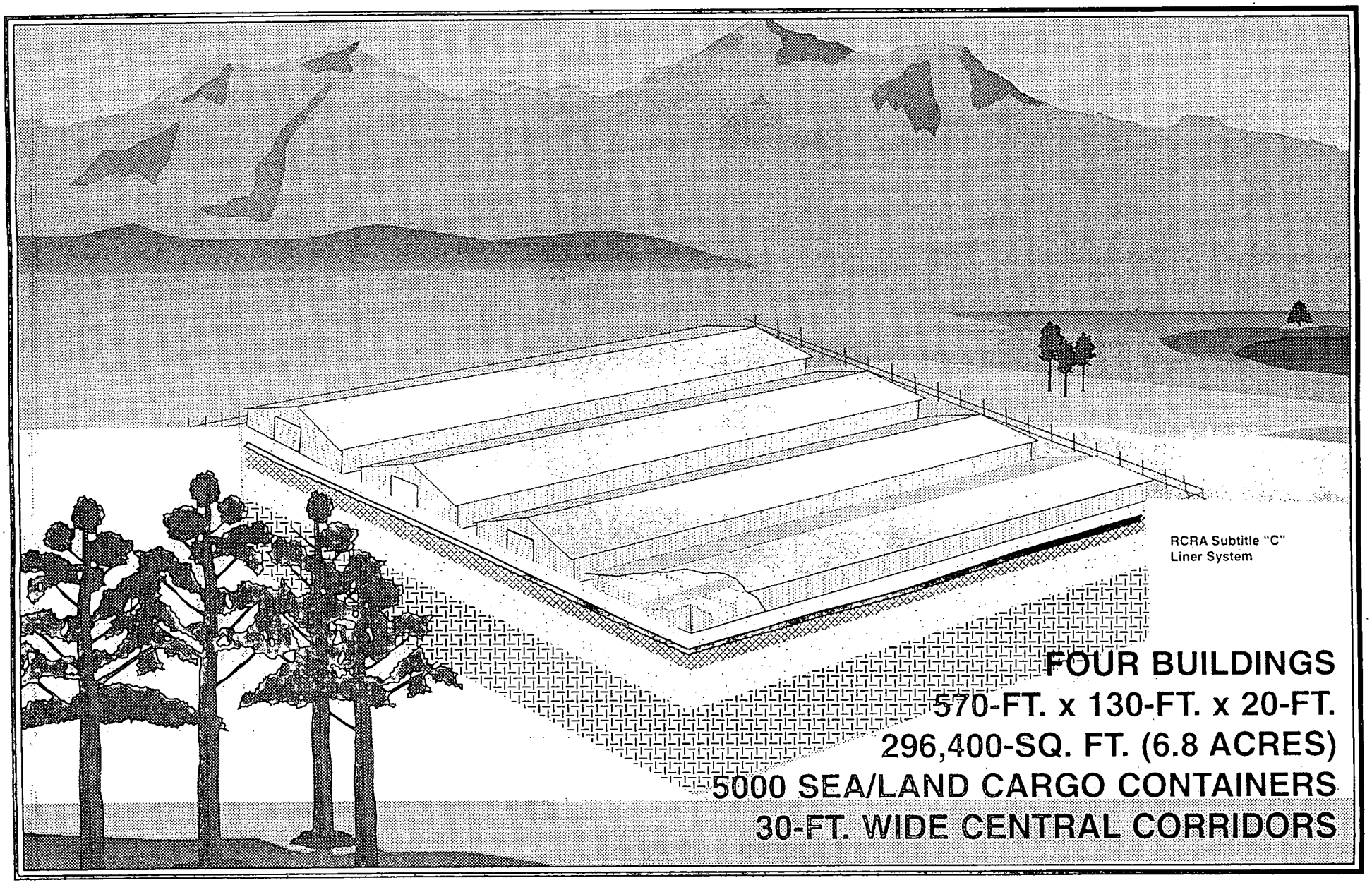

Figure 5-2

CONTAINERIZED STORAGE FACILITY

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CONTAINERIZED STORAGE FACILITY LINER

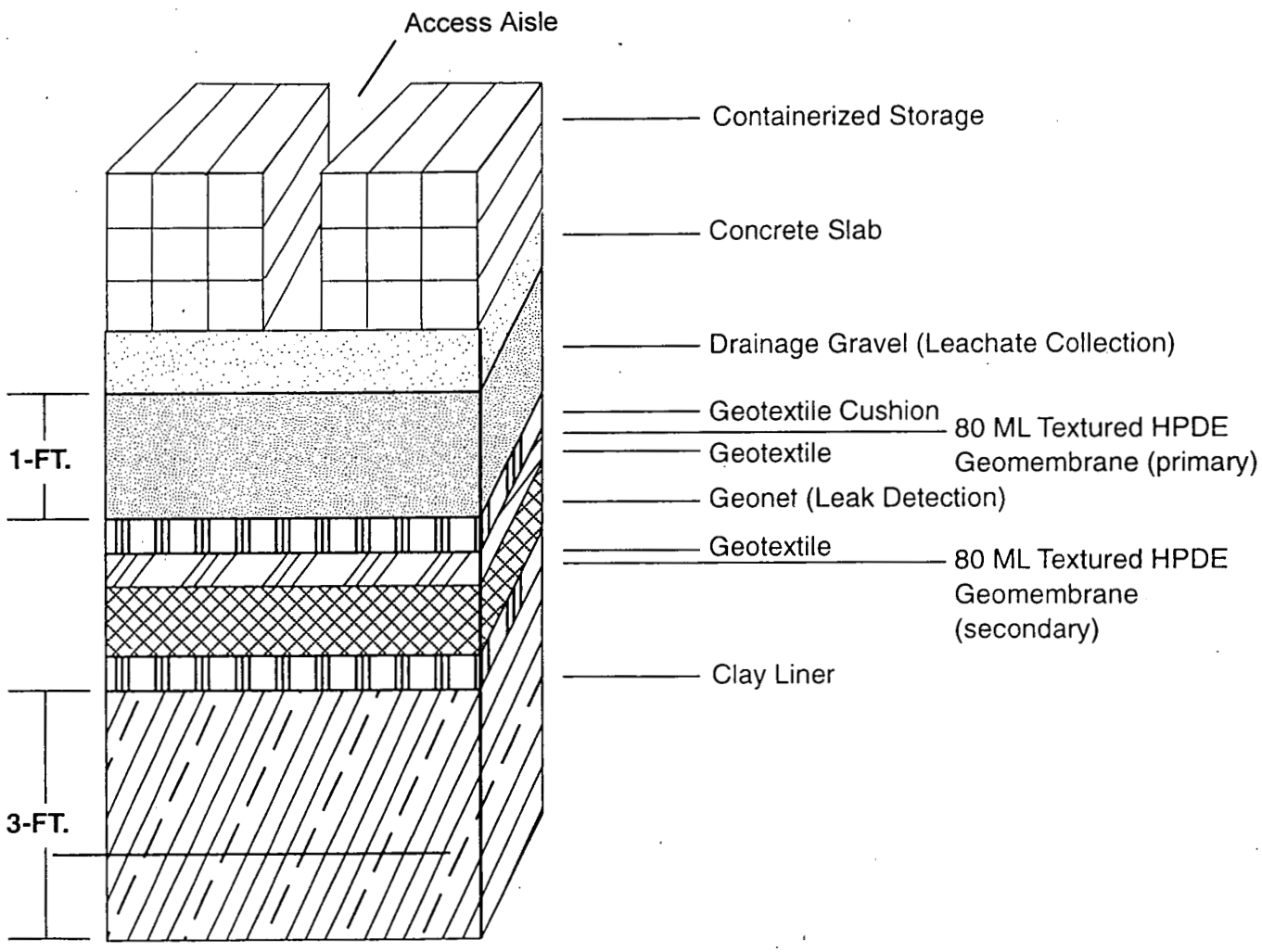

Figure 5-3

CONTAINERIZED STORAGE FACILITY CROSS SECTION

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We need to say this in Sec. 3 perhaps but if not, need it here.

met will be submitted during the design phase. Incorporated as part of the proposal alternative are the following:

- Detection and monitoring/inspection (part of the alternatives analysis and facility operational plans)
- Cap/liner in compliance with 6 CCR 1007-3 Part 264, Subpart N
- Ground water monitoring system to be developed as part of the design/construction

Note - a cap is not required unless the facility is to be closed as a landfill. A cap ~~this~~ design would be submitted with any proposal to close the facility as a landfill. It is presently assumed that the waste shall be removed from the facility for closure, and no cap will be required. See 5.4.3

Also, the following would be developed as part of the design/construction:

- Operating and design requirements (to be included as design submittals and operational plans)
- Requirements for responding to releases of wastes or constutuents from the units
- Waste treatment requirements (to be provided in the WAC)

The following features were used to develop a conceptual cost estimate (see Table 5-1):

- Four metal buildings, each 570 ft. long by 130 ft. wide and 20 ft. eave height
- Each building would be constructed, when required, dependent upon waste volumes
- Buildings would be constructed over a reinforced concrete floor
- A maximum total of 5000 - 20 cu yd cargo containers for the entire four building CSF
- Cargo containers would be stacked three high in the buildings
- Each building would have a thirty foot wide central corridor and personnel access aisles for routine monitoring and inspection
- A twenty year design life
- Cargo containers

Note also, Subpart N allows possibility that liner can be omitted upon approval 264.301(b) -

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- Double liner system and leachate collection system
- Groundwater monitoring wells (six total maximum) would be installed both up gradient and down gradient and would be operated through the life cycle of the CSF (20 years) – existing wells may be used for this purpose if properly located.

TABLE 5-1 SUMMARY OF COSTS FOR THE CSF

TASK DESCRIPTION	ESTIMATED COST
Containers	$68,177,000
Site Preparation	$1,209,000
Engineering Design / Project & Const. Mgmt.	$3,685,000
Construction	
A. Four Metal Buildings	$9,307,000
B. Double Liner System	$3,236,000
C. Leachate Collection/Detection System	$386,000
Total Cost [1]	**$86,000,000**

Notes:
1. A 25% contingency cost is included in the estimate

The leachate collection and retrieval system would collect any potential leachate and it would be transferred to a facility for treatment.

5.2 WASTE CHARACTERISTICS AND CONCEPTUAL WASTE ACCEPTANCE CRITERIA

The following sections describe the waste and associated acceptance criteria for the CSF. Section 5.2.1 gives a brief identification of the waste characteristics which could be received at the CSF. Section 5.2.2 gives estimates of the waste volumes and section 5.2.3 briefly explains what the Waste Acceptance Criteria (WAC) would address for the CSF.

5.2.1 Remediation Waste Characterization

This section describes the general waste types characteristics which may be placed in the CSF. Identification of waste characteristics, sources and projected volumes for the CSF clarify and substantiate the need for a contingency to existing waste storage. Only remediation waste would be considered for management in this facility.

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Remediation waste is defined as follows by RFCA, part 5, line 26, item (bf):

> (1) solid, hazardous, and mixed wastes; (2) all media and debris that contain hazardous substances, listed hazardous or mixed wastes or that exhibit a hazardous characteristic; and (3) all hazardous substances generated from activities regulated under this Agreement as RFCA corrective actions or CERCLA response actions, including decommissioning. Remediation waste does not include wastes generated from other activities. Nothing in this definition confers RCRA or CHWA authority over source, special nuclear, or byproduct material as those terms are defined in the Atomic Energy Act.

In addition, low-level waste, as defined by RFCA, is radioactive waste that is not high-level waste, spent nuclear fuel, by-product material, or transuranic waste (although it may contain small amounts of transuranic elements). The majority of the low-level waste managed at the CSF would have an average radionuclide activity much less than ten nanocuries per gram (nCi/g) based on the Hazard Categorization Analysis (Kaiser Hill, 1996).

Remediation waste types for the CSF are expected to include the following:

- Contaminated soil collected from remedial actions, usually treated to remove volatile organics
- Treated and untreated sludge and sediments
- Toxic Substance Control Act (TSCA) waste (such as asbestos and PCBs)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions
- IDM from past and future characterization activities, such as wells, and borings, if the IDM is characterized as hazardous, low-level, or low-level mixed remediation waste
- D&D waste which has been characterized as hazardous, low-level, or mixed waste. D&D waste includes building rubble, equipment, and utilities removed from the building prior to demolition.
- Protective clothing and equipment that is contaminated with remediation waste and wastes generated from decontamination of equipment and the like.

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5.2.2 Remediation Waste Volume

Waste volume estimates were based on planned risk reduction activities. A preliminary estimate of remediation waste volumes the may require storage prior to ultimate disposal is presented in Table 5-2 below. The total volume of remediation waste is estimated to be 101,800 m^3 or 133,000 cu yd which would be placed in the CSF. These estimates were based on current information and coincide with the Ten Year Plan waste volumes. These volume estimates are not intended to limit the size of the facility, but serve as a tool to create alternatives for the decision making process.

Table 5-2 Remediation Waste Volumes for the Containerized Storage Facility

Remediation Waste Types	Total Estimated Volume (m^3)	Total Estimated Volume (yd^3)	Volume Ranges (m^3)
Low Level Waste	40,716	53,293	32,573 m^3 to 81,432 m^3
Low Level Mixed Waste	53,438	79,945	48,863 m^3 to 122,156 m^3
Total	94,000	133,238	81,435 m^3 to 203,588 m^3

Notes:
1. These waste volumes are estimated within a range of -50% to +100%.

The actual volume of soil defined by Tier 1 and Tier 2 cleanup levels in RFCA could be larger or smaller because volume estimates were made with preliminary data from limited characterization.

5.2.3 Conceptual Waste Acceptance Criteria

The purpose of the CSF is to provide ER and D&D activities the services of a staging facility for the receiving, interim storage and ultimate shipping of remediation waste. Waste acceptance criteria (WAC) would be developed for the CSF to ensure remediation wastes comply with applicable regulatory and site requirements. The CSF would accept remediation waste in transportable containers which have accompanying documentation that meets the waste acceptance criteria of the anticipated target disposal facility. The WAC would be specific for the CSF and may not address specific requirements as required by other offsite disposal facilities which ultimately would receive the waste. For criteria which can be

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quantified, specific levels would be identified. The following objectives would be achieved in compliance with the WAC:

1. Remedial wastes are effectively isolated from potential natural environmental pathways to protect the public health and the environment.

2. Operating personnel of the CSF ensure continuous protection to the public health and the environment.

3. Remediation waste is routinely monitored and inspected.

4. Characterization data of the remediation waste is documented to the extent necessary to support project specific waste management objectives and WAC requirements for the CSF.

As previously mentioned, the CSF would receive remediation waste from ER and D&D activities which would be handled as bulk wastes in customized cargo containers verses crates or drums. The CSF **is not** a handling facility and is not intended to repackage waste once received.

The WAC would provide physical and chemical limitations and requirements for the proper management of remediation waste. Process knowledge and/or chemical and radiological analyses would become the tools to document accurate characterization of the remedial waste.

5.2.3.1 Physical Requirements

A summarized list of physical requirements which the WAC would address are listed below:

- Physical properties of bulk wastes such as soils, sediments, and treated sludge (e.g. maximum size range, specific weight, moisture content)

- Physical properties of wastes classified as debris (e.g. maximum size range, specific weight, moisture content, non-biodegradable)

- No free liquids (e.g. 6 CCR 1007-3 Subpart N 264.314; EPA Paint Filter Test)

- Conditions for filled and emptied containers (6 CCR 1007-3 Subpart N 264.315)

- Prohibitions of containerized gases, ignitable or reactive wastes (6 CCR 1007-3 Subpart N 264.312, 313)

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5.2.3.2 Chemical Requirements

A summarized list of chemical requirements which the WAC would address are listed below:

- Chemical analyses, acceptable analytical methods, and detection ranges.
- Prohibited constituents and chemical characteristics including reactive or ignitable substances (e.g. pyrophoric uranium; 6 CCR 1007-3 Subpart N 264.312)
- Chemical compatibility's (6 CCR 1007-3 Subpart N 264.313)
- pH limitations
- Composition of wastes

5.2.3.3 Health and Safety Issues

The primary concerns of Health and Safety for the CSF are itemized as follows:

- Operations involving heavy equipment (e.g. large forklifts/cranes) for the handling of containers
- Health and Safety issues for the industrial worker
- Threshold limits of radionuclides for the CSF
- The CSF would require operating and administrative procedures for the assurance of safe operations involving heavy equipment and protective measures for the industrial worker.

The WAC would address the following radiological requirements:

- Radiochemical analyses for characterization
- Threshold limits of radionuclides for the CSF

The majority of low level remediation waste to be managed at the CSF would have an average radionuclide activity less than ten nanocuries per gram (nCi/g) as mentioned previously under section 5.2.1. A preliminary hazard category analysis was performed for the CSF. The CSF

was categorized less than a Category 3 facility and designated as a Radiological Non-nuclear Facility based on preliminary threshold quantities of plutonium and other radioactive isotopes (Kaiser-Hill, 1996c). This categorization analysis was based on sampling data from some of the more radioactive IHSSs at RFETS (e.g. Solar Ponds, 903 Pad and Lip Area, and the Original Process Waste Lines). To be conservative in the hazard analysis, the highest activity concentrations were used from these IHSSs. The CSF would not receive transuranic waste (TRU).

5.3 Technical and Administrative Controls

Technical and administrative controls would be implemented in order to ensure that human health and the environment would be protected from areas where present or past activities preclude unrestricted access or use, controls are implemented. The technical and administrative controls would be met the requirements in RFCA paragraph 80 for a CAMU. Discussion of controls for the CSF is grouped into four major elements:

- Engineering Controls (e.g. double liner system, leachate collection/detection system, interim cover)
- Facility Monitoring (e.g. groundwater monitoring plan)
- Operational Controls (e.g. waste acceptance criteria, inspection, H&S plan, contingency/spill response plan)
- Administrative Controls (e.g limited access; institutional controls)

Engineering controls - There would be specific engineering controls designed into the facility in order to support protection of human health and the environment throughout the operational life of the facility. The following engineering controls of the CSF would comply with 6 CCR 1007-3, Part 264, Subpart N, 264301 - Design and operating requirements: 264.302 - Action leakage rate; 264.303 - Monitoring and inspection; and 264.304 - Response actions:

- Double liner system (e.g. primary barrier - geosynthetic layer; secondary barrier - composite layer consisting of clay layer overlain by geosynthetic)

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- Leachate collection/removal system (e.g. two systems; the first system is an integral collection/removal system constructed in the floor slab with sumps and piping; the second system is the coarse sand drainage layer above the primary barrier with integral collection pipes, pumps and sumps)

- Leak detection system (e.g. geonet layer between the primary and secondary barriers)

- An internal infrastructure designed to facilitate retrieval of wastes

Facility Monitoring - In addition to the monitoring and inspection per 264.303 for the double liner system and a fully instrumented leak detection system, an extensive monitoring network would ensure no releases pass undetected from the unit boundary. This would include both air and surface water monitoring stations and groundwater monitoring wells upgradient and downgradient of the CSF which would require a groundwater monitoring plan. These requirements would also be integrated into the overall RFETS monitoring program to ensure that a comprehensive network was in place to help protect human health and the environment.

Operational Controls - Operational controls would be put in place to ensure that waste management operations were conducted in such a way as to minimize the risk of release from the facility or exposure to personnel:

- An agency-approved waste acceptance criteria specifying a safety envelope for chemical and physical waste parameters including appropriate treatment requirements

- An operational health and safety plan approved by the agencies designed to provide operational constraints for personnel protection, weather conditions, decontamination procedures, training requirements, emergency response, and health and safety monitoring

- Standard operating procedures that establish clear repeatable guidelines for conduct of operations, including packaging and transporting of waste from D&D or IHSS remediation locations to the CSF

- Numerous quality assurance procedures from construction quality assurance, as cited earlier per Subpart 264.303 (a) monitoring and inspection, to procedural audits all designed to ensure the facility and operations meet designated performance standards

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- Closure plans that define how the facility would be decommissioned after the life of the operations and the performance standards for closure per Subpart 264.310 and 264.552 (e)

- Contingency/spill response plans per Subpart 264.304 would define how the facility responds to a release of waste or constituents from the CSF.

Administrative Controls - Administrative controls are defined to ensure that risk of exposure during construction, operations, and closure are minimized. These may include:

- Appropriate institutional controls (e.g. warning signs, fences, deed restrictions)

- Security plans which define site restriction requirements throughout the life of the project

- Cleanup standards which define the level of cleanup necessary to certify closure

In summary, numerous technical and administrative controls would be in place to insure that all aspects of this effort were conducted in such a way that risks to human health and the environment would be minimal.

5.4 NEPA VALUES

The proposed CSF would be authorized using a single, integrated Decision Document that would be signed by the DOE, and the State of Colorado, when approved. The Decision Document and review process would satisfy the documentation and procedural requirements of the RFCA. The National Environmental Policy Act (NEPA) process was integrated into the RFCA documentation and procedure, especially public involvement and decision-making, to reduce duplication and paperwork, and streamline the combined NEPA/CERCLA process. In accordance with the DOE Secretarial Policy issued in June 1994, integrated CERCLA/RCRA documents for environmental clean up activities are to incorporate NEPA values to the extent practical. This policy is intended to minimize the cost and time for document preparation and review while meeting the requirements of both acts.

The CSF would be anticipated to minimize cumulative effects on the environment by being placed in the Western Industrial Area because of the following:

550

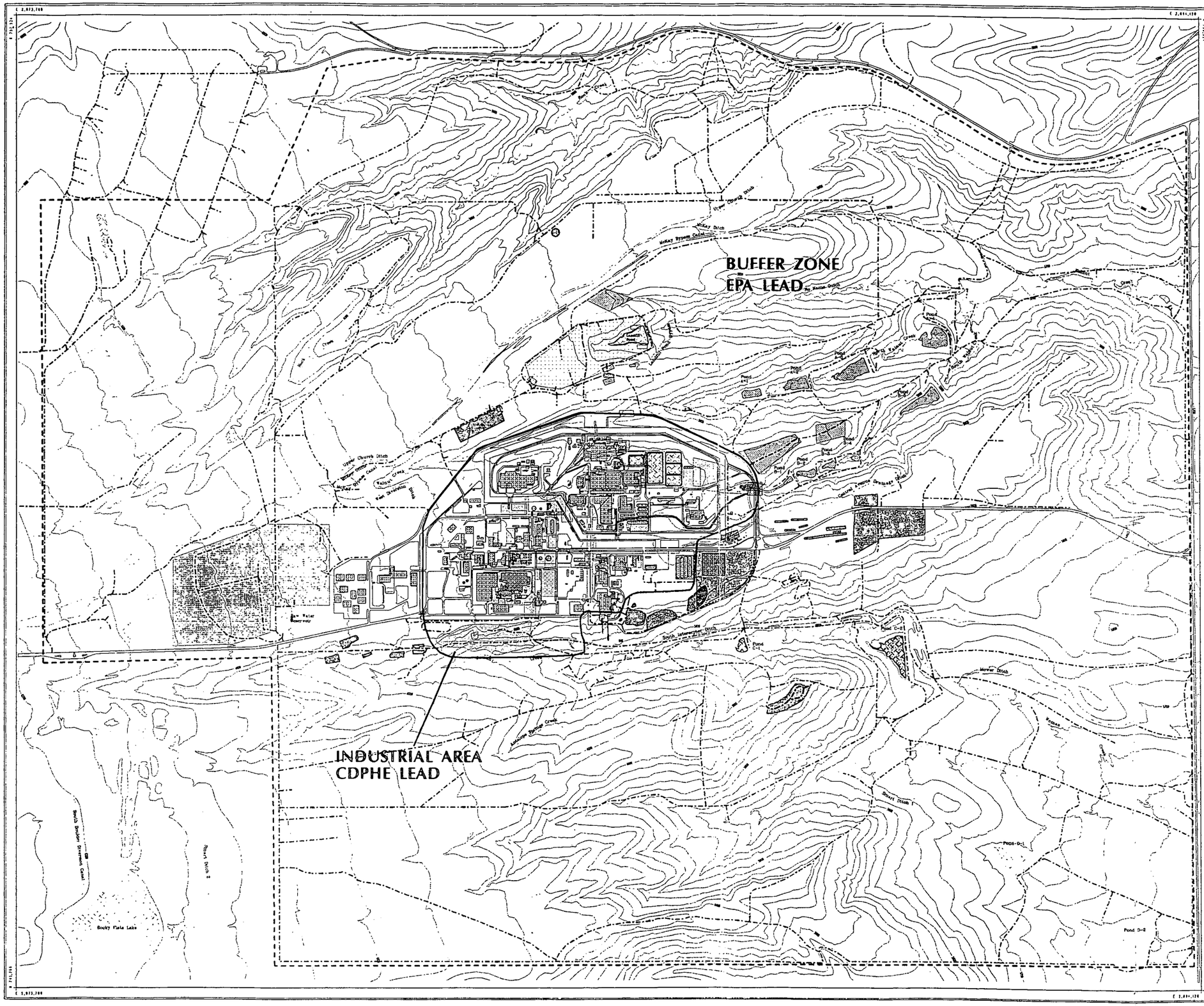

Figure 1-2
Proposed Consolidated Operable Units

Conceptual Strategy Purposes for Discussion Only

See paragraph 67 of RFCA

Symbology is difficult or impossible to interpret on the figure!!

EXPLANATION

Note: OU3 not shown

- Industrial Area OU
- Buffer Zone OU
- Operable Unit 1
- Operable Unit 5
- Operable Unit 6
- Operable Unit 7
- Operable Unit 11 Closed through CAD/ROD Process
- Operable Unit 15 Closed through CAD/ROD Process
- Operable Unit 16 Closed through CAD/ROD Process
- Individual Hazardous Substance Sites (IHSS)

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)
Proposed Consolidated OU's data provided by Annette Primrose of RMRS/SA - 9-1996.

Scale = 1 : 19910
1 inch represents approximately 1659 feet

600 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

MAP ID: x8682 August 14, 1996

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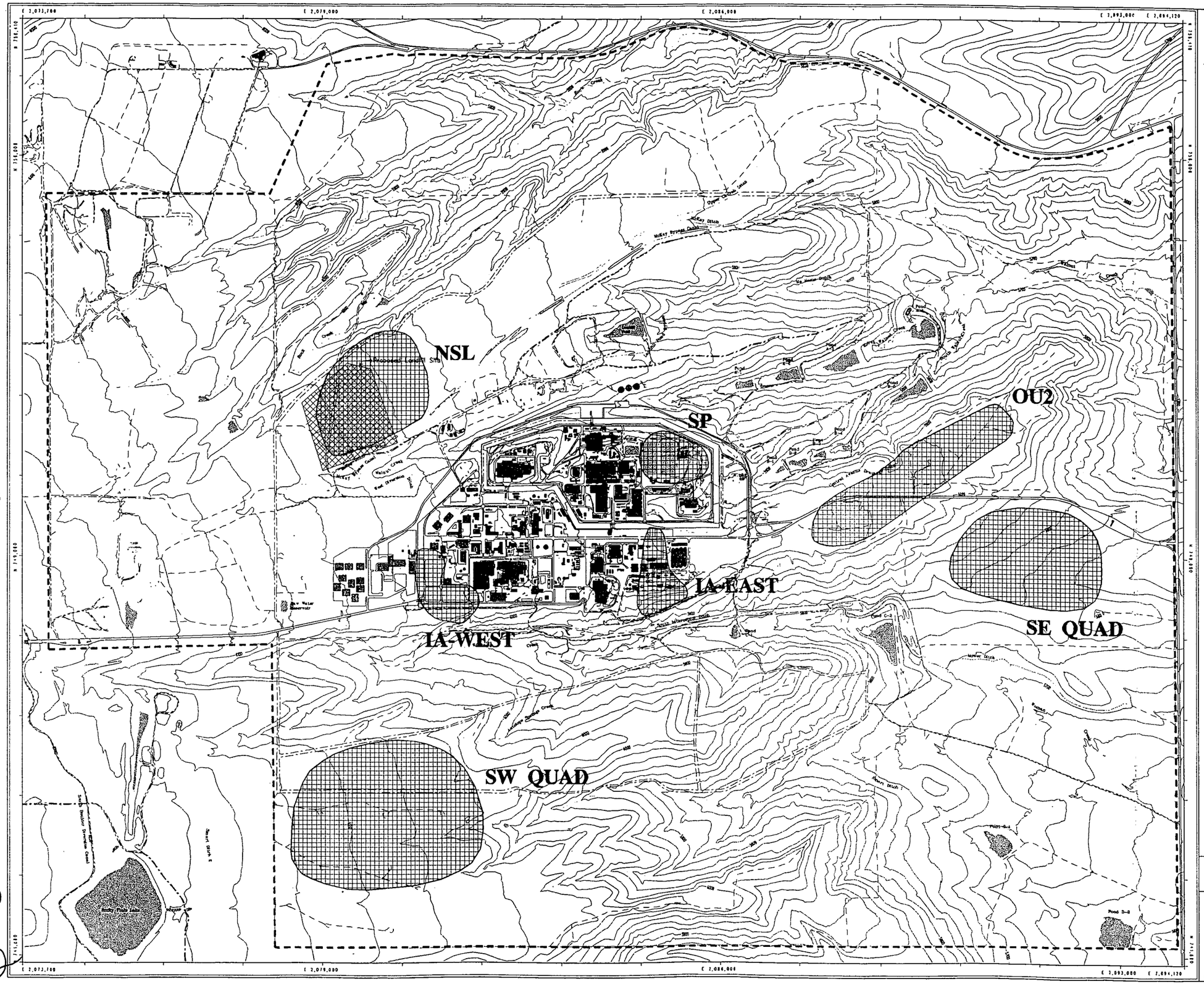

Figure 5-2
Location Map

Potential EXPLANATION

RWSF Site

NSL - New Sanitary Landfill
ESF - East Spray Fields
SP - Solar Ponds plus IHSS 165 and 176

SW QUAD - Southwest Quadrant
SE QUAD - Southeast Quadrant
IA WEST - Industrial Area West
IA EAST - Industrial Area East

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19840
1 inch represents approximately 1637 feet

600 0 1000 2000 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

RMRS Rocky Mountain Remediation Services, L.L.C.
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P.O. Box 464
Golden, CO 80402-0464

MAP ID: Draft

October 14, 1996

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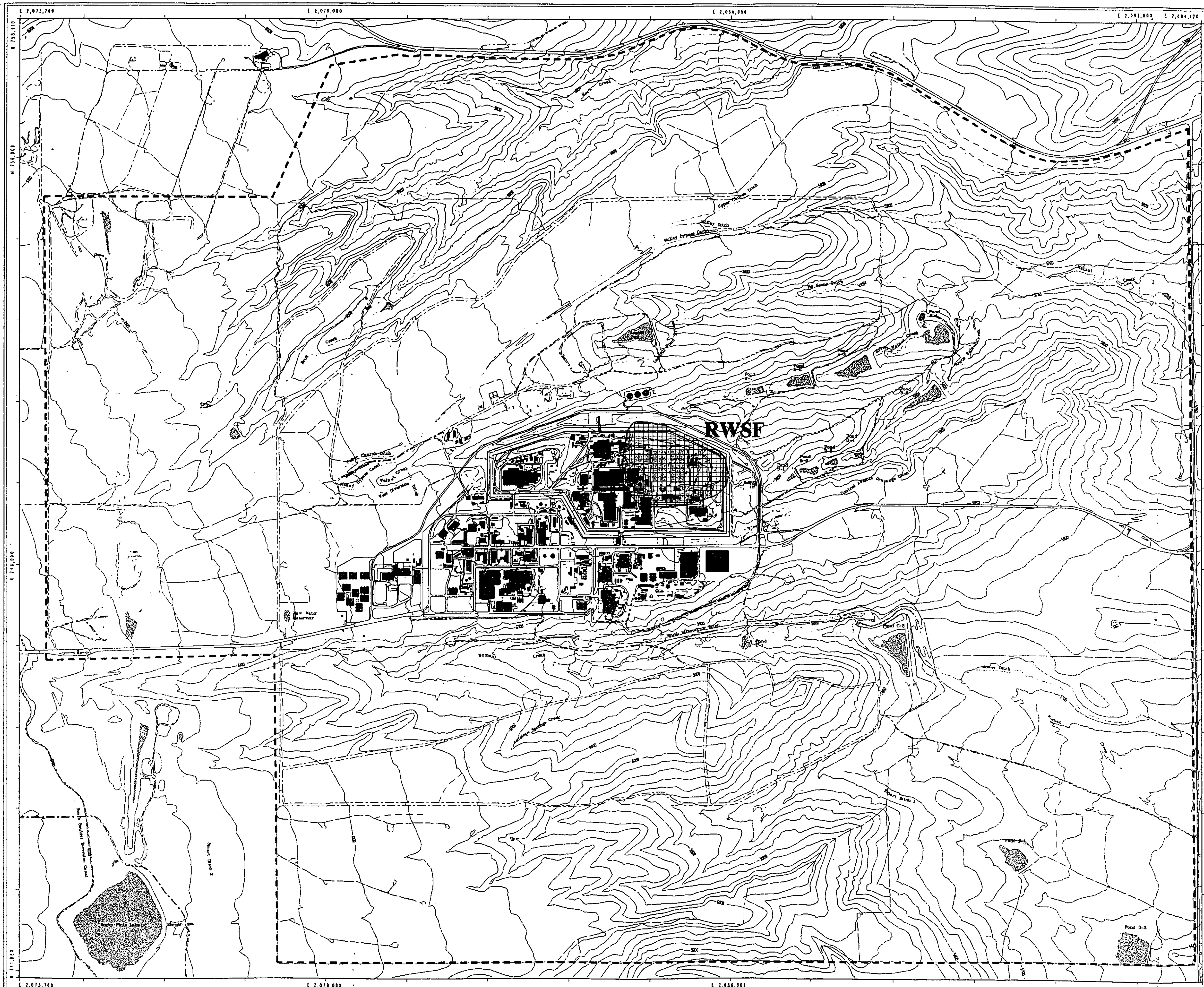

Selected figure 7-1
Site Location Map

EXPLANATION

RWSF Site

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
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Hydrology provided by USGS - (date unknown)

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500 0 1000 2000ft

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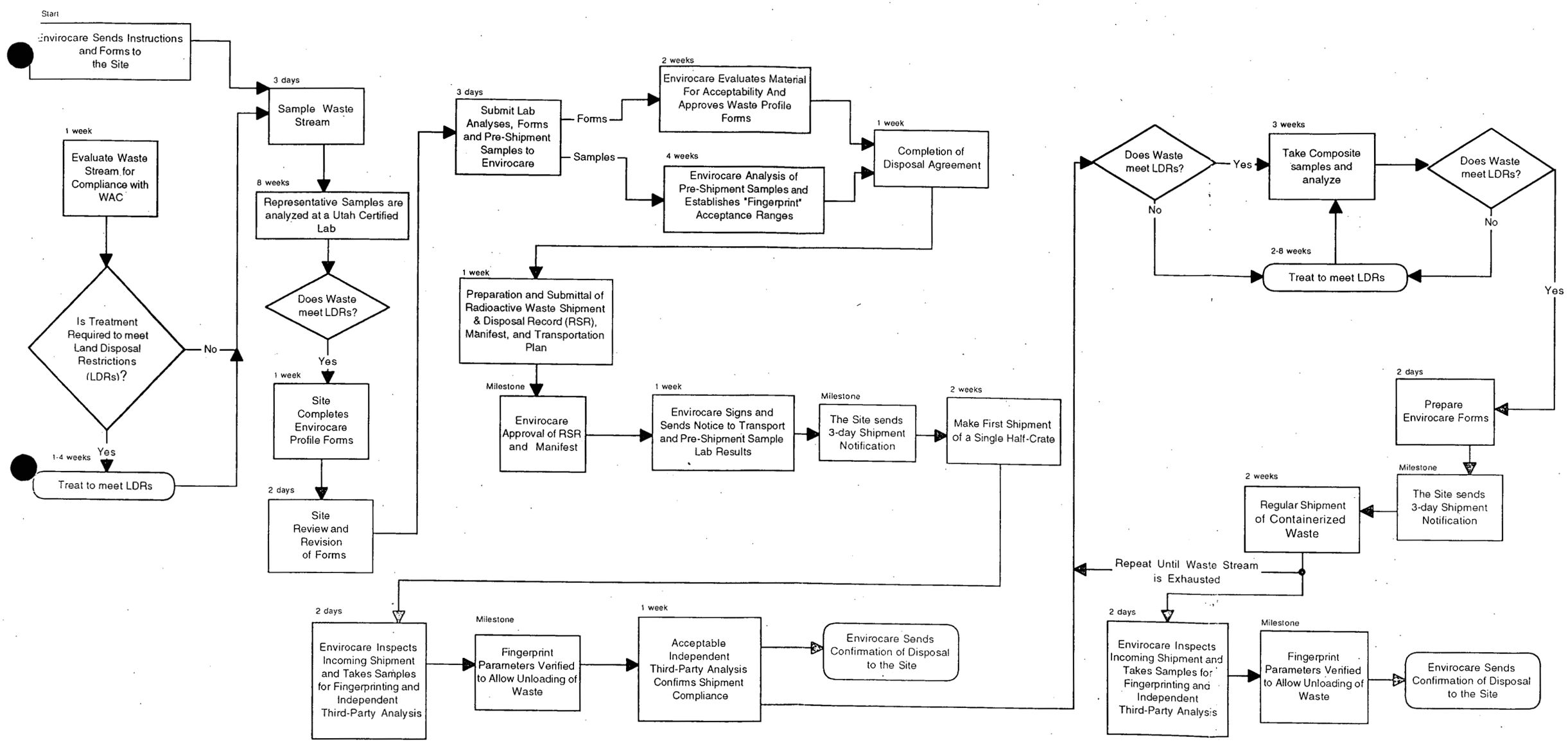
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: x8682 October 14, 1996



Estimated Time to Make First Shipment of Each Waste Stream: **32 - 48 Weeks**

Estimated Time to make Each Additional Shipment of Each Waste Stream: **9 - 25 Weeks**

Figure B-2

PROCESS FLOW DIAGRAM FOR OFFSITE WASTE DISPOSAL OPTION

108

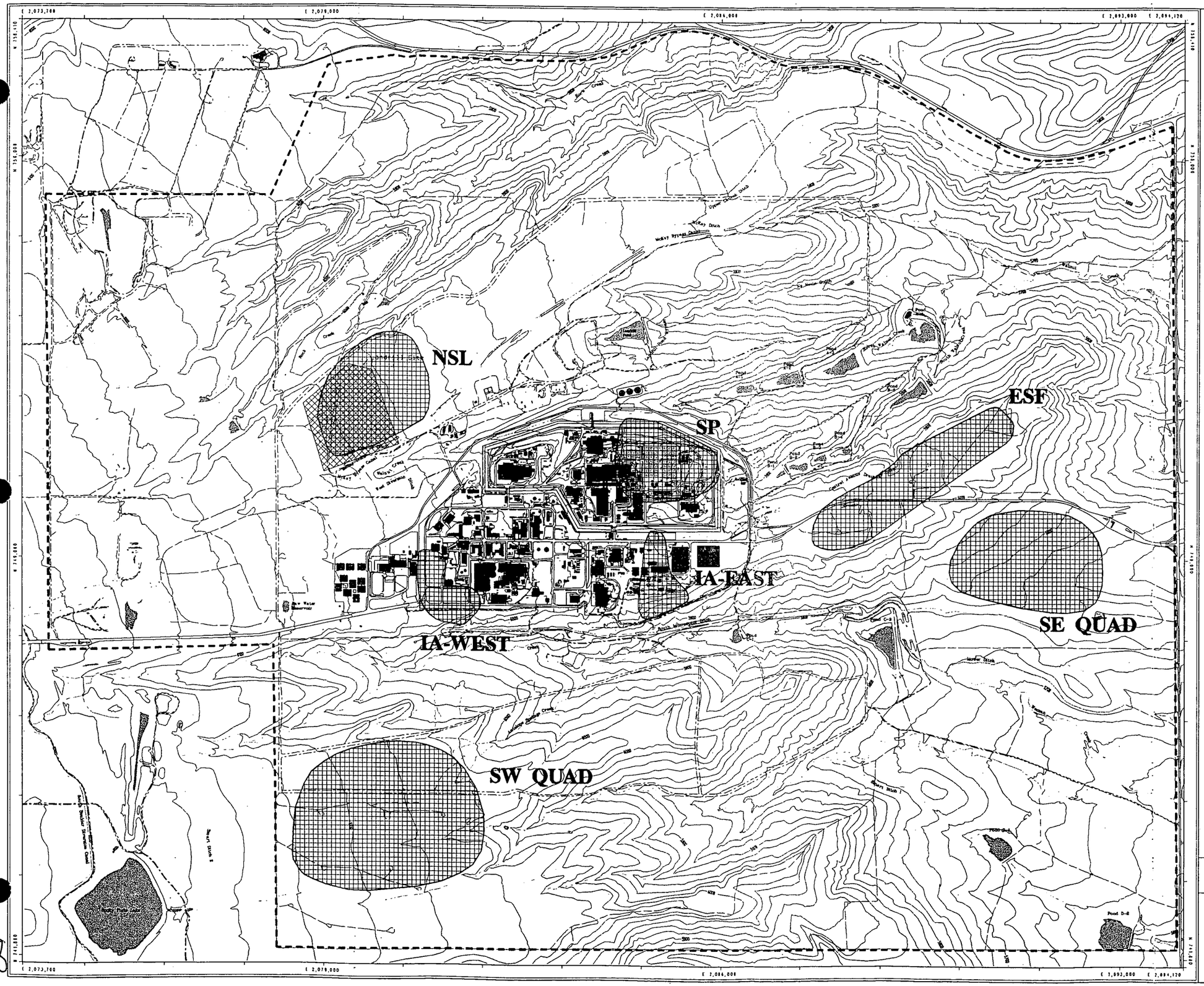


Figure 1
Location Map

EXPLANATION

RWSF Site

NSL - New Sanitary Landfill
ESF - East Spray Field
SP - Solar Ponds plus IHSS 165 and 176

SW QUAD - Southwest Quadrant
SE QUAD - Southeast Quadrant
IA WEST - Industrial Area West
IA EAST - Industrial Area East

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
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500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: Draft

October 15, 1996

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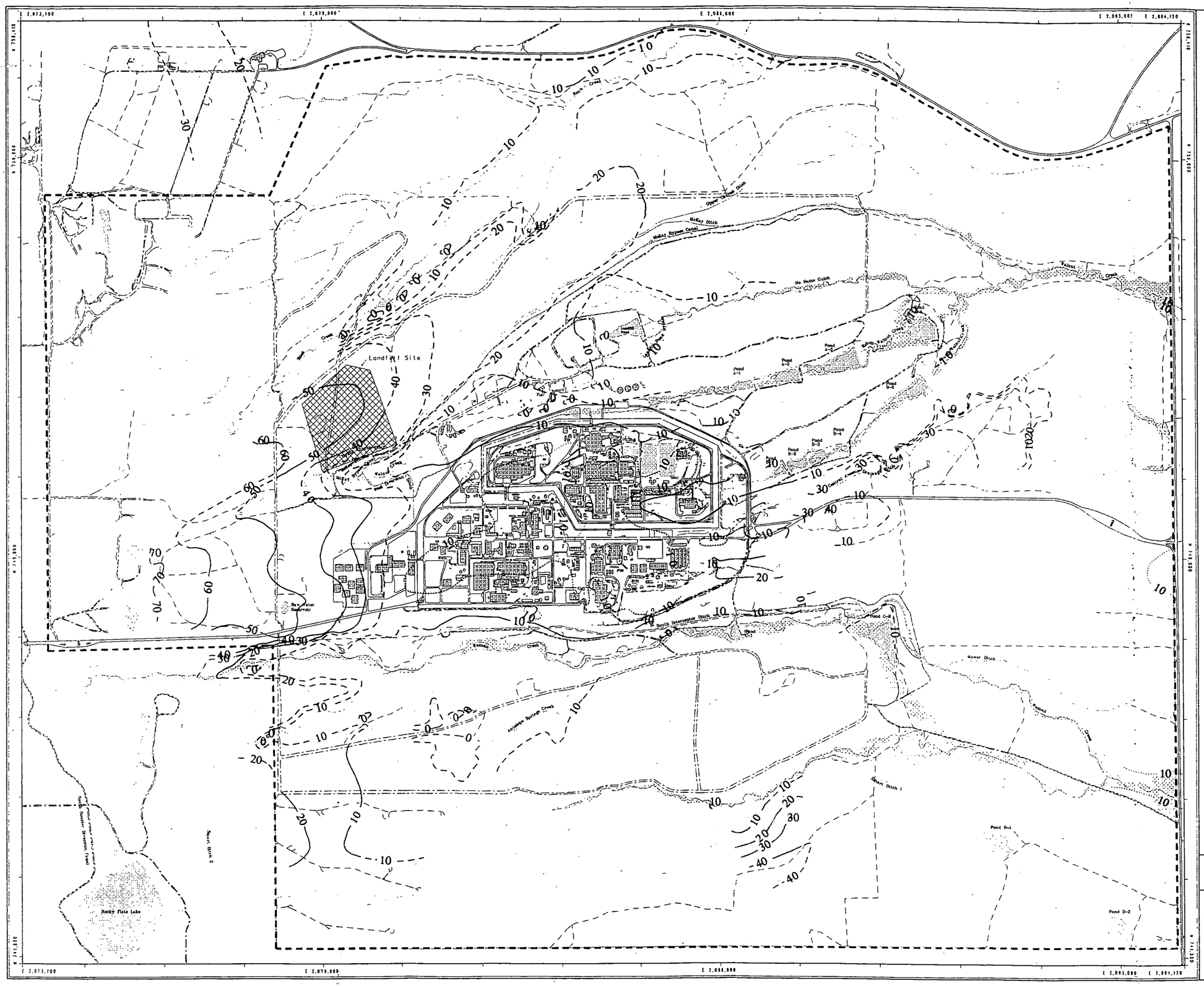

Figure 2
Hydrogeological Conditions

EXPLANATION

- Line of Equal Depth to Water (in feet)
- (dashed where inferred)
- Decreasing Line of Equal Depth to Water (in feet)
- (dashed where inferred)

Standard Map Features

- Buildings or other structures
- 100 year floodplain
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19840
1 inch represents approximately 1637 feet

600 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: Draft

August 08, 1996

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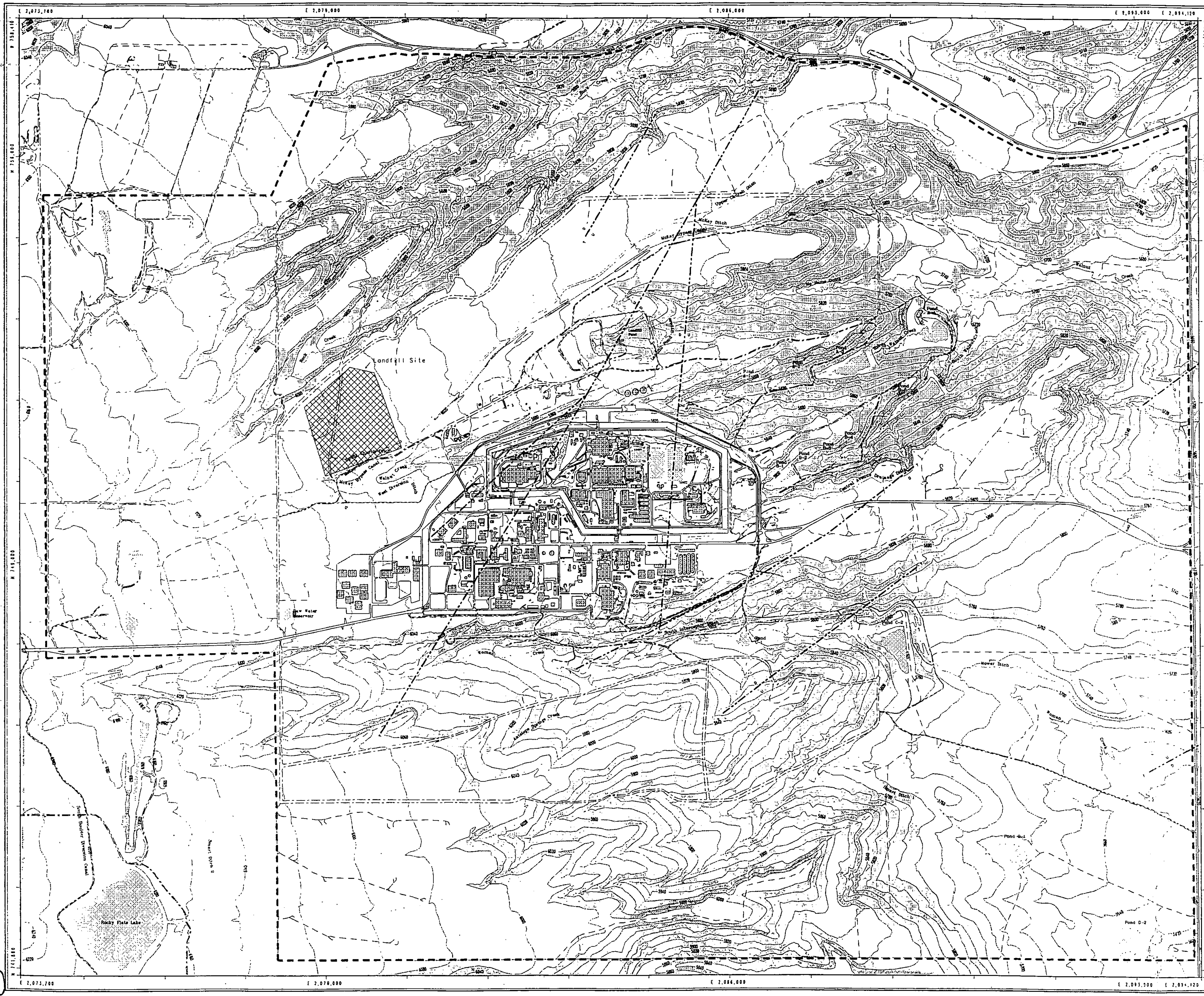

Figure 3
Geological and Geotechnical Conditions

EXPLANATION

Fault line - dashed where inferred

Slope Categories

- Slope = 15% - 20%
- Slope = 20% - 30%
- Slope > 30%

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

N

Scale = 1 : 19640
1 inch represents approximately 1637 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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Prepared by:
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MAP ID: Draft

August 08, 1996

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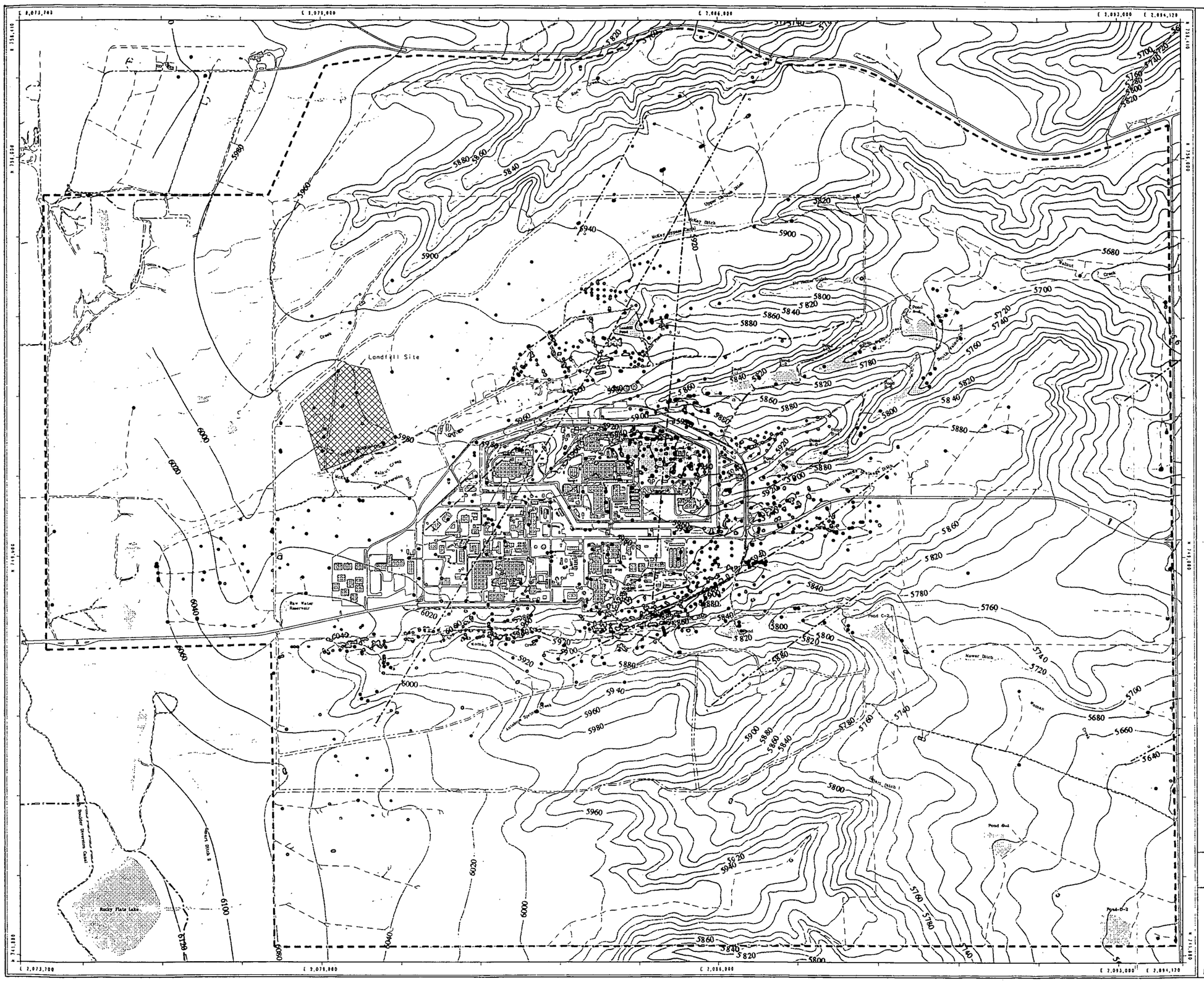

Figure 4
Structure Base of Alluvium

EXPLANATION

- Structure base of alluvium (top of bedrock elevation)
- Fault line - dashed where inferred
- Groundwater wells
- Boreholes

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

600 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: Draft

August 08, 1996

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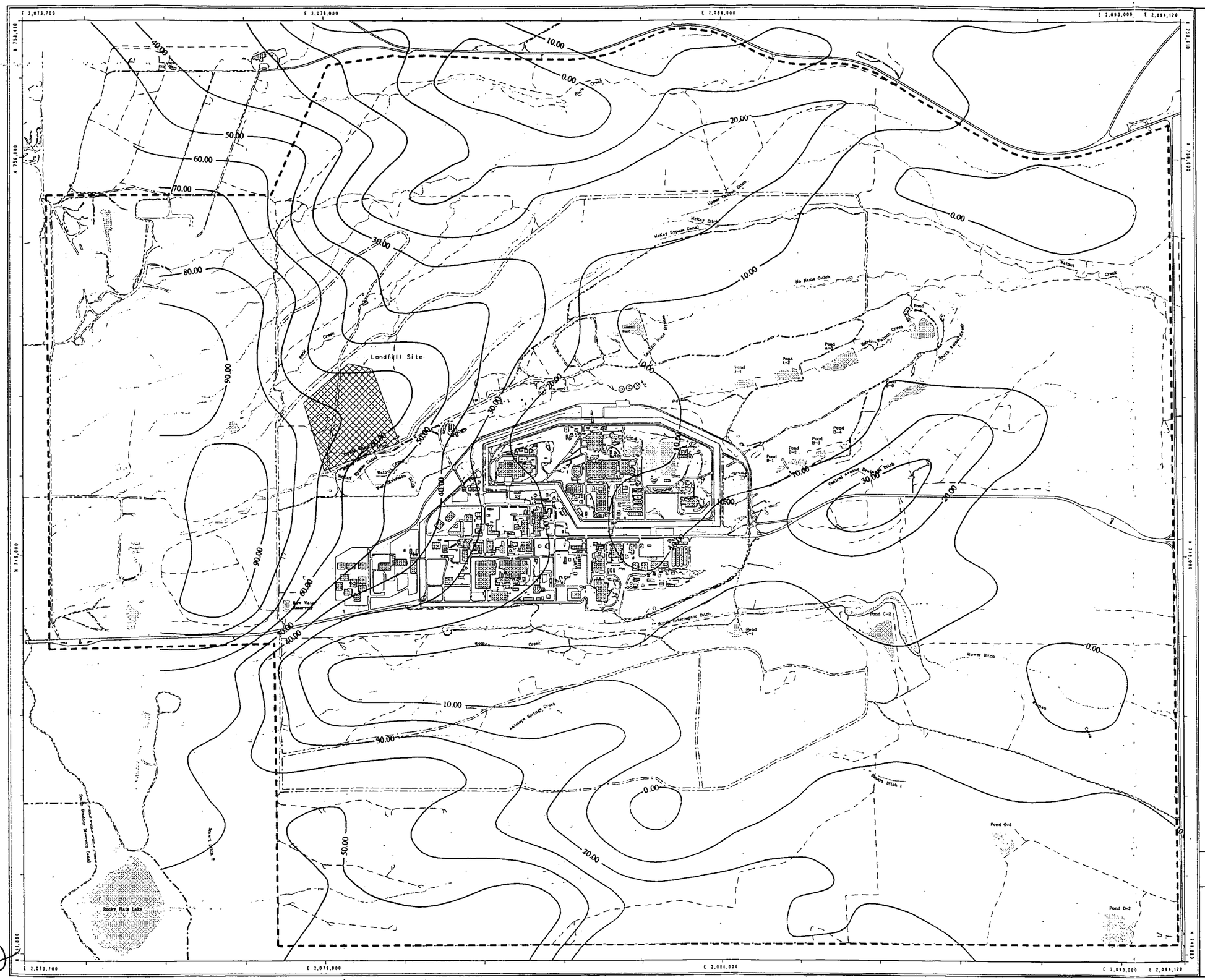

Figure 5
Thickness of Alluvium

EXPLANATION

Thickness of alluvium

Alluvium thickness greater than or equal to 40 Ft.

NOTE:
Potential economic thickness is 40 feet plus

Standard Map Features

Buildings or other structures

Lakes and ponds

Streams, ditches, or other drainage features

Fences

Rocky Flats boundary

Paved roads

Dirt Roads

Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: Draft

August 08, 1996

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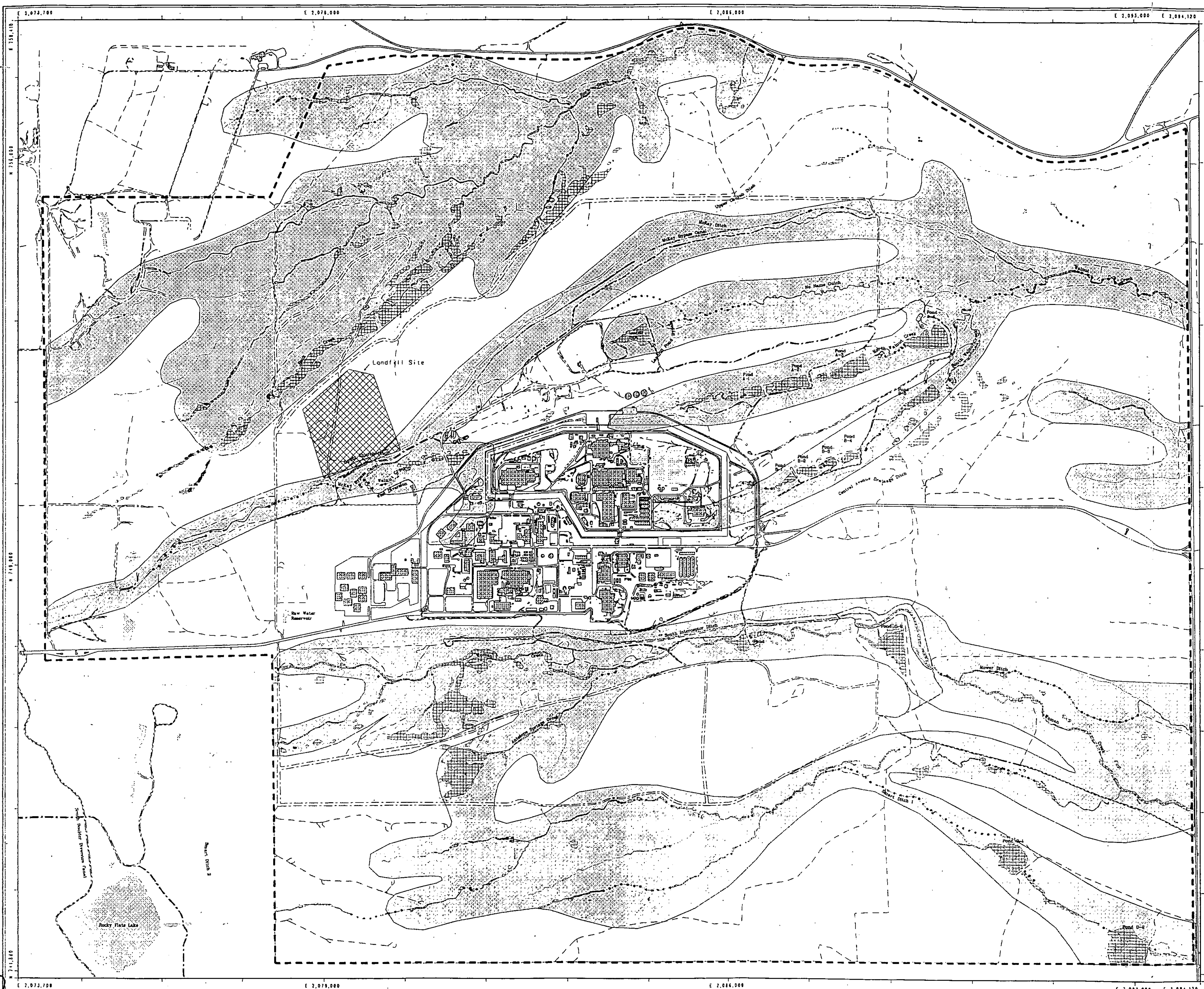

Figure 6
Ecology and NEPA Map

EXPLANATION

Wetland Features

- Wetlands
- Point Wetlands (< 10ft Diameter)
- Linear Wetlands (< 10ft wide)

Preble's Meadow Jumping Mouse

- Probable Range

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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P.O. Box 464
Golden, CO 80402-0464

MAP ID: Draft
August 08, 1996

203

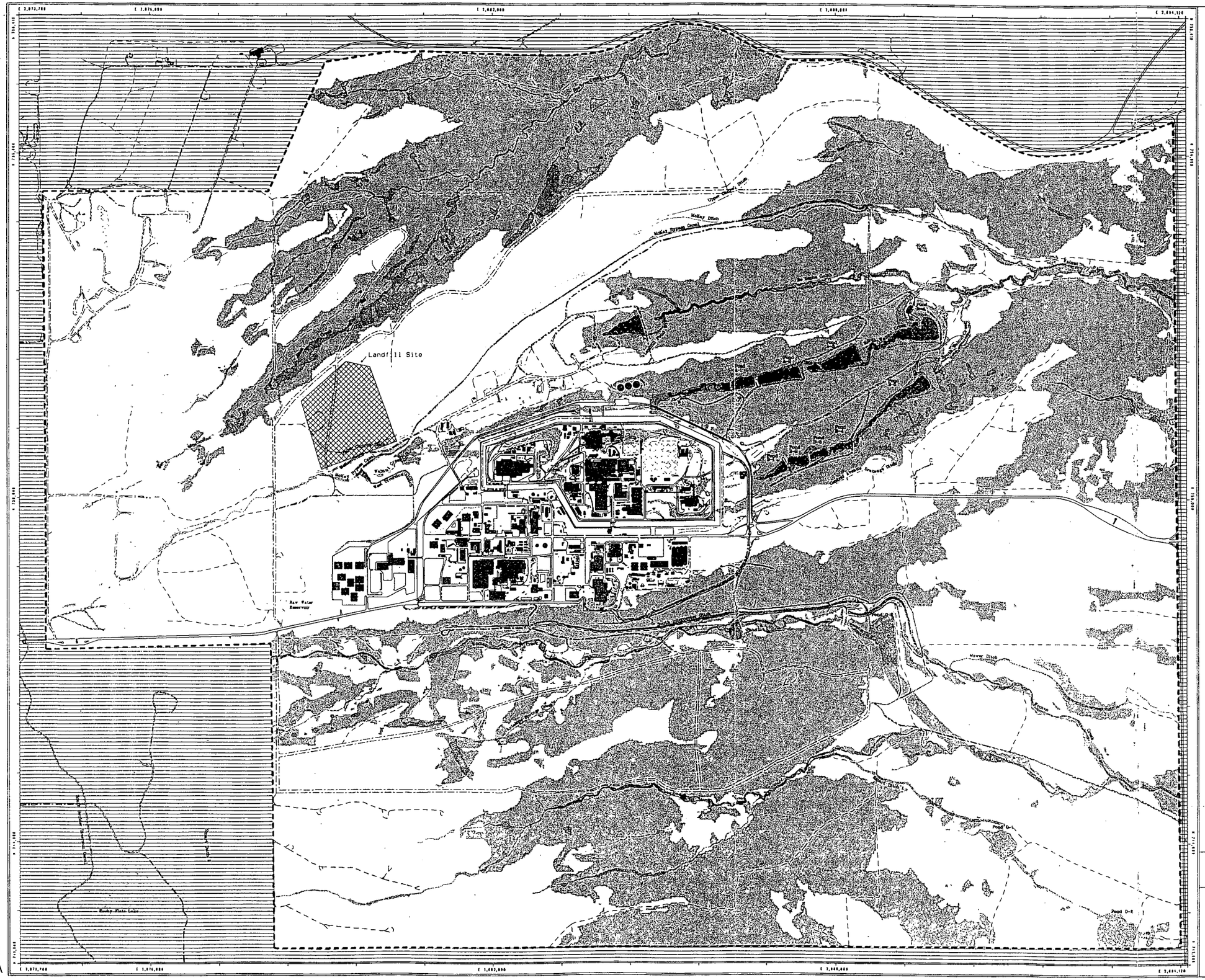

Figure 7
Adverse (for RWSF siting) Conditions Map

EXPLANATION

NOTE:
This map was created using the analytical capabilities of ARC/INFO. Three data layers (coverage's) were combined, representing physical restraining criteria, each given an equal weighting factor: wetlands, 100-year floodplain, and slopes greater than 15%. The surface was color coded based on the number of criteria present.
Point and line wetland features have a 50 foot buffer around them for better visibility.

WMF = Waste Management Facility

- Lands best suited for the placement of a Waste Management Facility, based on criteria stated above
- One criterion present
- Two criteria present
- Three criteria present (least suitable location)

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr. EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

500 0 1000 2000 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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Prepared by:
RMRS Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: x7707

October 18, 1996

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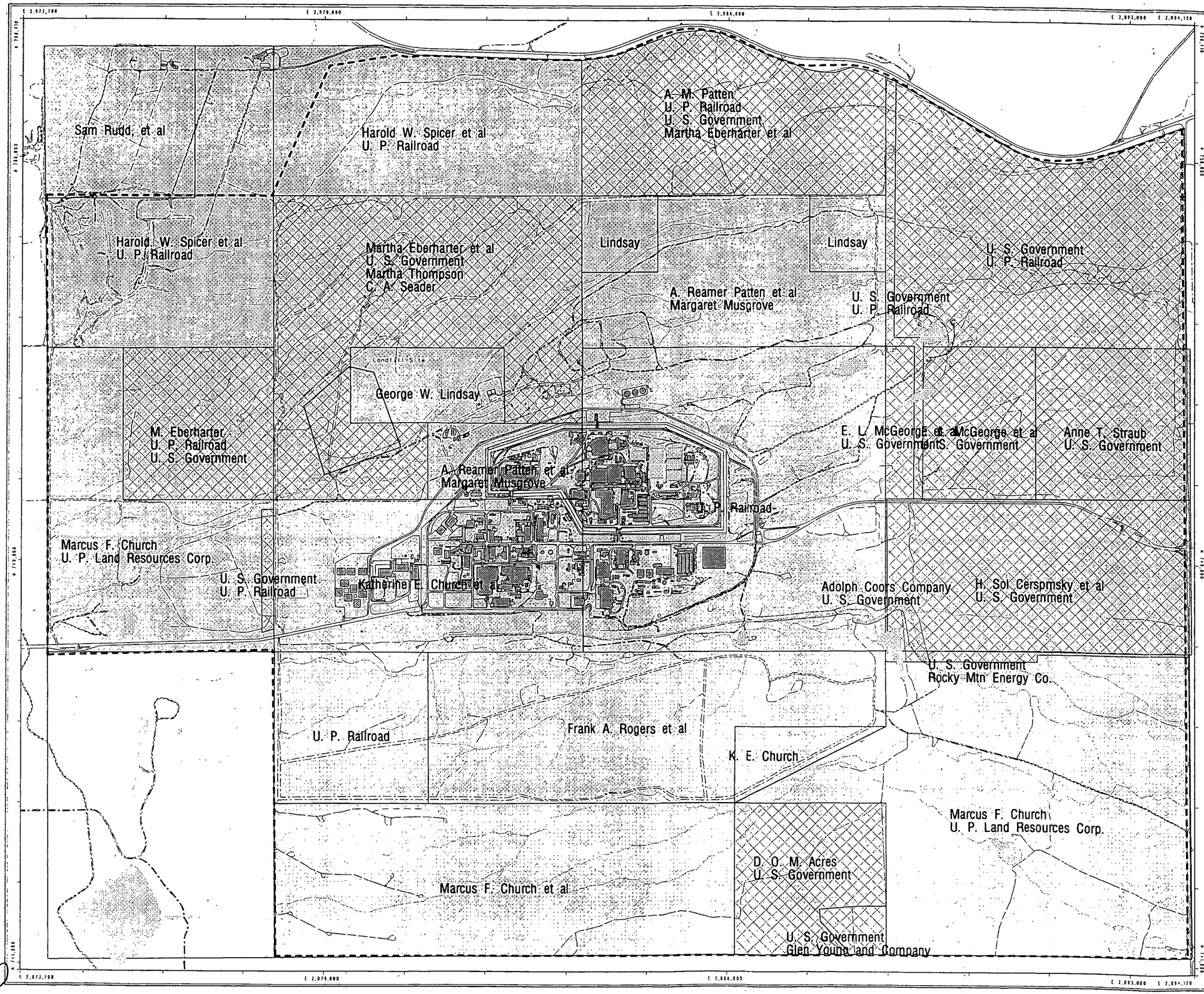

Figure 8
Mineral Ownership Map

EXPLANATION

- Private
- Government
- Both Government and Private

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

600 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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Prepared by:

Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: Draft

August 14, 1996

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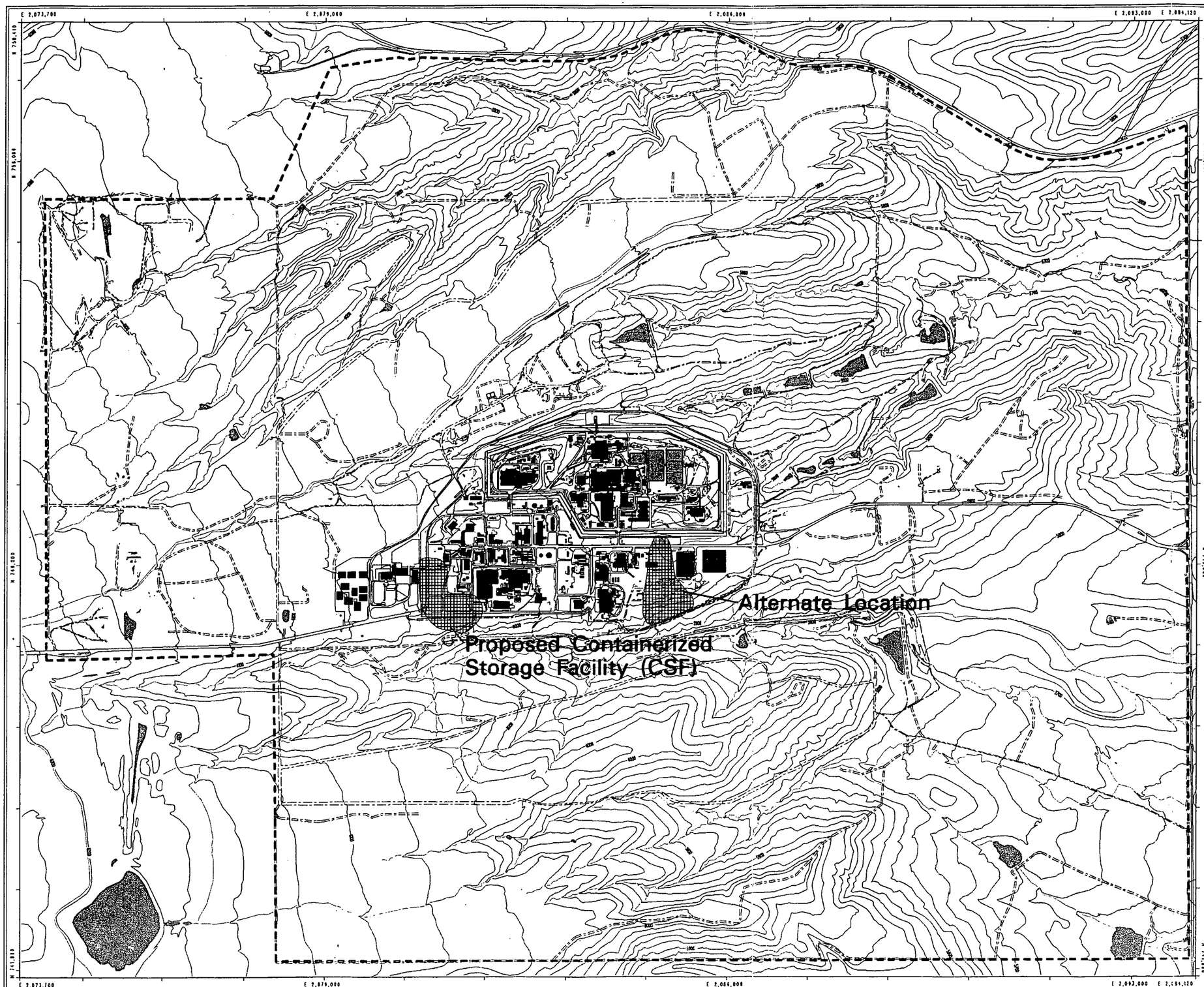

Figure 5-1
Location Map for Containerized Storage Facility (CSF)

EXPLANATION

Containerized Storage Facility (CSF)

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 20450
1 inch represents approximately 1704 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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Rocky Flats Environmental Technology Site

Prepared by:

RMRS Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: 97-0009

October 28, 1996

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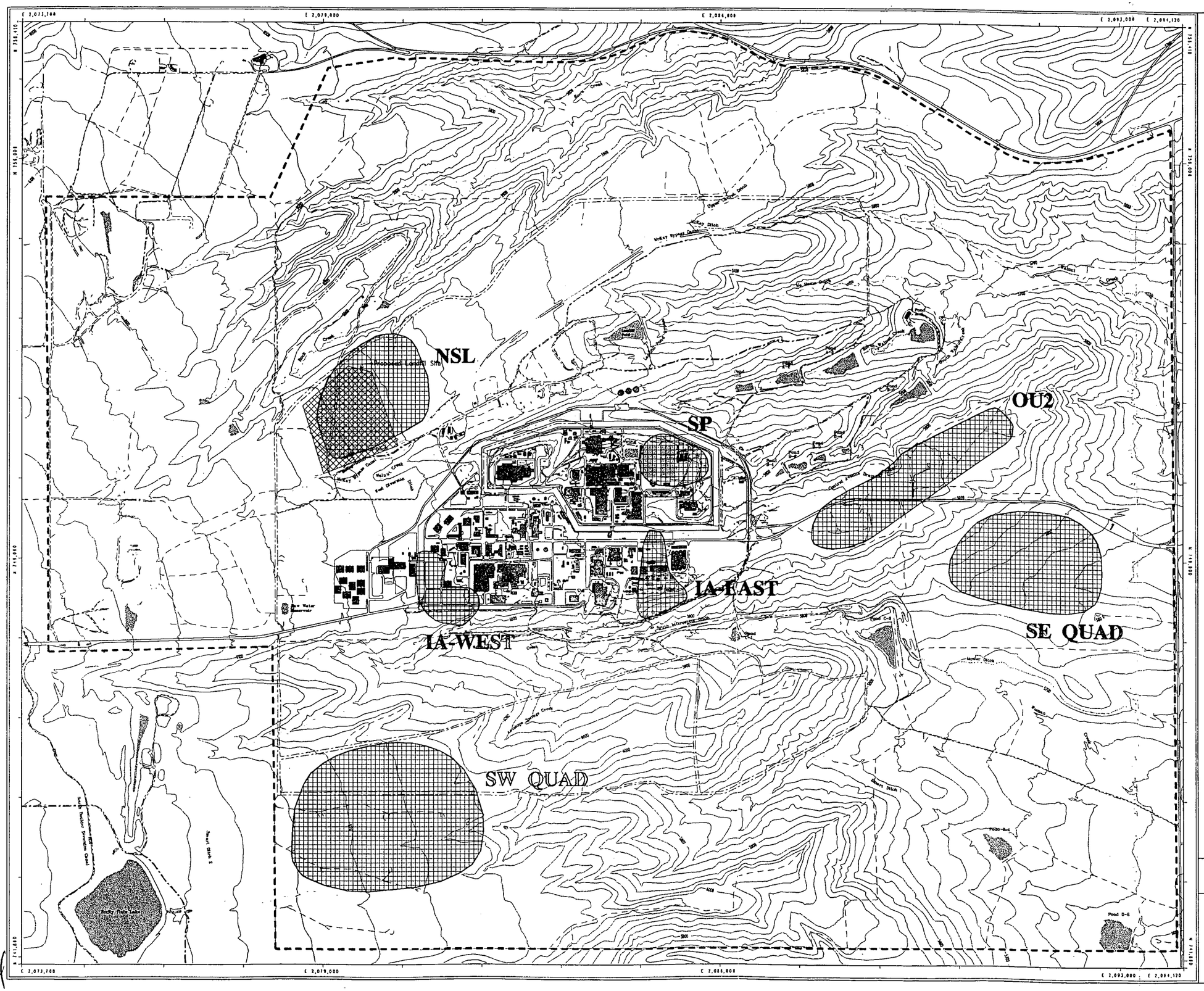

Figure 5-2
Location Map

EXPLANATION

RWSF Site

NSL - New Sanitary Landfill
ESF - East Spray Fields
SP - Solar Ponds plus IHSS 165 and 176

SW QUAD - Southwest Quadrant
SE QUAD - Southeast Quadrant
IA WEST - Industrial Area West
IA EAST - Industrial Area East

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
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- Paved roads
- Dirt Roads
- Trails

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Hydrology provided by USGS - (date unknown)

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Datum: NAD27

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Golden, CO 80402-0464

MAP ID: Draft

October 14, 1996

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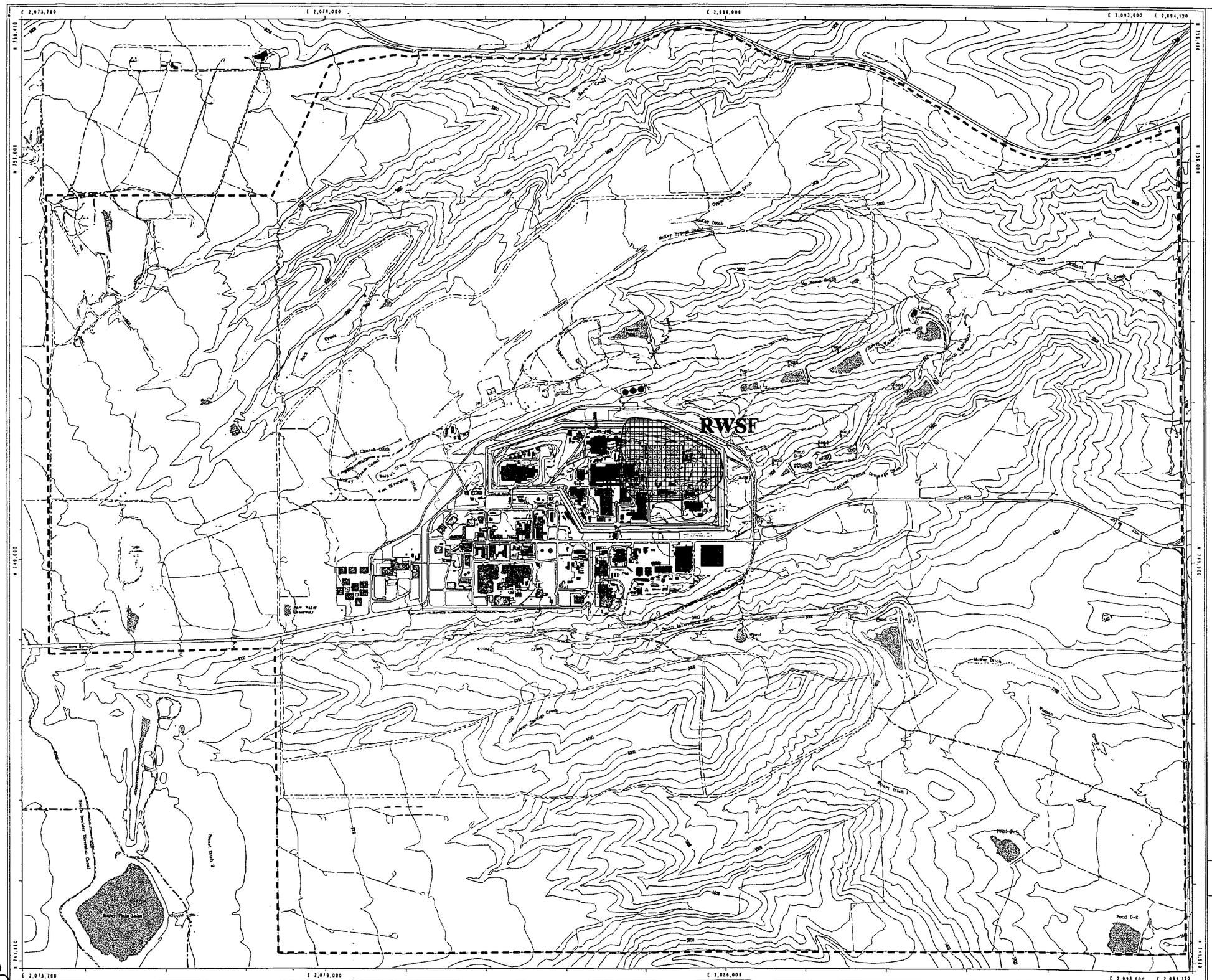

Selected figure 7-1
Site Location Map

EXPLANATION

RWSF Site

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

N

Scale = 1 : 19840
1 inch represents approximately 1637 feet

800 0 1000 2000 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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Prepared by:

RMRS Rocky Mountain Remediation Services, L.L.C.
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MAP ID: x8682

October 14, 1996

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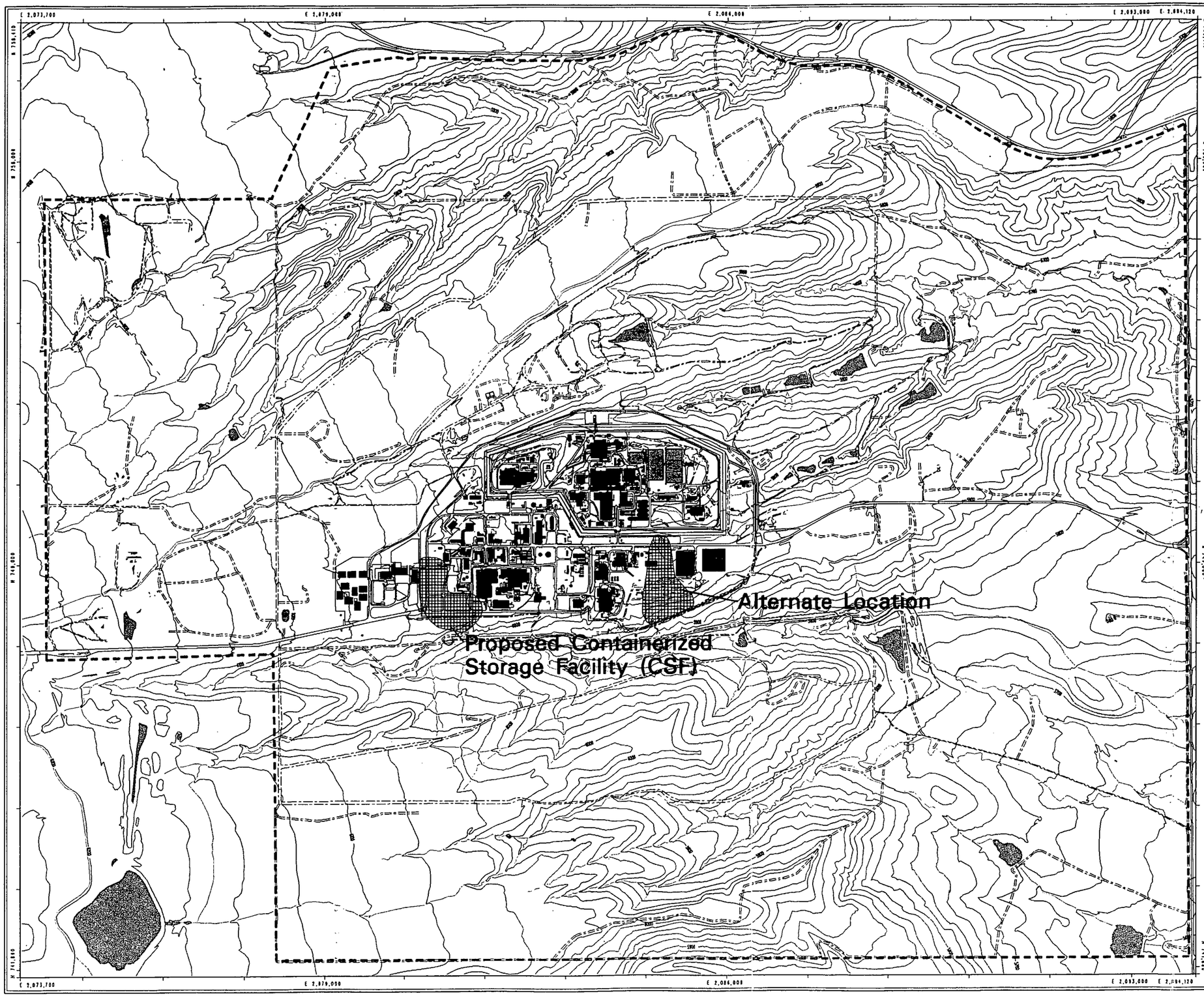

Figure 5-1
Location Map for Containerized Storage Facility (CSF)

EXPLANATION

- Containerized Storage Facility (CSF)

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt roads

DATA SOURCE:
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Hydrology provided by USGS - (date unknown)

Scale = 1 : 20450
1 inch represents approximately 1704 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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Prepared by:

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Golden, CO 80402-0464

MAP ID: 97-0009

October 28, 1996

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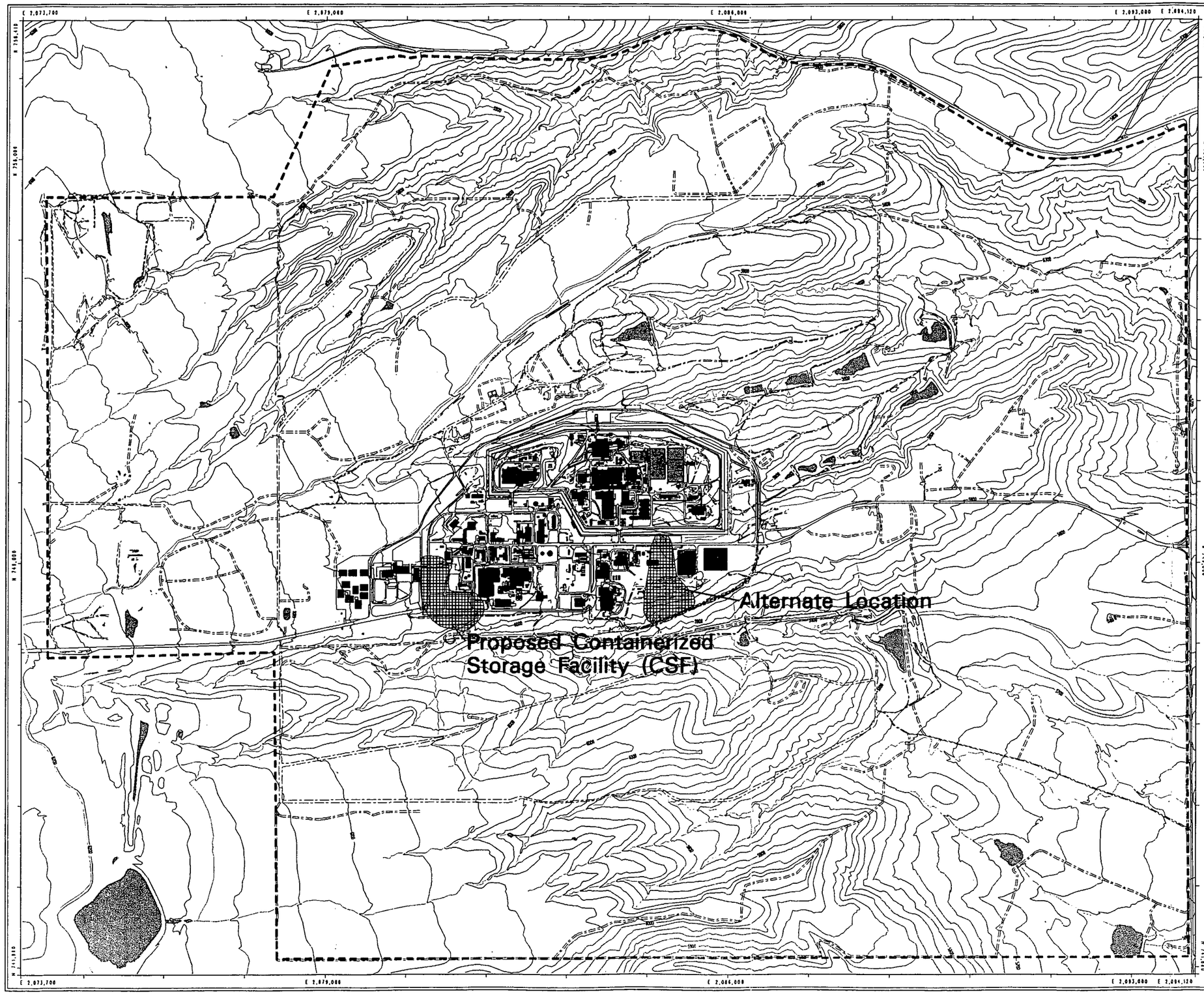

Figure 5-1
Location Map for Containerized Storage Facility (CSF)

EXPLANATION

- Containerized Storage Facility (CSF)

Standard Map Features

- Buildings or other structures
- Lakes and ponds
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- Paved roads
- Dirt roads

DATA SOURCE:
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Hydrology provided by USGS - (date unknown)

N

Scale = 1 : 20450
1 inch represents approximately 1704 feet

500 0 1000 2000 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 97-0009

October 28, 1996

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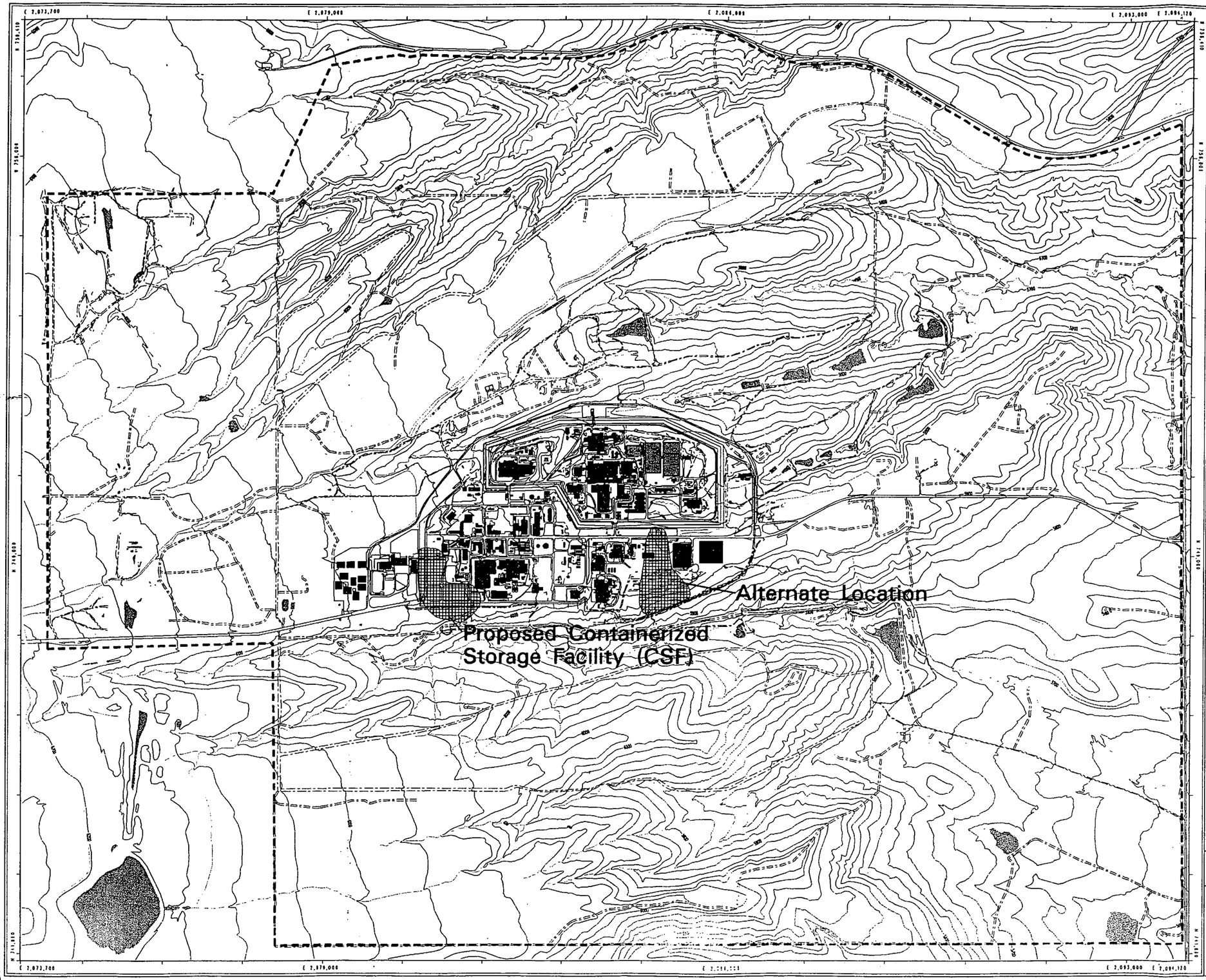

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Location Map for Containerized Storage Facility (CSF)

EXPLANATION

- Containerized Storage Facility (CSF)

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr. EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 20450
1 inch represents approximately 1704 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

RMRS Rocky Mountain Remediation Services, L.L.C.
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P.O. Box 464
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MAP ID: 97-0009

October 28, 1996

/gis/data/rfp-nasp-emb/97-0009/loam u.aml

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- The proposed area in the industrial area has been already disturbed and consolidation of waste is achieved
- Existing infrastructure already exists which would support the CSF
- The proposed area was selected based on a detailed siting study which screened out sensitive areas (e.g. areas populating the endangered species Prebles Jumping Mouse, steep slopes, wetlands, etc., were avoided)

The analyses required by NEPA were integrated throughout the Decision. Based on the analyses, the decision-making process requires no further documentation to complete the NEPA process.

5.5 REMEDIATION WASTE STORAGE FACILITY OPERATIONS

The CSF would be operated and maintained under a number of administrative requirements, as previously mentioned in section 5.3 "Technical and Administrative Controls," to ensure compliance with paragraph 80 of RFCA. Administrative controls would be administered for activities of waste operations in the following areas:

1. WAC documents and forms - These would be required to demonstrate compliance with the RWSF WAC and paragraph 80 of RFCA requirements previously mentioned in section 2.2
2. Operating procedures - Procedures for handling and placement of waste, facility maintenance and documentation to ensure safe and efficient operation of CSF
3. Training Plans - A plan to administer required training for operating personnel in procedures, safety, and quality assurance
4. Health & Safety plans - The health and safety requirements for operating personnel to conduct operations in a safe manner
5. Contingency/spill response plans would define, per Subpart 264.03, how the facility would respond to a release of waste or constituents from the CSF

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6. Limiting operating conditions - Identification of abnormal events which would require operations to temporarily stop activities (e.g. excessive wind velocities, and other weather conditions) to ensure safety to the public, the workers, and the environment

7. Administrative procedure and plans - Additional procedures and plans to ensure compliance with RFCA, DOE orders, and RFETS rules and policies

8. Control of fugitive dust emissions - Facility Monitoring plan as cited in section 5.3 to reduce dust emissions and monitor results to protect the public and worker

9. Closure Plan - This would include the requirements and performance standards for closure per Subpart 264.310 and 264.552 (e) to close the facility after the end of its operational life

Additional requirements addressed in the WAC or Facility Operations Plan for compliance would be areas addressing administrative controls. The following requirements would ensure the RWSF to be operated in a safe manner:

- Recordkeeping and documentation
- Waste information from process knowledge and/or sampling and analysis data for waste characterization
- Quality assurance/quality control (QA/QC) certification program and verification;
- Status reports and waste forecasts
- Shipment notification

Packaging and labeling requirements

5.4.3 CLOSURE REQUIREMENTS FOR THE CSF

note here that if cap req'd we'd design as part of closure

Once the CSF has shipped offsite all remediation waste it would be subjected to closure requirements under RFCA Part 9 Subpart B paragraphs 97, 118, and 121. A closure plan would be submitted which described the following items to meet the closure performance goals of 264.111:

cap may be req'd, e.g., if liner/leachate system is contaminated and we're not going to dig it up.

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- A description of how the CSF would be closed to meet the closure performance standards
- A description of how final closure would be conducted
- An estimate of the maximum inventory of remediation waste managed within the CSF
- A detailed description of the steps required to decontaminate all hazardous waste residues, containment system components, equipment, structures, and soils for final closure
- A description of how other activities ensure the closure performance standards are satisfied (e.g. ground-water monitoring, leachate collection, run-on and run-off controls.
- A schedule for final closure.

we are not applying to do this at this time can propose a cap.

5.5 CONCLUSION

The CSF is proposed as a contingency to the existing Ten Year Plan. This IM/IRA Decision Document is the tool to designate the proposed IA-West area as a CAMU for storage of remediation waste as a contingency to the Ten Year Plan. The Decision Document identifies and explains, in a detailed study and analysis, the best location onsite for the selected remedy—Metal Buildings. In the event remediation waste could not be shipped offsite as originally anticipated under the Ten Year Plan, the DOE would have the option of implementing the CAMU as their contingency for interim storage of remediation waste pending shipment.

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5.0 FACILITY DESCRIPTION

This section describes the conceptual design of the Containerized Storage Facility (CSF) which has been proposed for the management of remediation wastes. The CSF has been proposed to be located in the southwest corner of the Industrial Area (Figure 5-1). The CSF would be composed of a series of engineered metal buildings, as shown on Figure 5-2, which would be constructed to serve as a staging facility in the receiving, storage, and ultimate shipment of remediation waste. The proposed location benefits from minimal site preparation costs, ~~verses~~ versus alternate locations, and the presence of an adjacent rail spur for offsite shipment. A footprint of 6.8 acres would include up to four modular buildings which could ultimately store 5,000, 20-cu-yd-capacity cargo containers each, for a total capacity of up to 100,000 cu yds. The modular design would allow the final configuration and storage capacity to be flexible in order to meet changing waste-storage requirements. The Metal Buildings would be constructed on reinforced concrete foundations with a double liner and leachate collection system under each building foundation. The double liner and leachate collection system, (see Figure 5-3) would comply with RCRA Subtitle C requirements as defined in 6 CCR 1007-3, Part 264 Subpart N. The remediation waste would be effectively isolated from the environment by the following three barrier systems:

- Containers
- Structural concrete floor slab with integral leachate collection system
- Double liner system (e.g. primary barrier HDPE geomembrane and secondary barrier combined HDPE geomembrane and clay liner) with leachate detection and collection system

The CSF would have a design life of twenty years (e.g. 10 years operation under the Ten Year Plan (Ten Year Plan) and operation for an additional 10 years as a contingency) at which time it assumed the remediation waste would have been transported to an offsite facility for disposal.

5.1 RFCA DESIGN CONSIDERATIONS

RFCA paragraph 80 describes requirements that have been incorporated into the conceptual design such as leachate detection and collection. Details of how these requirements will be

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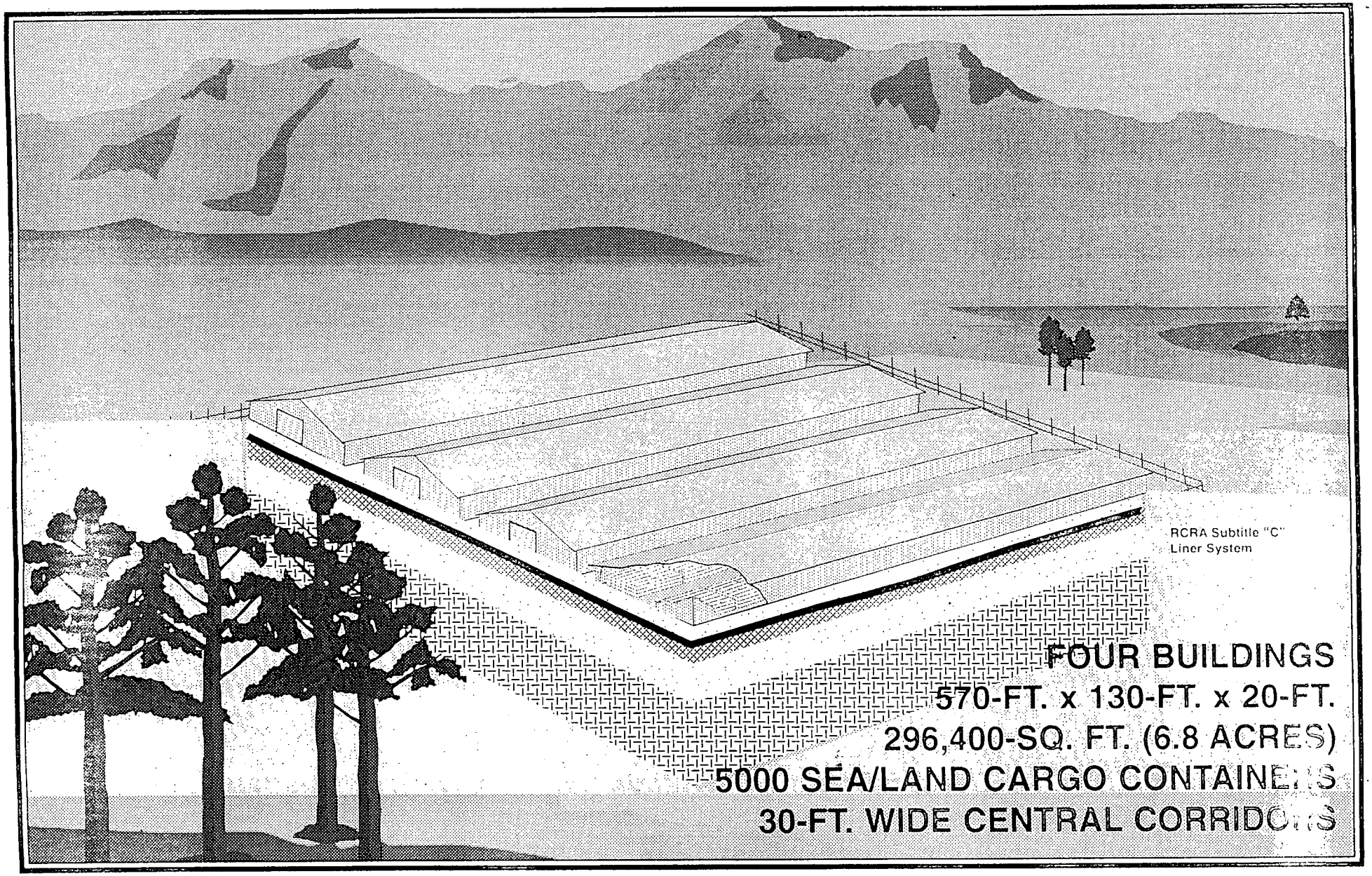

Figure 5-2

CONTAINERIZED STORAGE FACILITY

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CONTAINERIZED STORAGE FACILITY LINER

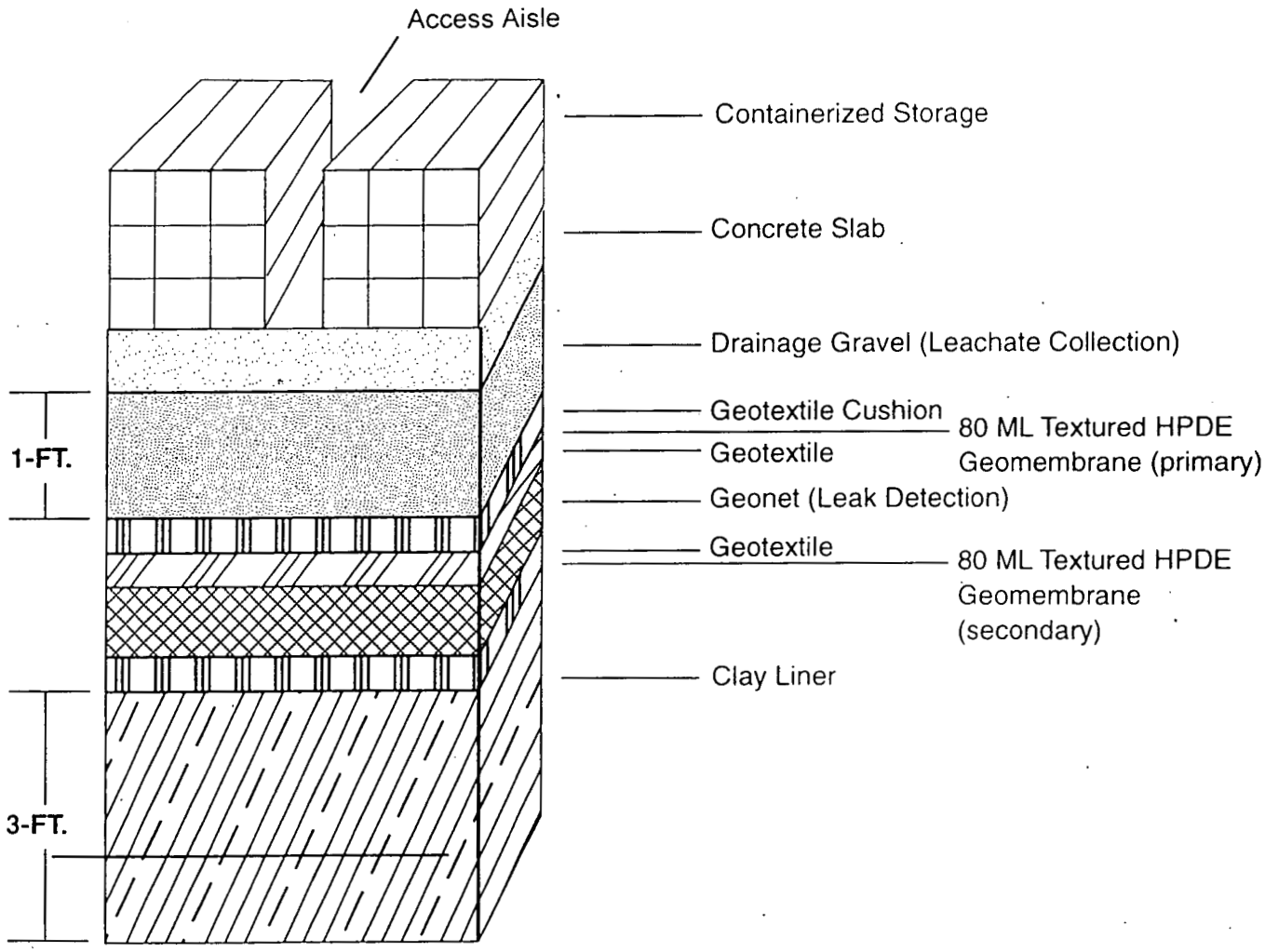

Figure 5-3

CONTAINERIZED STORAGE FACILITY CROSS SECTION

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met will be submitted during the design phase. Incorporated as part of the CAMU proposal alternative are the following:

- Detection and monitoring/inspection (part of the alternatives analysis and facility operational plans)
- Cap/liner in compliance with 6 CCR 1007-3 Par 264, Subpart N
- Ground water monitoring system to be developed as part of the design/construction

Also, the following would be developed as part of the design/construction:

- Operating and design requirements (to be included as design submittals and operational plans)
- Requirements for responding to releases of wastes or constutuents from the units
- Waste treatment requirements (to be provided in the WAC)

The following features were used to develop a conceptual cost estimate (see Table 5-1):

- Four metal buildings, each 570 ft. long by 130 ft. wide and 20 ft. eave height
- Each building would be constructed, when required, dependent upon waste volumes
- Buildings would be constructed over a reinforced concrete floor
- A maximum total of 5000 - 20 cu yd cargo containers for the entire four building CSF
- Cargo containers would be stacked three high in the buildings
- Each building would have a thirty foot wide central corridor and personnel access aisles for routine monitoring and inspection
- A twenty year design life
- Cargo containers

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- Double liner system and leachate collection system
- Groundwater monitoring wells (six total maximum) would be installed both up gradient and down gradient and would be operated through the life cycle of the CSF (20 years)

TABLE 5-1 SUMMARY OF COSTS FOR THE CSF

TASK DESCRIPTION	ESTIMATED COST
Containers	$68,177,000
Site Preparation	$1,209,000
Engineering Design / Project & Const. Mgmt.	$3,685,000
Construction	
A. Four Metal Buildings	$9,307,000
B. Double Liner System	$3,236,000
C. Leachate Collection/Detection System	$386,000
Total Cost [1]	**$86,000,000**

Notes:
1. A 25% contingency cost is included in the estimate

The leachate collection and retrieval system would collect any potential leachate and it would be transferred to a facility for treatment.

5.2 WASTE CHARACTERISTICS AND CONCEPTUAL WASTE ACCEPTANCE CRITERIA

The following sections describe the waste and associated acceptance criteria for the CSF. Section 5.2.1 gives a brief identification of the waste characteristics which could be received at the CSF. Section 5.2.2 gives estimates of the waste volumes and section 5.2.3 briefly explains what the Waste Acceptance Criteria (WAC) would address for the CSF.

5.2.1 Remediation Waste Characterization

This section describes the general waste types characteristics which may be placed in the CSF. Identification of waste characteristics, sources and projected volumes for the CSF clarify and substantiate the need for a contingency to existing waste storage. Only remediation waste would be considered for management in this facility.

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Remediation waste is defined as follows by RFCA, part 5, line 26, item (bf):

> (1) solid, hazardous, and mixed wastes; (2) all media and debris that contain hazardous substances, listed hazardous or mixed wastes or that exhibit a hazardous characteristic; and (3) all hazardous substances generated from activities regulated under this Agreement as RFCA corrective actions or CERCLA response actions, including decommissioning. Remediation waste does not include wastes generated from other activities. Nothing in this definition confers RCRA or CHWA authority over source, special nuclear, or byproduct material as those terms are defined in the Atomic Energy Act.

In addition, low-level waste, as defined by RFCA, is radioactive waste that is not high-level waste, spent nuclear fuel, by-product material, or transuranic waste (although it may contain small amounts of transuranic elements). The majority of the low-level waste managed at the CSF would have an average radionuclide activity ~~much~~ less than ten nanocuries per gram (nCi/g) based on the Hazard Categorization Analysis (Kaiser Hill, 1996).

Remediation waste types for the CSF are expected to include the following:

- Contaminated soil collected from remedial actions, usually treated to remove volatile organics
- Treated and untreated sludge and sediments
- Toxic Substance Control Act (TSCA) waste (such as asbestos and PCBs)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions
- IDM from past and future characterization activities, such as wells, and borings, if the IDM is characterized as hazardous, low-level, or low-level mixed remediation waste
- ~~DCD~~ Decommissioning waste which has been characterized as hazardous, low-level, or low-level mixed waste. ~~DCD~~ Decommissioning includes all activities that occur after deactivation. Remediation waste would include building rubble, equipment, and utilities removed from the building ~~prior to demolition.~~

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5.2.2 Remediation Waste Volume

Waste volume estimates were based on planned risk reduction activities. A preliminary estimate of remediation waste volumes the may require storage prior to ultimate disposal is presented in Table 5-2 below. The total volume of remediation waste is estimated to be 94,000 ~~101,800~~ m^3 or 123,200 ~~133,000~~ cu yd which would be placed in the CSF. These estimates were based on current information and coincide with the Ten Year Plan waste volumes. These volume estimates are not intended to limit the size of the facility, but serve as a tool to create alternatives for the decision making process.

Table 5-2 Remediation Waste Volumes for the Containerized Storage Facility

Fix Spacing & Format Errors

Remediation Waste Types	Total Estimated Volume (m^3)	Total Estimated Volume (yd^3)	Volume Ranges (m^3)
Low-Level Waste	40,716	53,293	32,573 m^3 to 81,432 m^3
Low-Level Mixed Waste	53,438	69,945 ~~79,945~~	42,750 to 106,876 ~~48,863~~ m^3 to ~~122,156~~ m^3
Total	94,000	123,200 ~~133,238~~	~~81,435~~ m^3 to ~~203,588~~ m^3 75,323 to 188,308

Notes:
1. These waste volumes are estimated within a range of -50% to +100%.

The actual volume of soil defined by Tier I ~~1~~ and Tier II ~~2~~ cleanup levels in RFCA could be larger or smaller because volume estimates were made with preliminary data from limited characterization.

5.2.3 Conceptual Waste Acceptance Criteria

The purpose of the CSF is to provide ER and Decommissioning ~~D&D~~ activities the services of a staging facility for the receiving, interim storage and ultimate shipping of remediation waste. Waste acceptance criteria (WAC) would be developed for the CSF to ensure remediation wastes comply with applicable regulatory and site requirements. The CSF would accept remediation waste in transportable containers which have accompanying documentation that meets the waste acceptance criteria of the anticipated target disposal facility. The WAC would be specific for the CSF and may not address specific requirements as required by other offsite disposal facilities which ultimately would receive the waste. For criteria which can be

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[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

[illegible]	[illegible]

quantified, specific levels would be identified. The following objectives would be achieved in compliance with the WAC:

1. Remedial wastes are effectively isolated from potential natural environmental pathways to protect the public health and the environment.
2. Operating personnel of the CSF ensure continuous protection to the public health and the environment.
3. Remediation waste is routinely monitored and inspected.
4. Characterization data of the remediation waste is documented to the extent necessary to support project specific waste management objectives and WAC requirements for the CSF.

As previously mentioned, the CSF would receive remediation waste from ER and D&D activities which would be handled as bulk wastes in customized cargo containers verses crates or drums. The CSF **is not** a handling facility and is not intended to repackage waste once received.

The WAC would provide physical and chemical limitations and requirements for the proper management of remediation waste. Process knowledge and/or chemical and radiological analyses would become the tools to document accurate characterization of the remedial waste.

5.2.3.1 Physical Requirements

A summarized list of physical requirements which the WAC would address are listed below:

- Physical properties of bulk wastes such as soils, sediments, and treated sludge (e.g. maximum size range, specific weight, moisture content)
- Physical properties of wastes classified as debris (e.g. maximum size range, specific weight, moisture content, non-biodegradable)
- No free liquids (e.g. 6 CCR 1007-3 Subpart N 264.314; EPA Paint Filter Test)
- Conditions for filled and emptied containers (6 CCR 1007-3 Subpart N 264.315)
- Prohibitions of containerized gases, ignitable or reactive wastes (6 CCR 1007-3 Subpart N 264.312, 313)

5e1

5.2.3.2 Chemical Requirements

A summarized list of chemical requirements which the WAC would address are listed below:

- Chemical analyses, acceptable analytical methods, and detection ranges.
- Prohibited constituents and chemical characteristics including reactive or ignitable substances (e.g. pyrophoric uranium; 6 CCR 1007-3 Subpart N 264.312)
- Chemical compatibility's (6 CCR 1007-3 Subpart N 264.313)
- pH limitations
- Composition of wastes

5.2.3.3 Health and Safety Issues

The primary concerns of Health and Safety for the CSF are itemized as follows:

- Operations involving heavy equipment (e.g. large forklifts/cranes) for the handling of containers
- Health and Safety issues for the industrial worker
- Threshold limits of radionuclides for the CSF
- The CSF would require operating and administrative procedures for the assurance of safe operations involving heavy equipment and protective measures for the industrial worker.

Insert Space

The WAC would address the following radiological requirements:

- Radiochemical analyses for characterization
- Threshold limits of radionuclides for the CSF

The majority of low level remediation waste to be managed at the CSF would have an average radionuclide activity less than ten nanocuries per gram (nCi/g) as mentioned previously under section 5.2.1. A preliminary hazard category analysis was performed for the CSF. The CSF

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was categorized less than a Category 3 facility and designated as a Radiological Non-nuclear Facility based on preliminary threshold quantities of plutonium and other radioactive isotopes (Kaiser-Hill, 1996a). This categorization analysis was based on sampling data from some of the more radioactive IHSSs at RFETS (e.g. Solar Ponds, 903 Pad and Lip Area, and the Original Process Waste Lines). To be conservative in the hazard analysis, the highest activity concentrations were used from these IHSSs. The CSF would not receive transuranic waste (TRU).

5.3 Technical and Administrative Controls

Technical and administrative controls would be implemented in order to ensure that human health and the environment would be protected from areas where present or past activities preclude unrestricted access or use, controls are implemented. ~~The technical and administrative controls would be met the requirements in RFCA paragraph 80 for a CAMU.~~ Discussion of these controls for the CSF are grouped into four major elements and meet the requirements in RFCA paragraph 80:

- Engineering Controls (e.g. double liner system, leachate collection/detection system, interim cover)
- Facility Monitoring (e.g. groundwater monitoring plan)
- Operational Controls (e.g. waste acceptance criteria, inspection, H&S plan, contingency/spill response plan)
- Administrative Controls (e.g limited access; institutional controls)

Engineering controls - There would be specific engineering controls designed into the facility in order to support protection of human health and the environment throughout the operational life of the facility. The following engineering controls of the CSF would comply with 6 CCR 1007-3, Part 264, Subpart N, 264.301 - Design and operating requirements: 264.302 - Action leakage rate; 264.303 - Monitoring and inspection; and 264.304 - Response actions:

- Double liner system (e.g. primary barrier - geosynthetic layer; secondary barrier - composite layer consisting of clay layer overlain by geosynthetic)

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- Leachate collection/removal system (e.g. two systems; the first system is an integral collection/removal system constructed in the floor slab with sumps and piping; the second system is the coarse sand drainage layer above the primary barrier with integral collection pipes, pumps and sumps)

- Leak detection system (e.g. geonet layer between the primary and secondary barriers)

- An internal infrastructure designed to facilitate retrieval of wastes

Facility Monitoring - In addition to the monitoring and inspection per 264.303 for the double liner system and a fully instrumented leak detection system, an extensive monitoring network would ensure no releases pass undetected from the unit boundary. This would include both air and surface water monitoring stations and groundwater monitoring wells upgradient and downgradient of the CSF which would require a groundwater monitoring plan. These requirements would also be integrated into the overall RFETS monitoring program to ensure that a comprehensive network was in place to help protect human health and the environment.

Operational Controls - Operational controls would be put in place to ensure that waste management operations were conducted in such a way as to minimize the risk of release from the facility or exposure to personnel:

- An agency-approved waste acceptance criteria specifying a safety envelope for chemical and physical waste parameters including appropriate treatment requirements

- An operational health and safety plan approved by the agencies designed to provide operational constraints for personnel protection, weather conditions, decontamination procedures, training requirements, emergency response, and health and safety monitoring

- Standard operating procedures that establish clear repeatable guidelines for conduct of operations, including packaging and transporting of waste from ~~D&D~~ Decommissioning activities or IHSS remediation locations to the CSF

- Numerous quality assurance procedures from construction quality assurance, as cited earlier per Subpart 264.303 (a) monitoring and inspection, to procedural audits all designed to ensure the facility and operations meet designated performance standards

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- Closure plans that define how the facility would be decommissioned after the life of the operations and the performance standards for closure per Subpart 264.310 and 264.552 (e)

- Contingency/spill response plans per Subpart 264.304 would define how the facility responds to a release of waste or constituents from the CSF.

Administrative Controls - Administrative controls are defined to ensure that risk of exposure during construction, operations, and closure are minimized. These may include:

- Appropriate institutional controls (e.g. warning signs, fences, deed restrictions)

- Security plans which define site restriction requirements throughout the life of the project

- Cleanup standards which define the level of cleanup necessary to certify closure

In summary, numerous technical and administrative controls would be in place to insure that all aspects of this effort were conducted in such a way that risks to human health and the environment would be minimal.

5.4 NEPA VALUES

The proposed CSF would be authorized using a single, integrated Decision Document that would be signed by the DOE, and the State of Colorado, when approved. The Decision Document and review process would satisfy the documentation and procedural requirements of the RFCA. The National Environmental Policy Act (NEPA) process was integrated into the RFCA documentation and procedure, especially public involvement and decision-making, to reduce duplication and paperwork, and streamline the combined NEPA/CERCLA process. In accordance with the DOE Secretarial Policy issued in June 1994, integrated CERCLA/RCRA documents for environmental clean up activities are to incorporate NEPA values to the extent practical. This policy is intended to minimize the cost and time for document preparation and review while meeting the requirements of both acts.

The CSF would be anticipated to minimize cumulative effects on the environment by being placed in the Western Industrial Area because of the following:

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- The proposed area in the industrial area has been already disturbed and consolidation of waste is achieved
- Existing infrastructure already exists which would support the CSF
- The proposed area was selected based on a detailed siting study which screened out sensitive areas (e.g. areas populating the endangered species Prebles Jumping Mouse, steep slopes, wetlands, etc., were avoided)

The analyses required by NEPA were integrated throughout the Decision. Based on the analyses, the decision-making process requires no further documentation to complete the NEPA process.

5.5 REMEDIATION WASTE STORAGE FACILITY OPERATIONS

The CSF would be operated and maintained under a number of administrative requirements, as previously mentioned in section 5.3 "Technical and Administrative Controls," to ensure compliance with paragraph 80 of RFCA. Administrative controls would be administered for activities of waste operations in the following areas:

1. WAC documents and forms - These would be required to demonstrate compliance with the RWSF WAC and paragraph 80 of RFCA requirements previously mentioned in section 2.2
2. Operating procedures - Procedures for handling and placement of waste, facility maintenance and documentation to ensure safe and efficient operation of CSF
3. Training Plans - A plan to administer required training for operating personnel in procedures, safety, and quality assurance
4. Health & Safety plans - The health and safety requirements for operating personnel to conduct operations in a safe manner
5. Contingency/spill response plans would define, per Subpart 264.03, how the facility would respond to a release of waste or constituents from the CSF

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6. Limiting operating conditions - Identification of abnormal events which would require operations to temporarily stop activities (e.g. excessive wind velocities, and other weather conditions) to ensure safety to the public, the workers, and the environment

7. Administrative procedure and plans - Additional procedures and plans to ensure compliance with RFCA, DOE orders, and RFETS rules and policies

8. Control of fugitive dust emissions - Facility Monitoring plan as cited in section 5.3 to reduce dust emissions and monitor results to protect the public and worker

9. Closure Plan - This would include the requirements and performance standards for closure per Subpart 264.310 and 264.552 (e) to close the facility after the end of its operational life

Additional requirements addressed in the WAC or Facility Operations Plan for compliance would be areas addressing administrative controls. The following requirements would ensure the RWSF to be operated in a safe manner:

- Recordkeeping and documentation
- Waste information from process knowledge and/or sampling and analysis data for waste characterization
- Quality assurance/quality control (QA/QC) certification program and verification;
- Status reports and waste forecasts
- Shipment notification

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- Packaging and labeling requirements

CLOSURE REQUIREMENTS FOR THE CSF

Once the CSF has shipped offsite all remediation waste it would be subjected to closure requirements under RFCA Part 9 Subpart B paragraphs 97, 118, and 121. A closure plan would be submitted which described the following items to meet the closure performance goals of 264.111:

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- A description of how the CSF would be closed to meet the closure performance standards
- A description of how final closure would be conducted
- An estimate of the maximum inventory of remediation waste managed within the CSF
- A detailed description of the steps required to decontaminate all hazardous waste residues, containment system components, equipment, structures, and soils for final closure
- A description of how other activities ensure the closure performance standards are satisfied (e.g. ground-water monitoring, leachate collection, run-on and run-off controls.
- A schedule for final closure.

CONCLUSION

The CSF is proposed as a contingency to the existing Ten Year Plan. This IM/IRA Decision Document is the tool to designate the proposed IA-West area as a CAMU for storage of remediation waste as a contingency to the Ten Year Plan. The Decision Document identifies and explains, in a detailed study and analysis, the best location onsite for the selected remedy—Metal Buildings. In the event remediation waste could not be shipped offsite as originally anticipated under the Ten Year Plan, the DOE would have the option of implementing the CAMU as their contingency for interim storage of remediation waste pending shipment.

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Response to
Colorado Department of Public Health and Environment

Comments on

DRAFT CORRECTIVE ACTION MANAGEMENT UNIT INTERIM MEASURE/INTERIM REMEDIAL ACTION DECISION DOCUMENT AND APPLICATION SUPPORT DOCUMENT FOR CONTAINERIZED STORAGE FOR ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

November 25, 1996

1. On page iii, Tables 5-1 and 5-2 are listed as being on pages 5-6 and 5-8, respectively. Tables 5-1 and 5-2 are actually on pages 5-4 and 5-6, respectively. Please modify document accordingly.

   Response: The page numbers have been corrected.

2. On page ES-1 it states, "This facility would be known as the Containerized Storage Facility (CSF)." Please change the above sentence to state, "The facility proposed to be situated within the CAMU would be known as the Containerized Storage Facility (CSF)."

   Response: The sentence has been modified to read "This facility, proposed to be located within the CAMU, would be known as the Containerized Storage Facility (CSF).".

3. Please change the third sentence of the first paragraph on page ES-1 to state, "This CSF CAMU designation is being requested to facilitate remedial activities in support of site closure at RFETS and may be used along with a separate bulk storage CAMU designation to provide a range of options for waste management."

   Response: The sentence has been modified to read "This CSF CAMU designation is being requested to facilitate remedial activities in support of site closure at RFETS and may be used along with a separate bulk storage CAMU to provide a range of options for management of remediation waste.".

4. Please delete the last sentence in the first paragraph on page ES-1. The text must be rewritten to reflect that references to a CAMU as a contingency is only applicable if an appropriate remedy is specified. A CAMU is not a remedy in and of itself. The text must explicitly state what the remedy is (offsite disposal) and specify a reasonable time frame for CAMU implementation (e.g., within 2 years after CAMU designation) and for remedy completion or CAMU closure.

   Response: The sentence was deleted. The text has been revised to read "The remedy at RFETS for cleanup of contaminated areas is source removal, including treatment if appropriate, followed by offsite disposal of remediation waste. This is embodied in the Site closure schedules. Planning assumptions in the site closure baseline, as described in the Ten Year Plan (DOE 1996a), call for offsite shipment for disposal of remediation waste as it is generated. This CAMU designation would serve as a contingency to this assumption, ensuring risk reduction activities could continue in the event immediate offsite shipment is not possible. The assumptions of site closure will be reviewed on a periodic basis along with funding profiles and risk reduction priorities to determine if or when implementation of this contingency would be appropriate.".

5. The second paragraph on page ES-1 presents waste volume estimates. The text should distinguish between CSF CAMU waste estimates and total site-wide waste estimates. The current overall volume estimates should be consistent throughout the document and with the overall waste volume estimates presented in the Draft Bulk CAMU document (see pages ES-3, 1-2, 5-6, etc.).

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Response: The text in the second paragraph was modified to state these estimates are for remediation wastes. This should distinguish these estimates from other waste streams on site. The upper end remediation waste volume estimate is 300,000 cubic yards. This is consistent with the bulk storage CAMU application and will be consistent throughout the text.

This facility is not intended to be able to support storage of 300,000 cubic yards. This design represents an option from the lower end of the waste management spectrum with respect to waste volumes. In the event that the waste streams generated would be closer to 300,000 cubic yards, this option would likely not be the one selected to support management of these volumes of waste.

The sentence on page 1-2 citing Ten Year Plan waste estimates has been deleted since these estimates are being refined as new information is gathered.

6. In order to clarify that the requested designation is for the CAMU, not the CSF, the first sentence of the third paragraph on page ES-1 should state: "This CSF CAMU designation request is presented as an Interim Measures/Interim Remedial Action (IM/IRA) Decision Document and Application Support Document."

   Response: The sentence has been modified to read "This CSF CAMU designation request is presented as an Interim Measures/Interim Remedial Action (IM/IRA) Decision Document and Application Support Document.".

7. The meaning of the last sentence in the third paragraph on page ES-1 would be clearer if modified to state, "The CSF would store waste ready to be shipped in the near-term to an available offsite disposal or treatment facility and waste not amenable for bulk storage."

   Response: The sentence has been modified to read " The CSF would store waste ready to be shipped in the near-term to an available offsite disposal or treatment facility and waste not amenable for bulk storage.".

8. On page ES-1, TSCA wastes are identified as being one of the types of remediation wastes to be managed in this facility. TSCA waste requirements specify a one-year storage ceiling. Please provide details as to how the facility will comply with this requirement for a ontainerized storage CAMU.

   Response: All TSCA waste will be managed under the requirements of TSCA. The text has been modified to delete references to TSCA.

9. At the top of page ES-2 it states, "The request that CDPHE make a finding of fact as to whether the proposed facility also meets the requirements for a disposal facility, as described in paragraph 80 of the RFCA, is deferred." The CSF is not designed to meet the Subpart N requirements and is not intended to become a disposal facility, therefore, this sentence should be eliminated. It is assumed that paragraphs 80 and 109 of the RFCA is intended to apply to the proposed bulk storage CAMU and that this CSF CAMU proposal will proceed as an IM/IRA Decision Document outside the purview of paragraphs 80 and 109. This decision document should clarify to which CAMU these paragraphs apply.

   Response: The sentence has been deleted. By joint agreement of all parties, the containerized CAMU application will proceed as an IM/IRA Decision Document under RFCA. The schedule for review for this CAMU application will follow the time frames outlined in Paragraph 109 of RFCA.

10. On page ES-2 it states, "A determination has not been made on the period of operation of the CSF CAMU." The period of operation for the CSF CAMU must be designated and should be consistent with the term of RFCA's Intermediate Site Condition, a maximum of 25-years, as well as the design life of the proposed alternative. In Section 5 of this document, the design life of the C10. The period of operation for the CSF will be clarified as 25 years

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consistent with the RFCA preamble definition of the intermediate site condition. This will be clarified in Section 5.0 as well. SF is given as 20 years.

11. Please change the last sentence of the paragraph at the top of page ES-2 to state, "Closure of the facility will be in accordance with 6 CCR 1007-3 § 264.552(e)(4)."

Response: The sentence has been modified to read "Closure of the facility would be consistent with cleanup levels established in the RFCA and in accordance with 6 CCR 1007-3 264.552 (e) (4)."

12. The first bullet on page ES-2 must be changed to incorporate the modifications mentioned in comment #4 above regarding the CSF CAMU serving as a contingency.

Response: The following sentence has been inserted after the first sentence in the bullet: "This remedy is source removal coupled with offsite disposal."

13. On page ES-2, please modify the last bullet to state: "The CSF CAMU may allow DOE to achieve economies of scale by consolidating remediation waste, making treatment and offsite disposal less costly and addressing long-term liability and safety issues." Please also provide further rationale for stating that the containerized CAMU approach would be less costly, overall. Cost must be computed not only in the present time frame, but over the long term as well. Every indication is that off-site disposal cost will continue to be on the rise.

Response: The decision document has never stated that the CAMU will achieve lower overall cost. the following paragraph has been added after the first paragraph for clarification: "The most cost effective approach to site closure is to ship remediation waste offsite as it is generated. the decision of whether or not to implement the CAMU contingency would need to balance cost issues with the ability to achieve timely risk reduction."

14. The text should further describe the physical characteristics of the "rolloff" type containers first mentioned on page.

Response: The container description, is used for cost estimating purposes only, and not intended to limit facility flexibility with respect to waste management. These containers have been described in more detail in Section 5.1 and in the design narrative. All containers used in this facility will be suitable for storage purposes. Container specifications will be described in the waste acceptance criteria.

15. Please replace the first sentence in Section 1 (page 1-1) with the following: "This is an application for designation of a Resource Conservation and Recovery Act (RCRA) Corrective Action Management Unit (CAMU) and a Rocky Flats Cleanup Agreement (RFCA) Decision Document. The storage unit within the proposed CAMU area would be known as the Containerized Storage Facility (CSF)."

Response: The first two sentences of Section 1 have been revised to read "This is an application for designation of a Resource Conservation and Recovery Act (RCRA) Corrective Action management Unit (CAMU) and a Rocky Flats Cleanup Agreement (RFCA) Decision Document. The storage unit within the proposed CAMU area would be known as the Containerized Waste Storage Facility (CSF).".

16. In the second paragraph on page 1-1 it states, "The flexibility provided by the CSF contingency enhances DOE's ability to ensure timely and cost-effective site closure in support of the aggressive offsite waste shipment strategy embodied in the Site Draft Ten Year Plan (DOE 1996a)." Please see comment #13 above.

Response: As stated for Comment Number 13, it was never the intent of this document to suggest this option is more cost effective than immediate offsite shipment. If this option

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is needed, however, it would be the most cost effective, given the consideration listed in Section 1, and would support timely risk reduction. No further revisions to the text have been made.

17. On page 1-2 it states, "The designation of the CSF as a CAMU provides an option for quick and effective handling of a larger volume of waste in a safer manner than the conventional RCRA approach allows." Please delete the above sentence or modify it to state, "The designation of the CSF CAMU may provide..." Also describe how a CAMU is safer than a "conventional RCRA approach."

Response: The sentence has been modified to state: "The designation of the CSF as a CAMU may provide an option for quick and effective handling of a larger volume of waste in a safer manner than what would occur from multiple smaller storage and shipping areas spread across RFETS". As explained in the paragraph, a centralized facility reduces the handling requirements and potential exposure that would occur if multiple work location across the Site were storing, handling, and shipping waste. This facility would provide storage capabilities significantly larger than those that currently exist so larger volumes could be handled.

18. Please change the sentence in the next-to-last paragraph on page 1-2 which states, "Remediation waste does not include wastes generated from non-ER or decommissioning activities." to say, "Remediation waste does not include wastes generated from other activities."

Response: The sentence has been modified to read "Remediation waste does not include wastes generated from process related or other activities.".

19. On page 1-4 it states, "This Decision Document contains the information necessary for the Colorado Department of Public Health and Environment (CDPHE) to designate a CSF [CAMU] used for containerized storage." Additional information is necessary, however, before a CAMU can be designated. Besides addressing our other comments, the Decision Document should also include: a comprehensive design narrative including geotechnical analyses (e.g., settlement, bearing capacity, slope stability) and pertinent design parameters (including a comprehensive table which addresses design items, components, performance standards, design guidance, design parameter demonstration, and resultant design criteria), guidance narrative which thoroughly addresses development of operational and maintenance requirements, guidelines for development of a Waste Analysis Plan, Security Plan outline, Personnel Training Plan outline, Inspection Plan outline, Construction Quality Assurance Plan outline, Health and Safety Plan outline, Operating Record System Plan outline, guidelines for development of a ground water monitoring plan (including field procedures and analysis of the proposed CSF monitoring network efficiencies), guidelines for development of a surface water monitoring plan, guidelines for closure and post-closure plan(s), preliminary specifications, Contingency Plan outline, and an outline for a chemical compatibility determination.

Response: 6-CCR-1007-3 264.552 (e) requires that requirements be specified with respect to waste management, closure, groundwater monitoring, and treatment. The issue here is defining the level of detail incorporated into the requirements. There is no language in the regulation requiring demonstration of compliance with a particular requirement, simply identification of the requirements themselves. The intent of this language, according to the proposed rule, was to allow flexibility outside pre-established requirements such as Subpart N. There is no specific regulatory guidance as to the level of detail. An inference can be made that this level should be consistent with the level of detail contained in the regulations. 6 CCR 1007-3 264.301 (Subpart N) establishes a general model for the level of detail considered to be adequate in terms of defining a requirement. This CAMU designation request meets or exceeds this level of detail.

Other guidance as to the level of detail is provided in the EPA final rule under section 264.552 (c) (1): Facilitation of Reliable, Effective, Protective, and Cost Effective Remedies where it states "The Agency does not intend that evaluation of this decision criterion will

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require a detailed cost/benefit or other quantitative analyses" (FR Vol. 58, No. 29 February 16, 1993, page 8668). This is supported by similar language in the proposed rule. No language to the contrary appears in the Colorado Notice of Final Adoption dated May 31, 1994.

RFCA Paragraph 80 has defined the requirements for the bulk storage CAMU as those in Subpart N. The level of detail required for any requirements should also be consistent with the detail in Subpart N. The level of detail to be contained in the CAMU designation request was specifically discussed during the RFCA negotiations where it was decided that only conceptual level information was needed rather than detailed design information. Detailed design information will be provided and be subject to approval if, and when, the Site decides to proceed with construction of the CAMU.

Additional supplementary information has been provided. No text was modified in response to this comment. A design narrative has been prepared in response to comment 19.

20. The CSF does not exist as a "regulated unit". Therefore, please delete the second sentence of the first paragraph on page 1-4.

Response: This sentence has been deleted.

21. In the first paragraph on page 1-4, the proper reference citation for RFCA is (DOE, 1996a).

Response: This reference has been corrected

22. On page 1-4 it states, "The CSF would consist of metal storage buildings with sealed concrete floors and would be constructed to store containerized remediation waste." The text should add that the sealed concrete floors must be constructed of components that will have appropriate chemical and physical properties to prevent failure. Also, the text should state that the facility design would incorporate internal leakage stops.

Response: The sentence has been modified to read: "The CSF would consist of metal storage buildings with chemically resistant sealed concrete floors, internal leak stops, and would be constructed to store containerized remediation waste.".

23. On page 1-4 it states, "It is the intent of DOE to request a CSF CAMU for storage only, and that all waste would be removed from the CSF prior to Site closure. The request that CDPHE make a finding of fact as to whether the proposed facility also meets the requirements for a disposal facility, as described in Paragraph 80 of the RFCA, is deferred." This sentence last should be deleted (see comment #9 above).

Response: This sentence has been deleted.

24. On page 1-6 it states, "Specific plans and documents detailing environmental monitoring, waste acceptance criteria, and closure are not in the scope of this document...." Please see comment #19 above. A ground water monitoring efficiency analysis must be incorporated into the document to show that the proposed ground water monitoring system is adequate.

Response: It is agreed that the groundwater monitoring requirements of 6 CCR 1007-3 264.552 (e) (3) (i) apply to this CAMU. Additional submittals for the CAMU will include a detailed groundwater monitoring plan that will be included as part of the Site Integrated Monitoring Plan (IMP) for groundwater. There is no requirement in the regulations for a "groundwater monitoring efficiency analysis". Determination of necessary and sufficient requirements for issues such as well spacing, screen placement, and sampling frequency will be developed in conjunction with facility design and be reviewed and approved by CDPHE.

25. The essence of the first bullet at the top of page 1-7 says, "...the management of ... remediation waste" ensures safety "through ... management of remediation wastes..."

Please modify this sentence to avoid this redundancy by replacing the phrase "management of remediation wastes at the RFETS" with "remedies".

Response: The bullet has been modified to read: "In support of the RFCA and the Draft Ten Year Plan, the management of low-level, low-level mixed, and hazardous remediation waste must ensure the safety of the public, RFETS workers, and the environment through reliable, effective, protective, and cost-effective implementation of interim and final remedies at the RFETS."

26. On page 1-7 the second bullet in Section 1.2.2 refers to "the uncertainties surrounding waste volume estimates". Please provide further details as to methods to be utilized to further pin down estimates, and a schedule for performing this analysis.

Response: The text was not changed in response to this comment. Estimates for waste volumes with respect to site closure are included in the Ten Year Plan.

As part of the overall strategy, an exercise has been conducted for the Ten Year Plan to estimate waste volumes. For D&D, volume estimates are being based on actual D&D volumes associated with recent buildings around the DOE complex including RFETS buildings. ER waste volumes are being estimated and revised based upon past characterization activities. Additional characterization activities are also being scoped for the Industrial Area to provide better detail for cleanup including waste volume estimates. Volumes are refined as new data are collected.

A mass balance exercise is also being conducted that assesses waste volume estimates, shipping capacity, current onsite storage capacity, other potential onsite storage resources, funding curves, and activity cost estimates. This will be used to provide overall waste generation curves and evaluate when, if at all, additional storage will be necessary. This assessment will drive the proposed scope of the Ten Year Plan. Once the Ten Year Plan is completed, periodic updates will provide a planning baseline intended to support issues such as determining the adequacy of RFETS storage capacity.

27. In the third bullet on page 1-7, please replace "solution" with "remedy".

Response: "Remedy" now replaces "solution" in the sentence.

28. In the last bullet in Section 1.2.3 (top of page), please delete "designated CSF contingency."

Response: The first two words were deleted as requested however, this facility is still a contingency and it is appropriate to identify it as such in the bullet.

29. On page 2-1, The first sentence in Section 2 should read, "The ability to designate the CSF CAMU is dependent in part on compliance with the criteria found in 6 CCR 1007-3 265.552 (c), Corrective Action Management Units."

Response: The sentence has been modified to read: "Designation of the CSF as a CAMU shall be in accordance with 6 CCR 1007-3 264.552 (c), Corrective Active Management Units. "

30. The second sentence of Section 2 on page 2-1 states, "In order to demonstrate a need for a CSF CAMU at RFETS, these seven criteria [6 CCR 1007-3 264.552(c)] were made an integral part of the decision-making process." §264.552 (c) specifies that the Department shall designate a CAMU in accordance with the seven items referred to in the above text. These regulations define how a CAMU must be designated and do not demonstrate the necessity of a CAMU. Please modify the text accordingly.

Response: The sentence has been deleted.

31. The regulatory citation in the first criterion listed in Section 2 should be 264.552 (c)(1).

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Response: The citation has been corrected.

32. The discussion on pages 2-1 through 2-3 addresses 6 CCR 1007-3 § 264.552(c)(1). Please rewrite this discussion to specify the remedy and how the proposed CAMU appropriately facilitates its implementation.

Response: The second paragraph has been modified to state the following:

"The CSF CAMU provides reliability and effectiveness by allowing the remedy of source removal coupled with offsite disposal to continue in the event offsite disposal capabilities cannot support near term waste generation during remedy implementation. This allows contaminant sources to be removed sooner rather than remain exposed in the environment because no storage or the offsite shipment is available. The CSF CAMU would be implemented to support continued risk reduction and mitigate delays to cleanup schedules in the event offsite disposal cannot occur in a timely manner, thereby facilitating remedy implementation."

33. On page 2-1 it states, "This CAMU is cost effective from both location and design standpoints." A detailed cost comparison of all CSF CAMU options should be provided and compared with costs of other potential alternatives (e.g., no action/using existing permitted units, etc.). Total costs of fully implementing the proposed remedy should be considered for all alternatives. Comment #54 below discusses adding these costs to Table 4-1.

Response: The total costs for implementing this interim action were considered. Costs for these options will be included in Section 4. Most of these costs will be based on the cost estimates prepared for the bulk storage CAMU and corrected for omission of liners and capacity. Since timely risk reduction rather than cost would drive the decision for implementation of this CAMU, cost estimates are included only to support selection of the most cost effective design rather than to demonstrate this option is more cost effective than immediate offsite disposal.

The no action alternative considers costs relative to the interim action only. These costs have been defined as essentially zero relative to the other options identified. In reality, some costs would be incurred for containers, packaging, and characterization if any level of cleanup occurred. Quantification of these costs is highly subjective and of little value when selecting an alternative for onsite storage since it has already been stated that the desire for risk reduction rather than cost would drive the decision to implement this CAMU.

The final remedy is source removal followed by offsite disposal. These costs are not part of the interim action and therefore not considered.

The focus of this document is to provide a proposed design for a cost effective containerized CAMU facility . It is not the objective of this document to establish a site wide waste management policy which evaluates numerous alternatives to a CAMU. The objective of this document is to evaluate CAMU alternatives. It is agreed that evaluation of all waste management options should occur prior to making a decision

34. On page 2-1 it states, "The design includes containment, retrievability, and inspection features which ensures that the facility is protective of human health and the environment." Please delete the above sentence from the text or modify the sentence to avoid the implication that protection of human health and the environment is guaranteed.

Response: The sentence has been modified to read: "The design includes containment, retrievability, and inspection features which supports protectiveness of human health and the environment.".

35. On page 2-2 it states, "Final shipping and offsite disposition of the wastes would be conducted once cleanup is complete, allowing resources to be more efficiently focused, economies of scale to be achieved, and support operations to be appropriately scaled." This statement apparently contradicts the criterion that a CAMU must expedite the timing of remedial activity implementation. Please delete the above sentence from the text.

Response: This sentence has been deleted.

36. The third criterion on page 2-3 states the preference to site the CAMU in uncontaminated areas of the facility. A more detailed map(s) (i.e., 1"=200') which at least encompasses the proposed CAMU area and the rail spur should be provided to support the discussion of this criterion.

Response: A more detailed map has been included.

37. The first bullet under criterion #3 on page 2-3 states, "The area is near the RFETS rail spur and other offsite shipment facilities." The third bullet states, "The area is not within the Protected Area." Please identify and describe any contaminated areas outside the Protected Area near the RFETS rail spur and other shipment facilities which could provide a suitable location for the CSF CAMU.

Response: This site was selected because the emphasis is on active offsite disposal. The location, therefore, was based on shipping logistics rather than longer term storage. A major emphasis during site selection was to locate an area with previous contamination however, no IHSS areas met the following criteria :

• The area needed to support near term implementation

• The area needed to support active offsite shipment including ease of use issues such as not being located within the PA.

• The area could not conflict with other risk reduction activities (i.e. Pu consolidation, D&D, and ER) or future near term site use such as existing plans for buildings and site infrastructure.

These considerations led to the selection of a site that did not incorporate current IHSSs but was in a previously disturbed portion of the Industrial Area adjacent to the rail line.

38. The second bullet on page 2-3 states, "The area is relatively free of obstructions such as buildings, utilities, and process waste lines which facilitates more rapid construction." Facilitating rapid construction does not suitably address § 264.552(c)(3). The second bullet should be deleted from the text.

Response: The ability to implement this facility relatively quickly if the need arises supports timely risk reduction, mitigates potential delays to cleanup activities, and allows exposed sources to be placed into a more protective configuration. All these factors associated with more rapid implementation as well as selection of an area that does not hamper risk reduction activities supports this criteria. The text was not modified in response to this comment.

39. The fourth bullet on page 2-3 states, "The area is within a previously disturbed industrial setting which limits the impacts to natural resources, endangered species habitat, and the environment." The proposed area appears to be located in an uncontaminated area above a shallow ground water table which does not particularly limit impacts to natural resources or the environment. Delete this bullet.

Response: The text was not modified for the following reasons:

• This bullet supports that fact that this area is not in an area of significant ecological importance since it has already been disturbed, is in an area of active use, and does not support endangered species or near term future site use such as potential open space.

• The area limits impact to natural resources such a gravel deposits since this area is not ideal for this type of operation.

• The area is also located within the surface water management area and, therefore, is supported by the current safety envelope of the Site. this makes the area more protective from an environmental standpoint than areas in the southern or northern buffer zones.

• The depth to groundwater is relatively constant across the entire Industrial Area including the Protected Area and does not factor significantly in site selection . In addition, most groundwater under the proposed site daylights in the seeps to the south. These seeps are within the current surface waster management safety envelope supporting the ability to maintain protectiveness or support corrective action.

40. Criterion #5 on page 2-5 indicates the CAMU shall expedite the timing or remedial activities. The text should specifically address how the proposed CAMU will expedite remedial activity implementation. Please also see comments #4 and #35 above.

Response: This paragraph has been revised as follows:

"This CSF CAMU is intended to be used as a contingency to the site closure strategy. As previously mentioned, the Ten Year Plan assumes wastes can be shipped and disposed offsite as they are generated. In the event this assumption fails, contaminant sources would either be stored at the point of generation or left exposed to the environment. This would delay implementation of the remedy of source removal and offsite disposal. Implementation of this contingency would ensure that the timing of remedial activities would not be impacted. This allows expedited cleanup schedules to continue as planned."

41. The text under criteria 6 and 7 on pages 2-4 and 2-5 should be deleted from the text and replaced with the following, "This criterion is not applicable. At this time, the intended use of this facility is for monitored, retrievable waste storage." (See text under criterion #4 at the top of page 2-4.)

Response: This revision has been incorporated and is consistent with Criterion 4.

42. The first sentence of Section 3 on page 3-1 should be deleted. Although it is within quotation marks, the text is not quoted verbatim. The CSF is not designed to meet Subpart N requirements and cannot be a disposal facility. Please also see comment #9 above.
42 and 43. Both sentences have been deleted and replaced with the following statement:

Response: "The approval of this IM/IRA Decision Document by the State of Colorado shall constitute approval of a CAMU designation for storage of containerized remediation waste. This section identifies the applicable requirements considered to be met upon approval of this decision document."

43. The second sentence of Section 3 on page 3-1, which refers to the CAMU rule, is also not verbatim. On page 1-6 it states, "The first step is the IM/IRA Concept Validation/CAMU Designation, which consists of this IM/IRA Decision Document." Accordingly, the sentence should be replaced with a statement to the effect that with the State's approval, this decision document will constitute a designation of the proposed CAMU.
42 and 43. Both sentences have been deleted and replaced with the following statement:

Response: "The approval of this IM/IRA Decision Document by the State of Colorado shall constitute approval of a CAMU designation for storage of containerized remediation

waste. This section identifies the applicable requirements considered to be met upon approval of this decision document."

44. Assuming that paragraph 80 of RFCA refers to the proposed bulk CAMU, the phrase "Consistent with RFCA paragraph 80" should be deleted from the first sentence under Section 3.2 on page 3-1 (see comment #9 above). The list of design and operating requirements is still appropriate. The sentence at the end of this list of requirements refers to further discussion in Section 5.4. This reference is apparently in error. In the next sentence, the reference to paragraph 109 of RFCA should be removed.

Response: This sentence and all other references to Paragraph 80 have been deleted.

45. Please delete the first paragraph under Section 3.3 on page 3-2 from the document. See comment #9 above.

Response: This paragraph has been deleted.

46. Additional requirements for designation enumerated in Part 264.552(e) of the CAMU rule are listed at the bottom of page 3-2. Please change the regulatory citation after bullet 2 to (Part 264.552(e)(2) and (4)) or change bullet 2 to read "Specification of the applicable design, operation and closure requirements" and add a fourth bullet which states, "Specification of closure and post closure requirements (Part 264.552(e)(4))."

Response: The citation was modified to include "and (4)".

47. On page 3-2 it states, "If implementation of this CSF CAMU becomes necessary to meet risk reduction goals, documentation and plans meeting the above requirements will be provided during the CSF design/preparation for construction phase." The CAMU areal configuration must be included in this decision document. Also, please see comment #19 above. All guidelines, outlines and conceptual plans mentioned above must be submitted as work plans during the design phase.

Response: The areal configuration for this CAMU has been identified in the new appendix. Please see response to Comment 19. All work control documents will be submitted for State review during the design phase should this CAMU contingency be implemented.

48. On page 4-1 it states, "All of the alternatives except No-Action, would provide handling and shipping capabilities for offsite transport." All alternatives should include handling and shipping capabilities for offsite transport. The document should present a detailed cost estimate for all alternatives to demonstrate that the CSF would support a cost-effective remedy.

Response: At this time, the intended use of this facility is to support storage and shipment with packaging and any onsite treatment performed at the project sites. It is agreed that maximum flexibility, with respect to design features, should be maintained in this document to ensure that the final design would support effective offsite transport for disposal.

Additional cost data has been provided in section 4 in Table 4-2. The cost estimates are used for relative comparisons between designs and support selection of the most cost effective design.

The usefulness of these estimates is for alternative comparisons only. The determination of whether or not to implement this CAMU option will not be based solely on cost since it is significantly more cost effective to ship waste offsite as it is generated. The cost of the facility will be balanced with the objective of timely risk reduction when the decision to implement this option is evaluated.

The level of detail in these estimates is consistent with conceptual level design and not intended to be definitive estimates. Addition or deletion of design features such as handling and shipping facilities would create no significant relative differences between the design alternatives and therefore, not impact alternative selection. Similar shipping and handling facility upgrades have relatively little value when comparing alternatives because, at the conceptual level of design, the costs would all be relatively equal and, therefore, not differentiate one design over another. Please also see the response to comment 47 with respect to the statement in the final rule regarding detailed cost benefit analyses. In addition, comment by the State regarding limiting flexibility by making statement limiting facility design options (Comment 63) should also consider the limited flexibility of building excessive design features into the designs at this early stage.

Conceptual level cost estimates have fairly high levels of uncertainty associated with them. These uncertainties, or margins of error, are quantified as contingency and cover omission or addition of design features such as those mentioned in the comment.

49. The first bullet on page 4-2 regarding rejection of the No Action Alternative states, "The current permitted storage capacity at RFETS would not likely support storage for the waste volumes estimated in the Draft Ten Year Plan in the event offsite shipment cannot keep pace with generation thus delaying cleanup." Please identify the factors which would prevent offsite shipment from "keeping pace with generation." The cost savings benefit resulting from not building the CSF might be better applied to facilities or procedures which will facilitate implementation of the offsite disposal remedy. Please also see comment #48 above.

Response: The factors that might impact offsite capabilities include availability of offsite disposal, future funding profiles, risk reduction priorities, generation rates, and shipping capabilities.

The intent of this decision document is to provide an option for a CAMU. This would not be the sole option for future waste management but it is the sole purpose of this document rather than assess infinite modifications to current site practices. Use of funding to upgrade facilities or otherwise enhance offsite shipment capabilities is a valid issue which would be considered during the CAMU implementation decision process.

50 The second bullet on page 4-2 regarding rejection of the No Action Alternative states, "Near-term costs for risk reduction activities could increase because additional resources might be needed sooner to meet land disposal restriction treatment requirements. This would delay the number of source removals that could take place in a given time frame." The document should also indicate that near-term costs for risk-reduction activities could also increase because additional resources

Response: The second bullet has been deleted. The basis for decision on whether or not to implement a CAMU is not cost based. The basis for CAMU implementation is the desire on the part of DOE to meet its commitments for expedited risk reduction even if offsite disposal is not immediately available and recognizing the additional costs necessary to support this. Cost, however, will be one of the primary factors influencing selection of the design.

51. On page 4-2 it states, "If the facility needed to be utilized for more than 30 years, the Hardened Concrete Vault might be the best alternative. However, the CSF facility is intended for short-term use only (as described in the Draft Ten Year Plan strategy)." On page 4-3 it states, "The Metal Buildings alternative was selected as the best alternative for short-term storage (10-20) years." Please see comments # 4 and #10 above.

Response: The first statement was modified to read: "If the facility needed to be utilized for more than 30 years, the Hardened Concrete Vault might be the best alternative. However, the CSF facility is intended for short-term use consistent with the 25 year time limit for the intermediate site condition as defined in the RFCA preamble.".

The second statement now reads: "The Metal Buildings alternative was selected as the best alternative for short-term storage consistent with the intermediate site condition as defined in the RFCA preamble (12 to 20-25 years).".

52. The sentence in the first bullet on page 4-3 states, "Air monitoring could be incorporated into existing programs." Please replace "could" with "would" in the above sentence.

Response: The text has been revised to read:. "Existing RFETS air compliance programs will incorporate the CSF facility."

53. Discussions of a leak (leachate) collection system and secondary containment, as in the third bullet on page 4-3, should include a commitment that components of these systems would be subject to chemical compatibility testing or demonstration.

Response: The second sentence in the third bullet has been revised to read: "The combination of strong tight containers, an enclosed building, a leak collection system, chemical resistant materials where applicable, and secondary containment would provide protectiveness to surface water and ground water.".

54. Table 4-1 modifications:

Under Worker Safety for the No Action alternative it states, "Waste would need to be immediately shipped in bulk to reduce exposure." This block also states, "Exposure could result if waste leaked from containers." Please clarify the apparent inconsistency between these two statements. Also, waste would not have to be immediately shipped in bulk if a handling facility was available for packaging purposes. This handling facility would also address the "lack of a waste handling facility" mentioned under Transportation for the No Action alternative.

The second sentence under Facility Design, Containment and Monitoring for the No Action alternative would make more sense if modified to read, "Source removals may not be continued in a timely fashion."

Please replace "CSF" with "Metal buildings" under Transportation for the Metal Buildings alternative and elsewhere in Table 4-1. Also, please explain why the metal buildings would allow more transportation options for offsite shipment than the other alternatives.

Under the Institutional Controls column it states that RFCA (or RCRA) will be an institutional control. While Institutional controls can established by decision documents such as this, RFCA itself (or RCRA) is not an institutional control. Delete this sentence from this table.

The detailed cost comparison of all CSF alternatives mentioned in comments #33 and #60 should be incorporated into the Cost column by listing the estimated costs, or may provided in a separate table. The narrative should explain that the cost for the No Action alternative is the basic final disposal cost.

Under Community Acceptance, it is assumed that the "desire for offsite disposal" is the general public's desire. It should be so identified.

Response:

a. The referenced block has been revise to read: "Cleanup schedules might be impacted if offsite shipment cannot occur. Exposure could result if sources are not contained or if waste leaked from containers left at project site.".

b. This block now reads: "Waste will not be consolidated. Sources removals may not be conducted in a timely fashion. Site monitoring requirements would not be reduced through cleanup activities.".

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c. The term "CSF" has been replaced with "metal buildings" throughout Table 4-1. the second sentence in the block now reads : "The metal buildings would allow coordination of transportation and more ease of transportation than vaults.".

d. The sentence has been revised to read: "Institutional controls requiring continued maintenance, inspection and monitoring of the facility would be required.".

e. Conceptual cost estimates are summarized in a new Table 4-2.

f. This statement was already included under this heading.

55. The first bullet under Section 5.1 on pages 5-1 and 5-4 states, "RFCA paragraph 80 describes requirements that have been incorporated into the conceptual design such as leachate detection and collection. Details of how these requirements will be met will be submitted during the design phase." A drawing(s) showing a conceptual floor design which incorporates integral drain channels and sumps built into the concrete slab should be included in the document. The text should state that the leachate collection system would be designed and operated to minimize clogging and that the sealed concrete floors should be subjected to chemical compatibility testing.

All guidelines, outlines and conceptual plans mentioned above must be submitted as work plans during the design phase (see comment #19).

Response:
a. The second bullet under Section 5 has been modified to read: "Structural concrete floor slab with chemical resistant coating and an integral leak collection system designed to minimize clogging. ".

b. A design narrative has been added to supply additional design and operational information.

56. A more detailed map has been included in the design narrative.

Response: Figure 5-1 illustrates the proposed containerized storage facility (CSF) footprint. A figure which illustrates the CSF CAMU areal configuration should be included in the document. The location of the proposed CSF footprint within the CAMU should also be shown. The importance of proximity to the rail spur has previously been expressed and so that feature should also be shown. A more detailed map (e.g., 1" = 200') which at least encompasscs the proposed CAMU area and the rail spur should be included.

57. Features used to develop the conceptual cost estimate are listed on page 5-4. The following additional features should also be listed:
- Surface water controls (the document should address the design criteria for surface water controls),
- Handling, packaging and transportation,
- Leachate management/treatment,
- A sludge-drying facility may need to be listed.

The next-to-last bullet in the list of features provides for 20,000 cargo containers which contradicts the 5,000 mentioned just above and in other previous sections. The use of "cargo containers" also differs from "rolloffs" used in previous sections. Please modify the text to make these items consistent.

Response: Additional information has been included in the design narrative. The basis for the cost estimates has already been established and as mentioned in response to Comment 48, these features create no relative difference between the design alternatives and provide no significant added benefit

58. On page 5-4 the last bullet states, "Groundwater monitoring wells (six total maximum) would be installed both up gradient and down gradient and would be monitored through the life cycle of the CSF (20 years)." Please insert the word "hydraulically" in front of the word "up" and the word "down" in the above sentence. As previously mentioned, a ground water monitoring efficiency analysis must be incorporated into the document to show that six wells are adequate.

Response:
a. The text was modified to include the word "hydraulically".

b. As stated in the text, the number of wells identified in this bullet are for conceptual cost estimating purposes only and not intended to establish a regulatory baseline. Some number needs to be assumed in order to estimate the facility costs. An analysis of sufficient groundwater monitoring will be conducted during the design phase and incorporated into a CDPHE approved groundwater monitoring plan.

59. Table 5-1 addresses a cost summary for the CSF. Total costs (including handling, packaging and transportation costs) associated with fully implementing the proposed cost effective than the No Action alternative (estimated at $215,000,000).

Response: It is acknowledged that the CAMU option would be significantly more expensive than No Action and would need to be balanced against risk reduction objectives prior to implementation. The nature of the design allows modular construction to ensure cost effective implementation. In addition, the total capacity of both options exceeds all current waste volume estimates making the scenario for implementation in this comment unlikely. The current waste management strategy is a focus on offsite shipment limiting additional storage to the extent practicable.

Since no leachate is expected with this design, design features have been focused on leak collection. These costs are negligible for a roofed facility housing water tight metal containers that do not contain free liquids. When used in this context, the term leachate suggests that water would infiltrate the roof of the facility and then into the sealed containers prior to leaking out through the same containers. This is an unlikely scenario. More likely is general water collection resulting from the influx of containers during precipitation events. The conceptual design accounts for water collection within the facility. References to "leachate" have been changed to "leak".

The additional cost of a drying facility would be approximately equal between alternative designs and, therefore, not significantly influence design selection. Inclusion of a drying facility may also impact design flexibility later. The current intention of the design information at this stage is not limit the possibility of incorporating this design feature later. This is consistent with Comment 63.

60. On page 5-5 it states, "The integral leachate collection and retrieval system built into the concrete floor would collect any potential leachate which would be transferred to a facility for treatment." Leachate management costs (and potential drying facility costs) should be included in the alternative analysis (see comment #57 above).

Response: Please see response to Comments 4857 and 59. Since it is highly unlikely that leachate could be generated from this type of facility design, the focus of the design is on leak collection. Leak collection costs would be minimal since this is a fully enclosed facility with waste in containers and free liquids would be prohibited in the waste acceptance criteria. Previous experience at RFETS with containerized storage facilities indicate no significant generation of leachate occurs and leak collection is already included in the design.

61. On page 5-6, treated and untreated sludge and sediments are listed as remediation waste types expected to be taken to the CSF. The text should state that wastes placed into the CSF must pass the Paint Filter Test.

Response: The paint filter test was already identified in the third bullet of Section 5.2.4. "Lack of free liquids shall be demonstrated by EPA Test Method 9095 (Paint Filter Test)." has been added to the conceptual waste acceptance criteria.

62. Waste acceptance criteria are discussed on pages 5-7 and 5-8. The text should state that pondcrete and saltcrete are solar ponds process wastes that will not be accepted at the CSF. The text should also state that waste acceptance criteria will be detailed in a workplan (see comment #19).

Response: It is clear throughout the document that only remediation waste will be accepted for the CAMU. "Remediation waste" was defined in Section 1. No text was modified in response to the first issue. The following sentence was added to the first paragraph of Section 5.2.3: "A detailed Waste Acceptance Criteria (WAC) will be developed during the design phase of the CSF." This was also specified in Section 5.3 under "Operational Controls".

63. On page 5-7 it states, "The CSF is not a handling facility and is not intended to repackage waste once received." This sentence conflicts with the statement in the second to last paragraph on page 4-1 and reduces flexibility. It should be modified to state how and where wastes will be managed (handled, treated, packaged) to facilitate the offsite disposal remedy.

Response: This sentence was deleted from the text. Details for management of wastes including handling, treatment, packaging etc. will be submitted during the design phase as stated in Comment 47.

During the evaluation of whether or not this facility is needed to support risk reduction it will be determined what type of design features this facility will require. The current assumption and the basis for the alternative cost estimates is that waste will be packaged and treated as necessary at the project specific sites. Additional treatment may also be conducted by offsite disposal sites.

During discussions with the State held February 13, it was mutually agreed that this document should not limit the flexibility of design. This resulted in deletion of the above referenced sentence. Likewise, flexibility should not be limited by specifying features that may not be necessary at the time of implementation.

It is also important to note that offsite disposal in and of itself is not the remedy. The actual remedy is source removal which is then followed by the waste management decision of offsite disposal.

64. On page 5-8 it states, "Process knowledge and/or chemical and radiological analyses would be the tools to document accurate characterization of the remedial waste." Please delete "/or" from the above sentence and describe how "process knowledge" can accurately

Response: The sentence was modified to read: "Historical knowledge including previous analytical data and/or current chemical and radiological analyses would become the tools to document accurate characterization of the remedial waste.".

65. Threshold limits of VOCs for the CSF should be included on the list of primary health concerns on page 5-9.

Response: The bullet has been revised to state: "Threshold limits for radionuclides and organic compounds for the CSF; and".

66. On page 5-9 it states, "The majority of low-level remediation waste to be managed at the CSF would have an average radionuclide activity less than ten nanocuries per gram (nCi/g) as mentioned previously under section 5.2.1." DOE and its contractors must protect workers against the worst possible exposures, and be prepared for those types of exposures in advance. Therefore, DOE must calculate a potential worker's exposure to the highest

concentrations present in waste scheduled to go into the CSF over a one year period, and protect to that level or greater. It cannot be guaranteed that a worker would only be exposed to average concentrations of radionuclides and not to higher concentrations over a significant portion of the year. This type of radiation protection policy is consistent with all the radiation protection policies RFETS has had in the past during plant operation.

Response: Agreed. These limits would be incorporated into health and safety and operational procedures as well as the WAC during the design phase. No change was mad to the text.

67. On page 5-10 it states, "This would include both air and surface water monitoring stations and groundwater monitoring wells upgradient and downgradient of the CSF." The text should specify that surface water and ground water monitoring stations will be "hydraulically" up gradient and "hydraulically" down gradient of the CSF.

Response: This sentence has been modified to read: "This would include both air and surface water monitoring stations and groundwater monitoring wells positioned hydraulically upgradient and hydraulically downgradient of the CSF.".

68. On page 5-10 it states, "A groundwater monitoring plan would be developed." The text should state that the ground water monitoring requirements in § 264.552(e)(3) would apply to the containerized storage CAMU.

Response: The sentence now reads: "A groundwater monitoring plan in compliance with CCR 1007-3 264.552 (e) (3) would be developed.".

69. The third bullet on page 5-11 addresses quality assurance procedures. This bullet should state that approval of quality assurance procedures will be required by the agencies.

Response: The bullet now reads: "Numerous quality assurance procedures from construction quality assurance, to procedural audits, all designed to ensure the facility and operations meet designated performance standards and approved, as appropriate, by the State;".

70. Please change the fourth bullet on page 5-11 to state, "Closure and post-closure plans approved by the agencies that define how the facility would be closed after the life of the operations and performance standards for closure and post-closure per 6 CCR 1007-3 § 264.552(e)(4); and"

Response: The bullet now reads: "Closure plans that define how the facility would be decommissioned after the life of the operations and the performance standards for closure per 6 CCR 1007-3 264.552 (e) (4); and"

71. The fifth bullet on page 5-10 should state that approval of contingency/spill response plans will 71. The response assumes that the comment actually refers to page 5-11. The bullet has been modified to read: "Agency approved contingency/spill response plans would define how the facility responds to a release of waste or constituents from the CSF.".be required by the agencies.

Response: The response assumes that the comment actually refers to page 5-11. The bullet has been modified to read: "Agency approved contingency/spill response plans would define how the facility responds to a release of waste or constituents from the CSF.".

72. The last sentence in Section 5.4.1 at the bottom of page 5-12 should be deleted from the text. The CSF will not be a disposal facility (see comment #9 above).

Response: This sentence has been deleted.

73. On page 5-13 the last bullet mentions a closure plan. This bullet should be entitled "Closure Plan and Post-Closure Plan." The appropriate regulatory citation is 6 CCR 1007-3 § 264.552(e)(4).

Response: The bullet now reads: "Closure and Post-Closure Plan - This would include the requirements and performance standards for closure per 6 CCR 1007-3 264.552 (e) (4) to close the facility after the end of its operational life."

74. The conclusion on page 5-14 should be modified to reflect these transmitted comments.

Response: The conclusion has been revised to read as follows:
"The CSF is proposed as a contingency to meet the accelerated risk reductions described in the Draft Ten Year Plan. The Draft Ten Year Plan assumes remediation waste can be shipped offsite at the same rate it is generated. The CAMU is proposed to address the contingency that offsite waste shipment and disposal are not available when the wastes are generated. This CAMU will support the final remedy of source removal followed by offsite disposal.

The CSF will consist of one or more metal buildings constructed on concrete pads with a chemical resistant coating and integral leak collection that is designed to minimize clogging. The Facility will have a storage capacity of up to 100,000 cubic yards of containerized remediation waste.

The length of operations for the CSF will be consistent with the intermediate site condition as defined in the RFCA preamble (12 to 20-25 years)."

75. The discussion of the CAMU designation process found in paragraph 109 of RFCA applies to the proposed bulk storage CAMU. Please delete this text from the document. Please also see comment #9 above. Paragraph 89 of RFCA discusses a joint process to determine a review schedule for decision documents such as this.

Response: It was agreed to by all parties that the schedule for document review will be consistent with the time frames listed under Paragraph 109 of RFCA. These time frames are still identified, however, the description of direct applicability of Paragraph 109 has been deleted.

76. Figure 6-1 presents the proposed containerized storage facility schedule. A reasonable amount of time for CDPHE review of the design should be allotted. A public comment period on the design should also be allotted.

Response: The schedule has been modified.

GENERAL COMMENTS:

77. Similar to the bulk CAMU IM/IRA, this document should contain figures (or references to figures) which illustrate hydrogeological conditions, geological and geotechnical conditions, structure base of alluvium, thickness of alluvium, ecology and NEPA map, adverse conditions map for CSF siting, and mineral ownership map.

Response: Figures similar to those included in the Bulk Storage Decision Document, Siting Study (Appendix C) have been included with the design narrative.

78. The document should address 6 CCR 1007-3 § 264.18.

Response: 6 CCR 1007-3 264.18 was incorporated into the original siting study for bulk storage. this area passed the original siting screen that considered these restrictions. This area, as indicated in the attached maps, is not located within a floodplain nor is it in an area

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of faulting within the Holocene time frame. The geology of this area is known to not contain salt formations or underground caves.

All editorial corrections have been made.

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96-RF-06715 Rev. 1

Draft
Corrective Action Management Unit Interim Measure/Interim Remedial Action Decision Document and Application Support Document for Containerized Storage

Rocky Flats Environmental Technology Site

Rocky Mountain Remediation Services, L.L.C.

March, 1997

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ABBREVIATIONS AND ACRONYMS

ALARA	As Low As Reasonably Achievable
CAMU	Corrective Action Management Unit
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHWA	Colorado Hazardous Waste Act
CSF	Containerized Storage Facility
cy	cubic yards
Decision Document	Interim Measure/Interim Remedial Action Decision Document
DOE	United States Department of Energy
ER	Environmental Restoration
ERDA	Energy Research and Development Administration
ft	feet or foot
PPE	Personal Protective Equipment
HW	Hazardous Waste
IA	Industrial Area
IA-East	Industrial Area-East
IA-West	Industrial Area-West
IDM	Investigation-Derived Material
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
in.	inch or inches
nCi/g	nanocuries per gram
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NTS	Nevada Test Site
OU	Operable Unit
QA/QC	Quality Assurance/Quality Control
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethene
pCi	Picocuries
PPRG	Programmatic Preliminary Remediation Goals
Pu	Plutonium
RCRA	Resource Conservation and Recovery Act

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RFCA	Rocky Flats Cleanup Agreement
RWSF	Remediation Waste Storage Facility
SE Quad	Southeast Quadrant
Site	Rocky Flats Environmental Technology Site
Site Vision	Rocky Flats Conceptual Vision
SW Quad	Southwest Quadrant
TCE	Trichloroethene
U.S.	United States
WAC	Waste Acceptance Criteria

EXECUTIVE SUMMARY

The Department of Energy is requesting that the State of Colorado designate a Corrective Action Management Unit (CAMU) for containerized storage of remediation wastes at the Rocky Flats Environmental Technology (RFETS). This facility, proposed to be located within the CAMU, would be known as the Containerized Storage Facility (CSF). This CSF CAMU designation is being requested to facilitate remedial activities in support of site closure at RFETS and may be used along with a separate bulk storage CAMU to provide a range of options for management of remediation waste. The remedy at RFETS for cleanup of contaminated areas is source removal, including treatment if appropriate, followed by offsite disposal of remediation waste. This is embodied in the strategy for Site closure. Planning assumptions in the site closure baseline, as described in the Ten Year Plan (DOE 1996a), call for offsite shipment for disposal of remediation waste as it is generated. This CAMU designation would serve as a contingency to this assumption, ensuring risk reduction activities could continue in the event immediate offsite shipment is not possible. The assumptions of site closure will be reviewed on a periodic basis along with funding profiles and risk reduction priorities to determine if or when implementation of this contingency would be appropriate.

The most cost effective approach to site closure is to ship remediation waste offsite as it is generated. The decision of whether or not to implement the CAMU contingency would need to balance cost issues with the ability to achieve timely risk reduction.

The lack of complete site characterization data for RFETS environmental media and decommissioning waste results in significant data gaps that impact waste volume estimates. Current remediation waste volume estimates range from approximately 54,000 cubic meters to over 300,000 cubic meters. These uncertainties with respect to waste volume estimates, as well as the unknown future availability of offsite disposal facilities underscore a need for a flexible waste management strategy in order to achieve cost effective and timely site closure. In addition to remediation waste storage, the CSF would also serve as a staging facility to support offsite shipment of the remediation waste.

This CSF CAMU designation request is presented as an Interim Measures/Interim Remedial Action (IM/IRA) Decision Document and Application Support Document. The CSF would support a cost-effective, flexible, and achievable remediation waste management strategy for RFETS. The overall objective of this designation request is to provide a proposed alternative and rationale that supports the goals of the Rocky Flats Cleanup Agreement (RFCA DOE 1996b) and site closure strategy. The CSF CAMU would support the RFCA goal (Preamble, B2(a)) of initially controlling sources of

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contamination as a priority over offsite shipment. The CSF CAMU would allow early cleanup to proceed by providing interim onsite storage for remediation wastes in the event offsite shipment is delayed. The CSF would store waste ready to be shipped in the near-term to an available offsite disposal or treatment facility and waste not amenable for bulk storage.

Only remediation wastes would be managed in this facility. Remediation waste types include contaminated soil collected from cleanup actions, treated and untreated sludge and sediments, treatment by-products from groundwater, surface water, and/or soil remedial actions, investigation-derived materials (IDM) and contaminated building decommissioning debris. It is the intent of DOE to request a CSF CAMU for storage only. The period of operation would be consistent with the 25 year term of RFCA preamble definition of the intermediate site condition. Closure of the facility would be consistent with cleanup levels established in the RFCA and in accordance with 6 CCR 1007-3 264.552 (e) (4).

This decision document details how the CSF CAMU designation supports risk reduction and eventual site closure in the following ways:

- The CSF CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies. This remedy is source removal coupled with offsite disposal. This would be implemented in accordance with the requirements of the RFCA, as a contingency to support site closure.

- The CSF CAMU designation would support a flexible waste management strategy that emphasizes near-term offsite remediation waste disposal, as emphasized in the site closure strategy included in the Draft Ten Year Plan, while recognizing the uncertainties associated with current remediation waste volume estimates and the timely availability of offsite disposal locations.

- The CSF CAMU would focus resources on immediate risk reduction by facilitating actual cleanup and source removal and deferring treatment not necessary to protect human health or the environment.

- The CSF CAMU would may allow DOE to achieve economies of scale by consolidating remediation waste, making treatment and offsite disposal less costly and addressing long-term liability and safety issues.

This document demonstrates how the CSF meets all regulatory requirements for CSF CAMU designation by the CDPHE and supports the selected location and design concepts. It also contains

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preliminary waste acceptance criteria, closure requirements, a timeline and a discussion of National Environmental Policy Act (NEPA) values.

Based on the waste management objectives of the RFCA and Draft Ten Year Plan, the best approach for an interim storage CSF CAMU was determined to be a metal building, e.g., a "Butler" type building, which would be constructed upon a concrete pad. The CSF CAMU would be located near the existing rail lines in the southwest quadrant of the Industrial Area. The design would incorporate features compliant with the Resource Conservation and Recovery Act (RCRA) Subtitle "C" requirements, as stated in the Code of Colorado Regulations (CCR) 6 CCR 1007-3, Part 264. The facility would consist of a maximum of four separate structures. Each structure would be able to store up to 25,000 cubic yards of remediation waste in containers for a maximum capacity of 100,000 cubic yards.

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1. INTRODUCTION

This is an application for designation of a Resource Conservation and Recovery Act (RCRA) Corrective Action Management Unit (CAMU) and a Rocky Flats Cleanup Agreement (RFCA) Decision Document. The storage unit within the proposed CAMU area would be known as the Containerized Waste Storage Facility (CSF). This Decision Document provides the United States Department of Energy's (DOE) technical justification and decision-making process for the option of siting and construction of a CSF for storage of remediation waste including decommissioning wastes, at the Rocky Flats Environmental Technology Site (RFETS) (Figure 1-1). The CSF CAMU designation is available as a regulatory alternative to facilitate the implementation of reliable, effective, protective, and cost-effective remedies.

The CAMU designation of a CSF is a necessary contingency to achieve the accelerated closure strategy that includes an aggressive schedule for near-term offsite shipment. The need the CSF is dependent on the waste volumes generated during Environmental Restoration (ER) and Decommissioning activities and the ability to ship these wastes offsite. The estimated volumes are uncertain because characterization is not yet complete for the Industrial Area (IA). Final disposal sites will be dependent on waste volumes and contaminant characteristics, which have not yet been determined, and may not be available on an as needed basis to support RFETS cleanup. In addition, the overall process of offsite shipment and disposal may not be able to keep up with waste volume generation, thus, impacting risk reduction capabilities. The flexibility provided by the CSF contingency enhances DOE's ability to ensure timely and cost-effective site closure in support of the aggressive offsite waste shipment strategy embodied in the Site Draft Ten Year Plan (DOE 1996b).

This CSF CAMU designation will be used along with a separate bulk storage CAMU designation to provide a range of options for waste management. The specific options used will depend on several factors, or uncertainties, as described above. In general, both CAMUs are intended to support two different needs at RFETS; bulk storage and containerized storage. Bulk storage considerations include:

- Ease of management of large volumes of remediation waste;
- Storage of waste for a period of several years (5 to 20) for logistical or budgetary reasons or to achieve economies of scale for treatment or disposal; and

- High cost of containers, and large number required due to the large volumes of waste.

Containerized storage considerations include:

- Remediation waste not amenable to bulk storage, such as types of metal building debris;
- Near-term offsite shipment within approximately one year; and
- Areas where very small volumes of waste are generated and bulk removal is not efficient or necessary.

The designation of the CSF as a CAMU may provide an option for quick and effective handling of a larger volume of waste in a safer manner than would occur from multiple smaller storage and shipping areas spread across RFETS. Instead of managing waste from each contaminated area individually, the CSF CAMU contingency allows for remediation waste to be brought to one centralized facility for storage and preparation for offsite shipment, treatment, and disposal.

The type of wastes to be managed in the facility would consist of low-level, low-level mixed, and hazardous remediation waste which is not amenable to bulk handling and storage or not desirable for bulk storage since near term offsite shipment is planned. RFCA paragraph 5, definition b.f. states:

" Remediation waste includes:
(1) solid, hazardous, and mixed wastes;
(2) all media and debris that contain hazardous substances, listed hazardous or mixed wastes or that exhibit a hazardous characteristic; and
(3) all hazardous substances generated from activities regulated under this Agreement as RCRA corrective actions or CERCLA response actions, including decommissioning."

Remediation waste does not include wastes generated from process related or other activities. Nothing in this definition confers RCRA or CHWA authority over source, special nuclear, or byproduct material as those terms are defined in the Atomic Energy Act.

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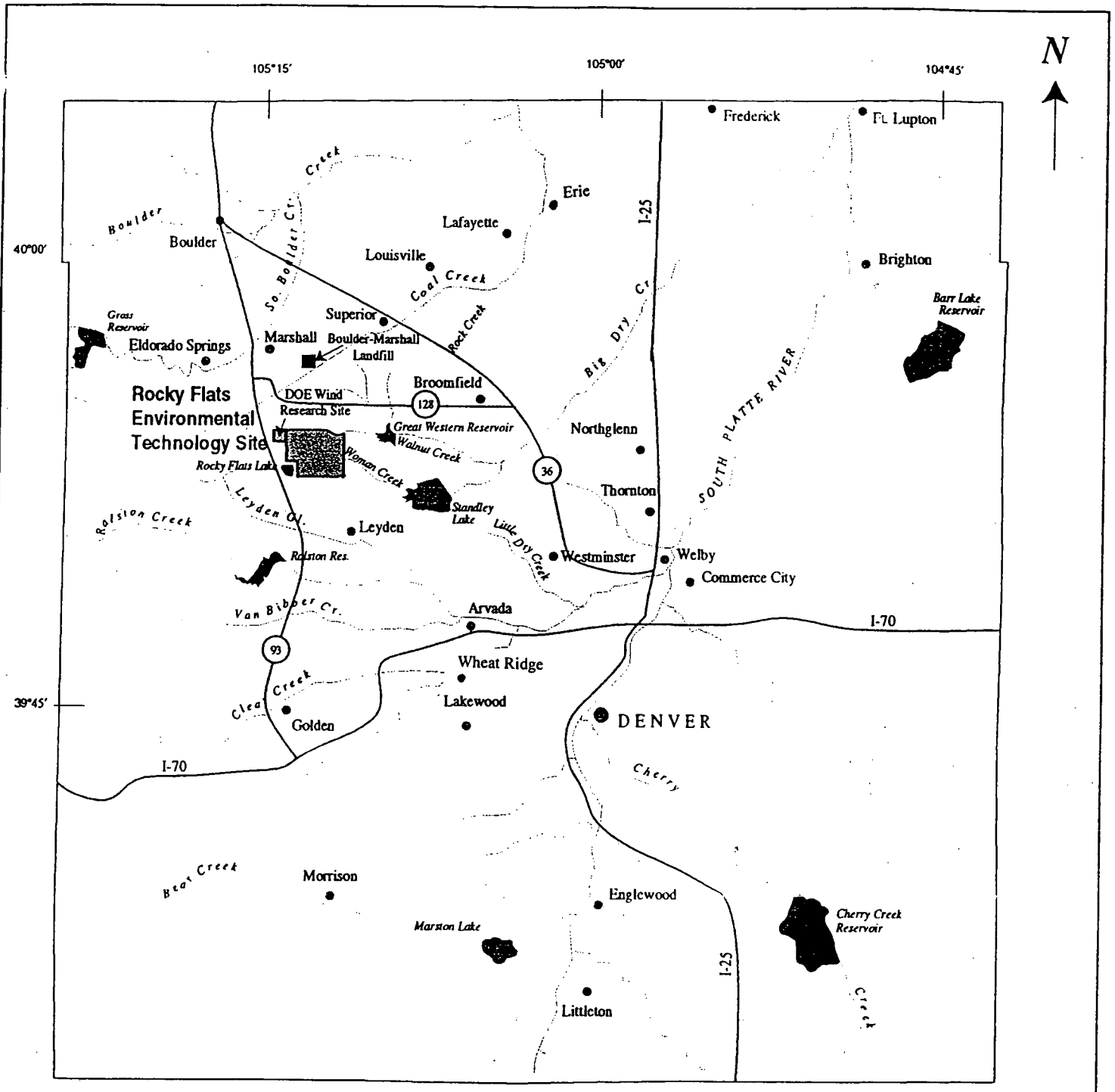

Rocky Flats Site, Golden, Colorado

Location of the Rocky Flats Site

Figure 1-1

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This Decision Document contains the information necessary for the Colorado Department of Public Health and Environment (CDPHE) to designate a CSF used for containerized storage. By having a CSF CAMU designation, the DOE can meet the waste management objectives consistent with the recently signed RFCA (DOE, 1996a). With the schedules proposed in the Draft Ten Year Plan, the flexibility provided by the CSF CAMU approach will provide contingency for facilitation of RFETS cleanup.

In addition to RFCA, the Draft Ten Year Plan has been developed to describe how accelerated cleanup and closure of RFETS would be achieved. The Draft Ten Year Plan addresses the management of remediation waste without a CSF CAMU. Included in the Draft Ten Year Plan, as Major Decision 4, are assumptions for waste storage and offsite disposal capabilities. The CSF CAMU designation is a contingency in the event a waste storage alternative is needed to support accelerated cleanup of the RFETS if offsite shipment of remediation waste cannot meet waste generation demands.

The CSF CAMU area is proposed to be located within the Industrial Area in the southwestern quadrant. The CSF would consist of metal storage buildings with chemically resistant sealed concrete floors, internal leak stops, and would be constructed to store containerized remediation waste. The facility would be modular in design and consist of several buildings so that facility size can be adjusted according to need. The facility is intended to support storage of up to 100,000 cubic yards of waste stored in 20 cubic yard " top loading containers.

It is the intent of the DOE to request a CSF CAMU for storage only, and that all waste would be removed from the CSF prior to Site closure.

1.1 DECISION DOCUMENT ORGANIZATION

This document is divided into six sections and is structured to provide the information required to support the technical justification for a CSF CAMU designation in sequence. This includes the following:

- Section 1.0.
- Section 2.0 identifies the need for a CSF CAMU based upon the criteria defined in 6 CCR 1007-3 Part 264 subpart S.

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- Section 3.0 identifies the additional requirements that a CSF CAMU at RFETS would need to meet.
- Section 4.0 is a discussion of the alternatives considered for the CSF.
- Section 5.0 which is a description of the recommended design and a discussion of how the design meets the previously identified criteria. This section also includes facility specific details such as waste characteristics, waste acceptance criteria, and closure requirements.
- Section 6.0 is the proposed CSF Schedule.
- Section 7.0 lists references cited in the document.

1.2 CSF CAMU DECISION DOCUMENT SCOPE AND OBJECTIVES

The following two sections discuss the scope and objectives for this Decision Document.

1.2.1 Scope Description

The scope of this document includes the following sequential decision process: first, this document identifies a need for a CSF CAMU designation for containerized waste storage; second, this document identifies the requirements a CSF CAMU at RFETS would need to satisfy; and third, this document describes the recommended CSF alternative and how it meets the requirements identified above. The following facility-specific issues are described:

- Waste characteristics and source volume estimates;
- Conceptual waste acceptance criteria (WAC);
- General design requirements; and
- General monitoring requirements.

Pretreatment requirements of remediation waste, other than the general requirements included as part of the WAC, are not included in the scope of this document except for the purpose of cost estimating. The reason for this approach is that pretreatment is very specific to an individual action and specific waste types. Pending changes within the regulatory environment such as the proposed Hazardous Waste Identification Rule (HWIR), area-specific cleanup levels based upon future land use agreed to in the RFCA may influence treatment requirements on an action specific basis. The

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pretreatment discussion for each accelerated cleanup action will be included in the project-specific Proposed Action Memorandum, Interim Measures/Interim Remedial Action Decision Documents, and Proposed Plans, or Remedial Action Plans for each specific IHSS, group of IHSS or building; allowing treatment to be tailored to the specific action.

Specific plans and documents detailing environmental monitoring, waste acceptance criteria, and closure are not in the scope of this document; however, the need for these plans is identified as a requirement under 6 CCR 1007-3 264.552. The approval process for a CSF CAMU is a three-step process as follows:

1. The first step is the IM/IRA Concept Validation/CAMU Designation, which consists of this IM/IRA Decision Document;

2. The second step is Design/Preparation for Construction, which consists of Title II design, Groundwater Monitoring Plan, Construction Quality Assurance Plan, Test Fill Plan, and Closure Plan preparation.

3. The third step, Construction/Preparation for Operations, will include Inspection, Operation, Waste Acceptance, Emergency, and Security Plans.

All phases would have State and public input with final State approval.

1.2.2 Decision Document Objectives

In order to meet the primary objective of designating a CSF CAMU, this document provides information on how a CSF CAMU at RFETS meets each of the seven decision criterion identified in the CSF CAMU regulations (6 CCR 1007-3, Part 264, Subpart S) as well as requirements defined in RFCA. This document also addresses how this facility would support the overall RFETS cleanup strategy described in the Draft Ten Year Plan.

The supporting objectives which lead to the determination that a CSF CAMU option is necessary include the following:

- In support of the RFCA and the Draft Ten Year Plan, the management of low-level, low-level mixed, and hazardous remediation waste must ensure the safety of the public, RFETS workers,

and the environment through reliable, effective, protective, and cost-effective implementation of interim and final remedies at the RFETS.

- The solution must support a flexible waste management policy combining contingencies for both long-term storage and shorter term staging/storage for offsite disposal as necessary. The solution must recognize the uncertainties surrounding waste volume estimates, future offsite disposal availability, and final disposal locations. A flexible policy would ensure that the most timely and cost-effective strategy that supports RFCA and Draft Ten Year Plan objectives can be implemented.

- The management of low-level, low-level mixed, and hazardous remediation waste must result in a cost-effective remedy that supports RFETS closure schedules.

- A means of consolidating remediation waste in one location must support near-term risk reduction and offsite waste shipment goals while addressing long-term liability and safety issues and remaining compatible with future land uses for the RFETS.

1.2.3 Site Justification for Designation

There are several considerations specific to RFETS that support the need for a CSF CAMU. The primary reason is to support timely risk reduction by providing an option that allows risk reduction to occur without slowdowns or impacts to cleanup capabilities. These considerations include:

- Cleanup of RFETS under the Ten Year Plan is completed within a much shorter time frame than previously considered. The Draft Ten Year Plan assumes:

  — all low-level and low-level mixed wastes will be shipped offsite for disposal;

  — low-level and low-level mixed waste generated in excess of shipping capacity will be managed in new onsite facilities; and

  — when ER and Decommissioning activities begin in earnest, storage facilities will be available to support remediation operations.

- The objective listed in the RFCA Section (B)(2)(a) states "Initially controlling the sources of contamination will take priority over offsite waste shipments to maximize risk reduction".

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- Placement of remediation waste in existing permitted units is limited due to of a lack of storage capacity.
- Unresolved uncertainties associated with the waste volume estimates and timely offsite disposal availability for remediation wastes create a need for a flexible waste management strategy that incorporates a CSF CAMU contingency.

1.3 SITE DESCRIPTION

The RFETS is a government-owned, contractor-operated facility, that is part of the nationwide Nuclear Weapons Complex. The Rocky Flats Environmental Technology Site (RFETS) was operated for the United States Atomic Energy Commission from its inception in 1951 until the it was dissolved in January 1975. At that time, responsibility for RFETS was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by DOE in 1977.

From 1953 through 1989, RFETS was used to produce components for nuclear weapons from materials such as plutonium, uranium, beryllium, and various alloys of stainless steel. Non-nuclear production continued through 1995 in Building 460. Additional plant missions included plutonium recovery and reprocessing, and waste management. Production activities included metal fabrication and assembly, chemical recovery and purification of process-produced transuranic radionuclides. The consequence of these various activities over nearly 40 years was the contamination of some of RFETS soils, groundwater, buildings, process pipelines, and associated waste management equipment.

The Rocky Flats Environmental Technology Site (RFETS) is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver (see Figure 1-1). Boulder to the northwest, Broomfield and Superior to the northeast, Westminster to the east, and Arvada to the southeast, are all located within 10 miles of RFETS. RFETS consists of approximately 6,550 acres with most of the structures located within a central "protected area" of approximately 400 acres.

The majority of residential development within five miles of RFETS is located immediately northeast, east, and southeast of RFETS. Commercial development is concentrated near residential developments north and southwest of Standley Lake as well as around Jefferson County Airport, approximately three miles northeast of RFETS. Industrial land use within five miles of RFETS currently includes quarrying and mining operations. Open space lands are located northeast of RFETS, near the City of Broomfield, in small parcels adjoining major drainages and in small neighborhood parks in the cities of Westminster and Arvada. The west, north, and east sides of

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Standley Lake are encompassed by Standley Lake Park open space. Irrigated and non-irrigated croplands, producing primarily wheat and barley, are located north and northeast of RFETS near the cities of Superior, Broomfield, Lafayette, Louisville, Boulder, and in scattered parcels adjacent to the eastern boundary of RFETS. Several horse operations and small hay fields are located south of RFETS. Future land use in the vicinity of RFETS could involve continued urban expansion, increasing the density of residential, commercial, and industrial land use in the area.

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2. VERIFICATION OF CSF CAMU DESIGNATION CRITERIA

Designation of the CSF as a CAMU shall be in accordance with 6 CCR 1007-3 264.552 (c), Corrective Active Management Units.. Each of the seven CSF CAMU criteria listed below as numbers 1 through 7 is followed by a description of how the selected CSF remedy demonstrates compliance with the criterion.

1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies (264.552 [c] [1]).

The CSF would ensure that RFETS can facilitate the implementation of reliable, effective, protective, and cost-effective remedies by:

The CSF CAMU provides reliability and effectiveness by allowing the remedy of source removal coupled with offsite disposal to continue in the event offsite disposal capabilities cannot support near term waste generation during remedy implementation. This allows contaminant sources to be removed sooner rather than remain exposed in the environment because no storage or offsite shipment is available. The CSF CAMU would be implemented to support continued risk reduction and mitigate delays to cleanup schedules in the event offsite disposal cannot occur in a timely manner, thereby facilitating remedy implementation.

The CSF CAMU would be protective by supporting timely removal of contaminant sources from the environment, reducing risk to human health and the environment.

This CAMU is cost effective from both location and design standpoints. This location provides a single location for storage and shipment since it is close to the RFETS rails spur and it has fewer security restrictions than other areas at RFETS. This reduces overall handling, inspection, and shipment costs. The design includes containment, retrievability, and inspection features which supports protectiveness of human health and the environment.

2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents (264.552[c][2]).

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A CSF CAMU would not create unacceptable risks and eliminates potential risks that might be associated with alternative storage options, or leaving waste sources exposed in the environment because offsite disposal is not available. The CSF CAMU minimizes risks to human health and the environment in the following ways:

- Remediation waste removed from the environment would be put into an effective and protective facility. Contaminant sources would not be exposed to natural transport phenomena that could spread the contamination.

- Safety precautions would be taken during construction of the facility. All activities would be performed within the safety and radiological protection standards that exist at RFETS. Individuals with expertise specific to construction safety would ensure that construction activities are carried out in a safe manner. Construction quality assurance efforts would ensure that the CSF would meet all design criteria and performance standards for protectiveness.

- Onsite transportation of the wastes would be performed in a controlled environment over short distances on non-public roads with minimal or controlled traffic. Operations would be closely monitored and safely controlled. Because the distances would be short and the process would be tightly controlled, the risk of transportation accidents would be minimized. Administrative and engineered controls would be used to ensure that high winds do not mobilize the contamination during packaging or transporting. These measures may include precautions such as covered loads, spraying water or other dust suppressants on the loads, high wind shut downs, and other appropriate precautions.

- Indirect effects and cumulative impacts of the ER and decommissioning programs at RFETS would be reduced by utilizing the centralized CSF, and disposing of all low-level and low-level mixed remediation wastes in offsite permitted facilities. Impacts to the environment would be minimized because the footprint of contaminated areas would be reduced to one facility compared to multiple IHSSs that now exist, and the CSF would be constructed in areas that have already been disturbed, and thus will not impact previously undisturbed areas of RFETS.

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3) The CAMU shall include uncontaminated areas of the facility, only if including such areas for the purposes of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility (264.552 [c][3]).

The proposed area is not within an IHSS or thought to be an area of major contamination. Still, this site was selected for the following reasons.

- The area is near the RFETS rail spur and other offsite shipment facilities. This location reduces the waste handling requirements and enhances the ease of offsite shipment, thereby reducing potential exposure to RFETS workers and enhancing ease of shipment.

- The area is relatively free of obstructions such as buildings, utilities, and process waste lines which facilitates more rapid construction.

- The area is not within the Protected Area. This location, therefore, enhances the ease of use of the facility and reduces potential exposure to workers during waste transport. Waste transportation, inspection and handling requirements are less for areas outside the PA due to security restrictions. This reduces risk to workers.

- The area is within a previously disturbed industrial setting which limits the impacts to natural resources, endangered species habitat, and the environment.

- The area is relatively isolated from other areas of the site and it is not near major building clusters or environmental restoration sites. This offers some degree of additional protectiveness to workers supporting site cleanup tasks.

4) Areas within the CAMU, where remediation wastes remain in place after closure of the CAMU, shall be managed and contained so as to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment (264.552 [c][4]).

This criterion is not applicable. At this time, the intended use of this facility is for monitored, retrievable waste storage pending offsite disposal.

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5) The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). See criteria 1 and 2 above.

This CSF CAMU is intended to be used as a contingency to the strategy in the Ten Year Plan. As previously mentioned, the Ten Year Plan assumes wastes can be shipped and disposed offsite as they are generated. In the event this assumption fails, contaminant sources would either be stored at the point of generation or left exposed in the environment. This would delay implementation of the remedy of source removal and offsite disposal. Implementation of this contingency would ensure that the timing of remedial activities would not be impacted. This allows expedited cleanup schedules to continue as planned.

6) The CAMU shall enable the use, when appropriate, of treatment technologies (including innovative technologies) to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste that will remain in place after closure (264.552 [c][6]).

This criterion is not applicable. At this time, the intended use of this facility is for monitored, retrievable waste storage pending offsite disposal.

7) The CAMU shall minimize the land area of the facility upon which remediation wastes will remain in place after closure of the CAMU unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). See criteria 1 and 2 above.

This criterion is not applicable. At this time, the intended use of this facility is for monitored, retrievable waste storage pending offsite disposal.

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3. IDENTIFICATION OF SUBSTANTIVE CRITERIA

The approval of this IM/IRA Decision Document by the State of Colorado shall constitute approval of a CAMU designation for storage of containerized remediation waste. This section identifies the applicable requirements considered to be met upon approval of this decision document.

3.1 CSF CAMU OBJECTIVES

The designation of a Corrective Action Management Unit must be performed in accordance with the seven criteria enumerated in 6 CCR 1007-3, Part 264.552(c). Section 2 discusses how the CSF would meet these criteria.

3.2 DESIGN REQUIREMENTS

The following design and operating requirements will be addressed and implemented:

- Double containment (containers and secondary containment integral with concrete slab);
- Waste storage in inspectable containers ready for offsite shipment;
- Spill collection;
- Visual inspection;
- A groundwater monitoring system;
- Corrective action for releases; and
- A waste acceptance criteria, consistent with design and operation, that provides treatment of wastes where necessary.

Seven areas of consideration were used in the alternatives analysis. These include the following:

- Worker safety;
- Protection of human health and the environment;
- Transportation;

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- Facility design, containment, and monitoring;
- Institutional controls;
- Cost; and
- Community acceptance.

These requirements are discussed in the alternatives analysis in Section 4 and are summarized in Table 4-1. Conceptual level cost estimates for the containerized storage alternatives are summarized in Table 4-2.

3.3 CAMU REQUIREMENTS

Additional requirements for designation are enumerated in Part 264.552(e) of the CAMU rule. The following are the additional CAMU requirements:

- Specification of the area configuration, Part 264.552 (e) (1);
- Specification of the design, operation, closure, and post-closure requirements Part 264.532 (e) (2) and (4); and
- Specification of groundwater monitoring requirements Part 264.552 (e) (3).

If implementation of this CSF CAMU becomes necessary to meet risk reduction goals, documentation and plans meeting the above requirements will be provided during the CSF design/preparation for construction phase.

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4. ANALYSIS OF ALTERNATIVES AND SELECTION BASIS

A variety of alternatives were considered ranging from No Action to highly engineered storage vaults. Four alternatives were selected to represent the spectrum of technologies available. These alternatives serve as a contingency to the Draft Ten Year Plan should waste volume, storage, or shipping assumptions in the Draft Ten Year Plan prove invalid. These four alternatives are:

- No-Action - Remediation waste would be treated and shipped to an offsite disposal facility as soon as it is generated, or would remain in storage in containers at the point of generation, or cleanup would be delayed until removal and shipment would be possible.
- Slab on Grade - Waste is stored in containers placed on an above grade concrete slab; Secondary containment would be built into the slab. The facility would have no roof or walls.
- Metal Buildings - Waste would be enclosed in containers placed inside engineered metal buildings on concrete slabs; Secondary containment would be built into the floor slabs. This is current practice at the centralized waste storage facility at RFETS.
- Hardened Concrete Vault - Waste in containers would be placed in an above grade freestanding concrete structure. The floor of this structure would serve as a secondary containment system. This is a current practice at the DOE Savannah River Site.

All of the alternatives except No-Action, would provide handling and shipping capabilities for offsite transport. A summary of the alternatives analysis using the seven RFCA criteria is presented in Table 4-1. The following text discusses each of the alternatives.

The No Action Alternative was rejected because it would not support timely risk reduction for the following reasons:

- The current permitted storage capacity at RFETS would not likely support storage for the waste volumes estimated in the Draft Ten Year Plan in the event offsite shipment cannot keep pace with generation thus delaying cleanup

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- If risk reduction activities do not occur in a timely fashion, more resources will be necessary to continue maintenance, monitoring, and inspection for areas not cleaned up, which limits the resources that can be applied towards actual risk reduction.

The Slab On Grade alternative was rejected because this design is not as protective of human health and the environment as other storage alternatives. This alternative would not protect the waste containers from corrosion due to the weather, or contaminants from dispersal by the wind if containers leaked. Waste containers may be exposed to the environment for unknown duration due to the uncertainties associated with offsite disposal resources. This would increase costs for maintenance, monitoring, and inspection. For these reasons, this alternative would not as adequately address worker safety; protection of public health and the environment; or facility design, containment and monitoring criteria as well as the Hardened Concrete Vault or Metal Building alternatives.

The Hardened Concrete Vault was rejected primarily due to cost. It would adequately address worker safety, protection of public health and the environment, and containment requirements. For short-term storage, it would not provide any more protectiveness than the Metal Buildings. If the facility needed to be utilized for more than 30 years, the Hardened Concrete Vault might be the best alternative. However, the CSF facility is intended for short-term use consistent with the 25 year time limit for the intermediate site condition as defined in the RFCA preamble. The added durability of the Hardened Concrete Vault, therefore, was not a factor in the selection process. The Hardened Concrete Vault also might not offer the flexibility needed for changing waste volumes or transportation requirements. Once constructed, the facility would be difficult to reconfigure. When the facility is no longer needed, its closure would be more complicated and costly than the other alternatives since by design, this type of structure is more permanent by design.

The Metal Buildings alternative was selected as the best alternative for short-term storage consistent with the intermediate site condition as defined in the RFCA preamble (12 to 20-25 years). The Metal Buildings would provide adequate protectiveness at a lower cost. Other advantages that Metal Buildings offer include:

- Containers would be protected from the elements and potential airborne dispersal should any of the containment units fail. . Existing RFETS air compliance programs will incorporate the CSF facility.

- The use of a modular building design allows flexibility in addressing changing storage requirements, i.e. buildings could be constructed as needed.

- The level of containment would be protective of workers, the public, and the environment. The combination of strong tight containers, an enclosed building, a leak collection system, chemical resistant materials where applicable, and secondary containment would provide protectiveness to surface water and ground water.

- Metal buildings would offer the same protection as more sophisticated designs, and at a lower cost. The use of pre-engineered buildings would further reduce cost and expedite the schedule. Lower costs allows more resources to be directed towards risk reduction activities.

- Use of the Metal Buildings alternative for the storage of waste is an established and implementable technology currently in use at RFETS and elsewhere.

- Closure of the facility would be less complicated and more cost effective than the hardened concrete vault.

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Table 4-1 Summary of Analysis of Alternatives

RFCA CRITERIA				
Final Design Alternatives	**Worker Safety**	**Protection of Public Health and the Environment**	**Transportation**	**Facility Design, Containment and Monitoring**
No Action	Cleanup schedules might be impacted if offsite shipment cannot occur. Exposure could result if sources are not contained or if waste leaked from containers left at project site.	Visual inspections would allow leaks to be detected before release to the environment. However, Exposed containers could eventually pose a risk. Lack of adequate storage capacity could delay some remediation work.	The necessity of immediate shipping could limit transportation options and cleanup schedules. Loading and unloading could be hampered by the lack of a waste handling facility. No centralized facility to routinely handle large volumes increases risk of spills from multiple small operations with less handling ability.	Waste will not be consolidated. Sources removals may not be conducted in a timely fashion. Site monitoring requirements would not be reduced through cleanup activities.
Slab on Grade	Exposure via wind dispersal could result if waste leaked from containers. Construction of the facility poses minimal risk. More maintenance on containers would be needed.	Visual inspections would allow leaks to be detected before release to the environment. Containerized waste would be stored uncovered prior to shipment. Exposed containers could eventually pose a risk to the human health and the environment, if not maintained.	The Slab on Grade would facilitate transportation. Facility could double as a loading and unloading facility. Facility could be accessed from many different sides. Facility would not be expected to have a detrimental impact to traffic flow onsite.	Containers and structure would be exposed to the elements which could accelerate deterioration and leakage. The slab itself is a containment and collection system. Exposed contaminants could be subject to airborne migration.
Metal Buildings	Waste would be isolated from workers. Construction of the facility poses minimal risk. Less container maintenance would be needed.	Visual inspections would allow leaks to be detected before release to the environment. Waste containers would be sheltered from the elements.	The metal buildings would allow coordination of transportation and more ease of transportation than vaults. CSF would double as a loading and unloading facility. Facility is not expected to have a detrimental impact to traffic flow.	Secondary containment would be incorporated into the building design. Monitoring would be accomplished through visual inspection and secondary containment system.
Hardened Concrete Storage Vault	Waste would be isolated from workers. Construction of the facility poses minimal risk. Destruction and decommissioning of facility would be more difficult than other alternatives.	Visual inspections would allow leaks to be detected before release to the environment. Vault would provide better long-term protection than other alternatives. Waste containers would be sheltered from the elements.	Access to facility would be more limited. Facility would not be expected to have a detrimental impact to traffic flow. Shipping could be required through several population centers.	Secondary containment would be incorporated into the building design. Monitoring would be accomplished through visual inspection and secondary containment system.

Table 4-1 Summary of Analysis of Alternatives (continued)

	RFCA CRITERIA		
	Institutional Controls	**Cost**	**Community Acceptance**
No Action	The current RFETS access limitations and procedures would be institutional controls for waste stored at remedial action and D&D sites prior to shipment off site. Each site with waste stored pending shipment would require regularly scheduled inspections. Once shipped, institutional controls would exist offsite; the nature of those institutional controls would be dependent on the selected disposal facility.	Least expensive of alternatives. Some cost savings could be realized by not constructing a storage unit. Delayed source removals could increase inspection and monitoring costs for RFETS.	Waste containers would continue to be exposed to the environment prior to shipment. Supports desire for offsite disposal.
Slab on Grade	Institutional controls requiring continued maintenance, inspection and monitoring of the facility would be required. Since the use of the facility is for short-term storage, controls beyond existing controls are not necessary.	Least expensive storage facility to construct and operate at least in the short term. Cost savings come at the expense of protectiveness due to lack of an enclosed facility. Cost higher for maintenance and inspection. Final disposal costs would still apply.	This alternative provides less protective measures to the public than the other two facilities evaluated. The Slab on Grade supports the overall RFETS strategy of offsite shipment. It is easy to retrieve waste and transport it. Supports desire for offsite disposal.
Metal Buildings	. Institutional controls requiring continued maintenance, inspection and monitoring of the facility would be required. Since the use of the facility is for short-term storage, controls beyond existing controls are not necessary.	Metal Buildings were in the mid-range of costs for the storage facilities evaluated. Final disposal costs would still apply.	The metal buildings provide better monitoring and retrieval capabilities. The metal buildings support the overall RFETS strategy of offsite shipment. It is easy to retrieve waste and transport it. Supports desire for offsite disposal.
Hardened Concrete Storage Vault	Institutional controls requiring continued maintenance, inspection and monitoring of the facility would be required. Since the use of the facility is for short-term storage, controls beyond existing controls are not necessary.	Most expensive of the storage facility alternatives to construct due to expense of constructing hardened concrete shell. Less resources would be available for risk reduction. Final disposal costs would still apply. Decommissioning costs higher.	This alternative is protective. Facility is more permanent than other facilities considered but still can support Draft Ten Year Plan goals. Waste is more difficult to retrieve. Closure of this alternative would be more difficult. Supports desire for offsite disposal.

Table 4-1 Summary of Analysis of Alternatives (continued)

Final Design Alternatives	NEPA VALUES	NEPA VALUES
	SHORT-TERM EFFECTIVENESS	LONG-TERM EFFECTIVENESS
No Action	Additional effort would be needed for inspecting waste left at cleanup sites until shipment. The limited ability to store large quantities of waste on site could limit risk reduction activities in the short term.	All offsite disposal facilities under consideration have been designed for long-term use. The No Action alternative would not be effective if it causes significant delay of source term removals.
Slab on Grade	Rapid construction due to modular design would accelerate the availability of the facility. Un-enclosed transport containers could be subject to weather damage. Slab drainage and leak collection system could be impacted by heavy rains. This alternative would not be suitable for volumes over 100,000 cy, because of space restrictions. Allows timely risk reduction to continue.	Not designed as a long-term facility. No long-term protection. All offsite disposal facilities under consideration have been designed for long-term use.
Metal Buildings	Rapid construction due to modular design would accelerate the availability of the facility. This alternative would not be suitable for volumes over 100,000 cy, because of space restrictions. Allows timely risk reduction to continue.	Not designed as a long-term facility. All offsite disposal facilities under consideration have been designed for long-term use.
Hardened Concrete Storage Vault	Rapid construction due to modular design would accelerate the availability of the facility. Containerized waste storage inside a concrete vault would not be suitable for volumes over 100,000 cy, because of space restrictions. Allows timely risk reduction to continue.	Designed as a long-term, permanent facility to support long-term waste placement.

Table 4-2 Alternative Costs for the Containerized Waste Storage Facility

Alternative	Hardened Concrete Vault	Slab On Grade	Metal Buildings	No Action
Cost Element				
Containers	$ 69,700,000	$ 69,700,000	$ 69,700,000	N/A*
Packaging	$ 920,000	$ 920,000	$ 920,000	N/A*
Characterization	$ 3,920,000	$ 3,920,000	$ 3,920,000	N/A*
Transportation to Facility	$ 770,000	$ 770,000	$ 770,000	N/A
Design, Construction Management, & Project Management	$ 3,750,000	$ 1,228,000	$ 3,690,000	N/A
Preconstruction Activities	$ 76,000	$ 76,000	$ 76,000	N/A
Site Preparation	$ 1,460,000	$ 1,210,000	$ 1,210,000	N/A
Construction	$ 33,540,000	$ 2,180,000	$ 9,310,000	N/A
Operations	$ 6,320,000	$ 7,100,000	$ 6,320,000	N/A*
Monitoring & Inspections	$ 13,420,000	$ 10,970,000	$ 13,420,000	N/A*
Closure	$ 4,520,000	$ 2,320,000	$ 3,350,000	N/A
Total Estimated Cost	$ 138,396,000	$ 100,394,000	$ 112,686,000	N/A*

* *Some costs for this element would be incurred if any cleanup were to occur under this alternative. These costs were applied to the storage alternatives for the purposes of supporting selection of the most cost effective containerized storage alternative.*

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5. FACILITY DESCRIPTION

This section describes the conceptual design of the CSF proposed for the management of remediation wastes. The CSF is proposed to be located in the southwest corner of the Industrial Area (Figure 5-1). The CSF would be a series of engineered metal buildings, as shown on Figure 5-2, to serve as a staging facility for the receiving, storage, and ultimate shipment of remediation waste. The proposed location benefits from minimal site preparation costs, and the presence of an adjacent rail spur for offsite shipment. A footprint of 6.8 acres would include up to four modular buildings which could store 5,000, 20-cu-yd-capacity containers, for a total capacity of up to 100,000 cy. The modular design would allow the final configuration and storage capacity to be flexible in order to meet changing waste-storage requirements. The metal buildings would be constructed on reinforced sealed concrete foundations. The remediation waste would be effectively isolated from the environment by the following barrier systems:

- Containers and
- Structural concrete floor slab with chemical resistant coating and an integral leak collection system designed to minimize clogging.

The CSF would have a design life of up to twenty-five years (e.g. consistent with the intermediate site condition as defined in the RFCA preamble) at which time the remediation waste would have been transported to an offsite facility for treatment and disposal.

5.1 DESIGN CONSIDERATIONS

Specific design requirements have been incorporated into the conceptual design such as leak collection. Details of how these requirements will be met will be submitted during the design phase.

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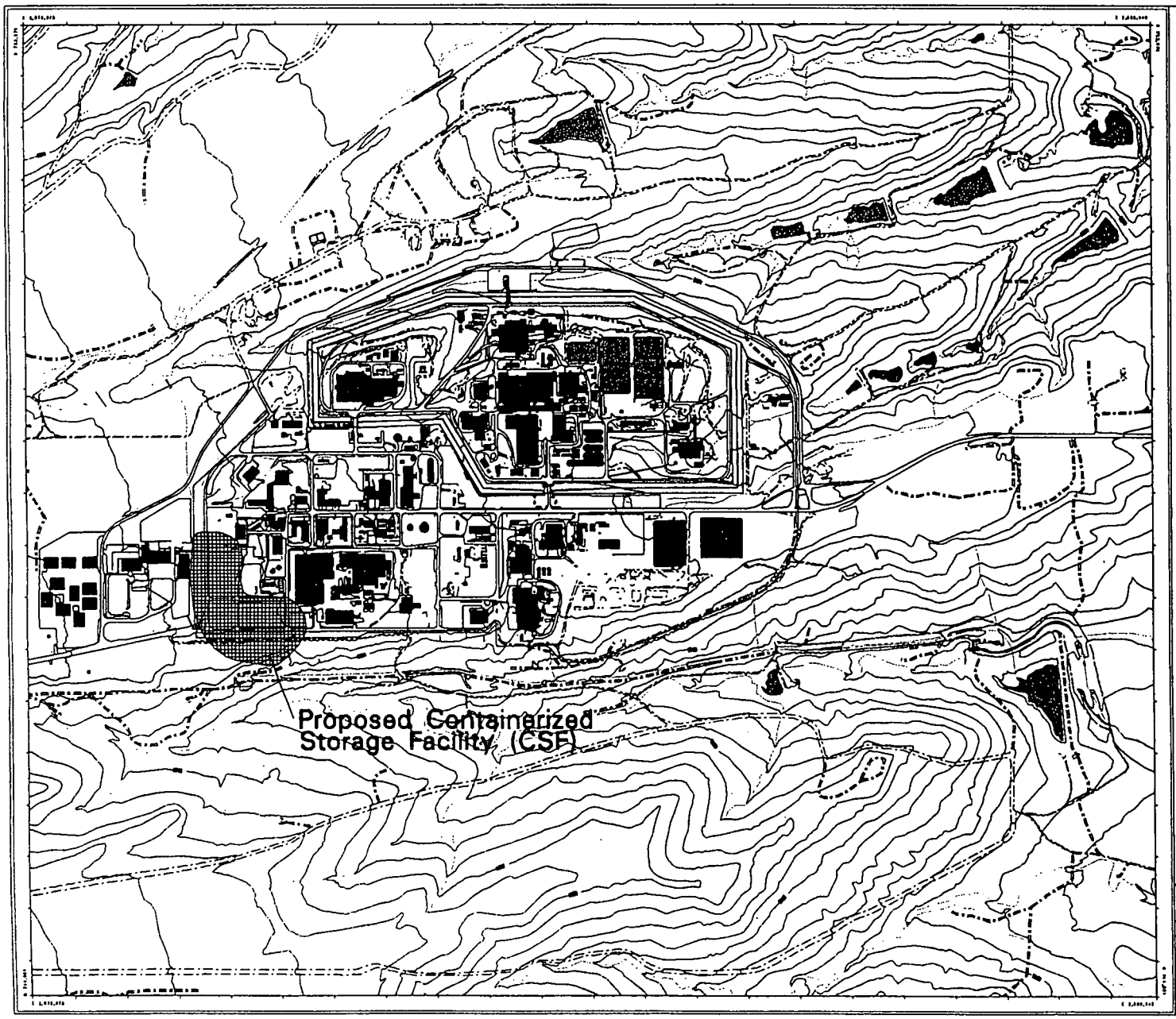

Figure 5-1
Location Map for Containerized Storage Facility (CSF)

EXPLANATION

Containerized Storage Facility (CSF)

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' intervals)
- Rocky Flats boundary
- Paved roads
- Dirt roads

Scale = 1 : 17820
1 inch represents approximately 1488 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

RMRS Rocky Mountain Remediation Services, L.L.C.

MAP ID: 97-0009

November 25, 1996

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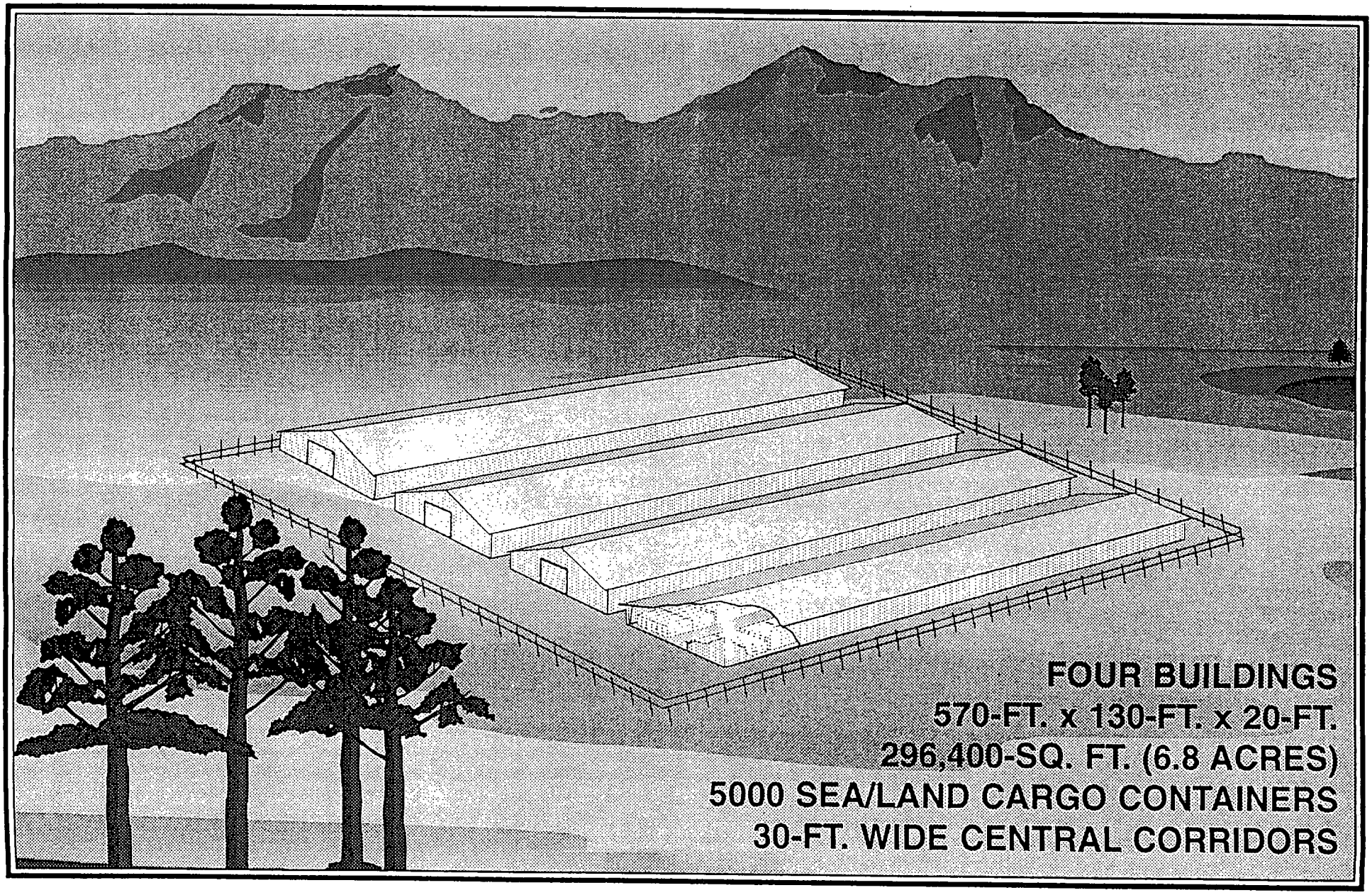

Figure 5-2

CONTAINERIZED STORAGE FACILITY

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The following features were used to develop a conceptual cost estimate (see Table 5-1):

- Four metal buildings, each 570 ft. long by 130 ft. wide and 20 ft. eave height;
- Each building would be constructed, when required, dependent upon waste volumes;
- Buildings would be constructed over a reinforced concrete floor;
- A maximum storage capacity total of 5,000 - 20 cu yd containers for the entire four building CSF;
- Containers would be stacked up to four high in the buildings;
- Each building would have a thirty foot wide central corridor and personnel access aisles for routine monitoring and inspection;
- A twenty-five-year design life ;
- 5,000 stackable, reinforced bathtub style metal containers with over-under lids and fork tubes; and
- Groundwater monitoring wells (six total maximum) would be installed both hydraulically up gradient and hydraulically down gradient and would be monitored through the life cycle of the CSF (20 years).

TABLE 5-1 SUMMARY OF CONSTRUCTION COSTS FOR THE CSF

TASK DESCRIPTION	ESTIMATED COST
Containers	$69,700,,000
Site Preparation	$ 1,210,000
Engineering Design / Project & Const. Mgmt.	$ 3,690,000
Construction A. Four Metal Buildings	$ 9,275,000
B. Leak Collection System	$ 35,000
Total Construction Cost [1]	**$82,413,000**

Notes:
1. A 25% contingency cost is included in the estimate.

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The integral leak collection and retrieval system designed to minimize clogging and built into the chemically resistant coated concrete floor would collect any potential leakage which would be transferred to a facility for treatment.

5.2 WASTE CHARACTERISTICS AND CONCEPTUAL WASTE ACCEPTANCE CRITERIA

The following sections describe the waste and associated acceptance criteria for the CSF. Section 5.2.1 gives a brief identification of the waste characteristics which could be received at the CSF. Section 5.2.2 gives estimates of the waste volumes and section 5.2.3 briefly explains what the Waste Acceptance Criteria (WAC) would address for the CSF.

5.2.1 Remediation Waste Characterization

This section describes the general waste types characteristics which may be placed in the CSF. Identification of waste characteristics, sources and projected volumes for the CSF clarify and substantiate the need for a contingency to existing waste storage. Only remediation and decommissioning waste would be considered for management in this facility.

Remediation waste is defined as follows by RFCA, part 5, line 26, item (b.f.):

> (1) solid, hazardous, and mixed wastes; (2) all media and debris that contain hazardous substances, listed hazardous or mixed wastes or that exhibit a hazardous characteristic; and (3) all hazardous substances generated from activities regulated under this Agreement as RFCA corrective actions or CERCLA response actions, including decommissioning. Remediation waste does not include wastes generated from other activities. Nothing in this definition confers RCRA or CHWA authority over source, special nuclear, or byproduct material as those terms are defined in the Atomic Energy Act.

In addition, low-level waste, as defined by RFCA, is radioactive waste that is not high-level waste, spent nuclear fuel, by-product material, or transuranic waste (although it may contain small amounts of transuranic elements). The majority of the low-level waste managed at the CSF would have an average radionuclide activity less than ten nanocuries per gram (nCi/g) based on the Hazard Categorization Analysis (Kaiser Hill, 1996a).

Remediation waste types for the CSF are expected to include the following:

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- Contaminated soil collected from remedial actions, usually treated to remove volatile organics;
- Treated and untreated sludge and sediments;
- Treatment by-products from groundwater, surface water, and/or soil remediation actions;
- IDM from characterization activities, such as wells and borings, if the IDM is characterized as hazardous, low-level, or low-level mixed remediation waste;
- Decommissioning waste which has been characterized as hazardous, low-level, or low-level mixed waste. Decommissioning includes all wastes generated after deactivation. This waste would include contaminated building rubble, equipment, protective equipment, and utilities .

5.2.2 Remediation Waste Volume

Waste volume estimates were based on planned risk reduction activities. A preliminary estimate of remediation waste volumes that may require storage prior to ultimate disposal is presented in Table 5-2 below. The total volume of remediation waste is estimated to range from 54,000 cubic yards up to 300,000 cubic yards. These estimates were based on current information and were obtained from the Draft Ten Year Plan waste volumes. These volume estimates are not intended to limit the size of the facility, but serve as a tool for the decision making process.

Table 5-2 Remediation Waste Volumes for the Containerized Storage Facility

Remediation Waste Types	Total Estimated Volume (m^3)	Total Estimated Volume (cu yd)	Volume Ranges (m^3)
Low-Level Waste	40,716	53,293	32,573 m^3 to 81,432 m^3
Low-Level Mixed Waste	53,438	69,945	42,750 m^3 to 106,876 m^3
Total[1]	94,000	123,200	75,323 m^3 to 188,308 m^3

Notes:
1. These waste volumes have an error range of -50% to +100% based on available data.

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The actual volume of soil defined by the Tier I and Tier II in RFCA Action Levels and Standards Framework could be larger or smaller because volume estimates were made using preliminary data from limited characterization.

5.2.3 Conceptual Waste Acceptance Criteria

The purpose of the CSF is to provide ER and Decommissioning activities the services of a staging facility for the receiving, interim storage, and ultimate shipping of remediation waste. A detailed Waste Acceptance Criteria (WAC) will be developed during the design phase of the CSF. WAC would be developed for the CSF to ensure remediation wastes comply with applicable regulatory and site requirements. The CSF would accept remediation waste in transportable containers which have accompanying documentation that meets the waste acceptance criteria of the anticipated target disposal facility. The WAC would be specific for the CSF and may not address specific requirements as required by other offsite disposal facilities which ultimately would receive the waste. For criteria which can be quantified, specific levels would be identified.

The following objectives would be achieved in compliance with the WAC:

- Remedial wastes are effectively isolated from potential natural environmental pathways to protect the public health and the environment;
- Operating personnel of the CSF ensure continuous protection to the public health and the environment;
- Remediation waste is routinely monitored and inspected; and
- Characterization data of the remediation waste is documented to the extent necessary to support project specific waste management objectives and WAC requirements for the CSF.

As previously mentioned, the CSF would receive remediation waste from ER and decommissioning activities which would be handled as bulk wastes in customized containers versus crates or drums.

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The WAC would provide physical and chemical limitations and requirements for the proper management of remediation waste. Historical knowledge including previous analytical data and/or current chemical and radiological analyses would become the tools to document accurate characterization of the remedial waste.

5.2.4 Physical Requirements

A summarized list of physical requirements which the WAC would address are listed below:

- Physical properties of bulk wastes such as soils, sediments, and treated sludge (e.g. maximum size range, specific weight, moisture content);
- Physical properties of wastes classified as debris (e.g. maximum size range, specific weight, moisture content, non-biodegradable);
- No free liquids (e.g. 6 CCR 1007-3 Subpart N 264.314; EPA Paint Filter Test);
- Conditions for filled and emptied containers (6 CCR 1007-3 Subpart N 264.315); and
- Prohibitions of containerized gases, ignitable or reactive wastes (6 CCR 1007-3 Subpart N 264.312, 313).
- Lack of free liquids shall be demonstrated by EPA Test Method 9095 (Paint Filter Test).

5.2.5 Chemical Requirements

A summarized list of chemical requirements which the WAC would address are listed below:

- Chemical analyses, acceptable analytical methods, and detection ranges;
- Prohibited constituents and chemical characteristics including reactive or ignitable substances (e.g. pyrophoric uranium; 6 CCR 1007-3 Subpart N 264.312);
- Prohibition of incompatible waste (6 CCR 1007-3 Subpart N 264.313);
- pH limitations; and

  Composition of wastes.

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5.2.6 Health and Safety Issues

The primary health and safety concerns for the CSF are itemized as follows:

- Operations involving heavy equipment (e.g. large forklifts/cranes) for the handling of containers;
- Health and safety issues for the industrial worker;
- Threshold limits for radionuclides and organic compounds for the CSF; and

The CSF would require operating and administrative procedures for the assurance of safe operations involving heavy equipment and protective measures for the industrial worker.

The WAC would address the following radiological requirements:

- Radiological analyses for characterization; and
- Threshold limits of radionuclides for the CSF.

The majority of low-level remediation waste to be managed at the CSF would have an average radionuclide activity less than ten nanocuries per gram (nCi/g) as mentioned previously under section 5.2.1. A preliminary hazard category analysis was performed for the CSF. The CSF was categorized as less than a Category 3 facility and designated as a Radiological Non-nuclear Facility based on preliminary threshold quantities of plutonium and other radioactive isotopes (Kaiser-Hill, 1996). This categorization analysis was based on sampling data from some of the more radioactive IHSSs at RFETS (e.g., 903 Pad and Lip Area, and the Original Process Waste Lines). To be conservative in the hazard analysis, the highest activity concentrations were used from these IHSSs.

5.3 TECHNICAL AND ADMINISTRATIVE CONTROLS

Technical and administrative controls would be implemented in order to ensure that human health and the environment would be protected from areas where present or past activities preclude unrestricted access or use. Discussion of these controls for the CSF are grouped into four major elements:

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- Engineering Controls (leak collection/detection system);
- Facility Monitoring (e.g. groundwater monitoring plan);
- Operational Controls (e.g. waste acceptance criteria, visual inspection, Health and Safety plan, contingency/spill response plan); and
- Administrative Controls (e.g. limited access; institutional controls).

Engineering controls - There would be specific engineering controls designed into the facility in order to support protection of human health and the environment throughout the operational life of the facility. The following engineering controls for the CSF are:

- Double containment (e.g., containers and secondary containment by concrete floor slab);
- Leak collection/removal is an integral collection/removal system constructed in the floor slab with sumps and piping; and
- An internal infrastructure designed to facilitate retrieval of wastes.

Facility Monitoring - An extensive monitoring network would ensure no releases pass undetected from the unit boundary. This would include both air and surface water monitoring stations and groundwater monitoring wells positioned hydraulically upgradient and hydraulically downgradient of the CSF. A groundwater monitoring plan in compliance with CCR 1007-3 264.552 (e) (3) would be developed. These requirements would also be integrated into the overall RFETS monitoring program to ensure that a comprehensive network was in place to help protect human health and the environment.

Operational Controls - Operational controls would be put in place to ensure that waste management operations were conducted in such a way as to minimize the risk of release from the facility or exposure to personnel:

- An agency-approved waste acceptance criteria specifying a safety envelope for chemical and physical waste parameters including appropriate treatment requirements;

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- An operational health and safety plan approved by the agencies designed to provide operational constraints for personnel protection, weather conditions, decontamination procedures, training requirements, emergency response, and health and safety monitoring;
- Standard operating procedures that establish clear, repeatable, guidelines for conduct of operations, including packaging and transporting of waste from decommissioning activities or IHSS remediation locations to the CSF;
- Numerous quality assurance procedures from construction quality assurance, to procedural audits, all designed to ensure the facility and operations meet designated performance standards and approved, as appropriate, by the State;
- Closure plans that define how the facility would be decommissioned after the life of the operations and the performance standards for closure per 6 CCR 1007-3 264.552 (e) (4); and
- Agency approved contingency/spill response plans would define how the facility responds to a release of waste or constituents from the CSF.

Administrative Controls - Administrative controls are defined to ensure that risk of exposure during construction, operations, and closure are minimized. These may include:

- Appropriate institutional controls (e.g. warning signs, fences);
- Security plans which define site restriction requirements throughout the life of the project; and
- Cleanup standards which define the level of cleanup necessary to certify closure.

In summary, numerous technical and administrative controls would be in place to insure that all aspects of this effort were conducted in such a way that risks to human health and the environment would be minimal.

5.4 NEPA VALUES

The proposed CSF would be authorized using a single, integrated Decision Document that would be signed by the DOE and the State of Colorado when approved. The Decision

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Document and review process would satisfy the documentation and procedural requirements of the RFCA. The National Environmental Policy Act (NEPA) process was integrated into the RFCA documentation and procedure, especially public involvement and decision-making, to reduce duplication and paperwork, and streamline the combined NEPA/CERCLA/RCRA process. In accordance with the DOE Secretarial Policy issued in June 1994, integrated CERCLA/RCRA documents for environmental clean up activities are to incorporate NEPA values to the extent practical. This policy is intended to minimize the cost and time for document preparation and review while meeting the requirements of both acts.

The CSF would be anticipated to minimize cumulative effects on the environment by being placed in the Western Industrial Area because of the following:

- The proposed area in the industrial area has been already disturbed and consolidation of waste is achieved;
- Existing infrastructure already exists which would support the CSF; and
- The proposed area was selected based on a detailed siting study which screened out sensitive areas (e.g. areas populated by the rare species, the Prebles Jumping Mouse, steep slopes, wetlands, etc., were avoided).

The analyses required by NEPA has been integrated throughout the decision process. Based on the analyses, the decision-making process requires no further documentation to complete the NEPA process.

5.4.1 ANTICIPATED DAMAGES TO NATURAL RESOURCES

The alternatives analyzed, excepting the No Action alternative, would not result in irreversible damage to natural resources because releases to the environment would be averted through the use of double containment and leak collection systems for waste storage preceding shipment. In addition, none of the alternatives analyzed will result in irreversible and irretrievable damages to natural resources because the remediation waste stored in the proposed CSF CAMU is to be shipped offsite to a disposal facility.

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5.5 CONTAINERIZED WASTE STORAGE FACILITY OPERATIONS

The CSF would be operated and maintained under a number of administrative requirements, as previously mentioned in section 5.3 "Technical and Administrative Controls,". Administrative controls would be administered for activities of waste operations in the following areas:

- WAC documents and forms - These would be required to demonstrate compliance with the CSF WAC requirements previously mentioned in section 2.2;
- Operating procedures - Procedures for handling and placement of waste, facility maintenance and documentation to ensure safe and efficient operation of CSF;
- Training plan - A plan to administer required training for operating personnel in procedures, safety, and quality assurance;
- Health & Safety Plan - The health and safety requirements for operating personnel to conduct operations in a safe manner;
- Contingency/spill response plan would define, per Subpart 264.304, how the facility would respond to a release of waste or constituents from the CSF;
- Limiting operating conditions - Identification of abnormal events which would require operations to temporarily stop activities (e.g. excessive wind velocities, and other weather conditions) to ensure safety to the public, the workers, and the environment
- Administrative procedure and plans - Additional procedures and plans to ensure compliance with RFCA, DOE orders, and RFETS rules and policies;
- Control of fugitive dust emissions - Facility Monitoring Plan as cited in section 5.3 to reduce dust emissions and monitor results to protect the public and worker; and
- Closure and Post-Closure Plan - This would include the requirements and performance standards for closure per 6 CCR 1007-3 264.552 (e) (4) to close the facility after the end of its operational life.

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Additional requirements addressed in the WAC or Facility Operations Plan for compliance would be administrative controls. The following requirements would ensure the CSF to be operated in a safe manner:

- Recordkeeping and documentation;
- Waste information from process knowledge and/or sampling and analysis data for waste characterization;
- Quality assurance/quality control (QA/QC) certification program and verification;
- Status reports and waste forecasts;
- Shipment notification;
- Packaging and labeling requirements.

5.6 CONCLUSION

The CSF is proposed as a contingency to meet the accelerated risk reductions described in the Draft Ten Year Plan. The Draft Ten Year Plan assumes remediation waste can be shipped offsite at the same rate it is generated. The CAMU is proposed to address the contingency that offsite waste shipment and disposal are not available when the wastes are generated. This CAMU will support the final remedy of source removal followed by offsite disposal.

The CSF will consist of one or more metal buildings constructed on concrete pads with integral leak collection. The facility will have a storage capacity of up to 100,000 cubic yards of containerized remediation waste.

The length of operations for the CSF will be consistent with the intermediate site condition as defined in the RFCA preamble (12 to 20-25 years).

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6. SCHEDULE

The Parties have agreed to the following time frames:

> b. Within 45 days of receipt of DOE's draft IM/IRA, CDPHE shall determine that the IM/IRA meets or fails to meet the criteria in subparagraph (a). If CDPHE determines that the draft fails to meet the criteria, it shall, at the end of its 45 day review, explain with specificity the necessary modifications and allow Doe to resubmit within 30 days or to invoke dispute resolution within 14 days. If CDPHE determines that the application meets the criteria described in subparagraph (a) , it shall issue the draft IM/IRA for public comment for a period of 60 days.
>
> c. Within 30 days of the close of the public comment period, CDPHE shall review the comments received and modify the draft if appropriate. The agency shall also prepare a response to significant public comments at this time. At the end of this 30 day period, if CDPHE still agrees that the IM/IRA as modified meets the regulatory criteria for designation and the criteria in paragraph 80, CDPHE shall designate the storage CSF CAMU. If CDPHE has determined that the IM/IRA does not meet these same criteria, it shall state the changes that DOE must make to receive approval.

Once the CSF CAMU designation is complete, design and construction of the facility would occur only as a contingency action and would take a little more than two years (Figure 6-1). The facility would then be tested and opened for use. Placement of remediation waste in the facility would be dependent on the progress of decommissioning and remediation activities. The schedule for eventual shipment of the waste offsite has not been determined; nonetheless the Draft Ten Year Plan assumes that all low level mixed waste would be disposed offsite.

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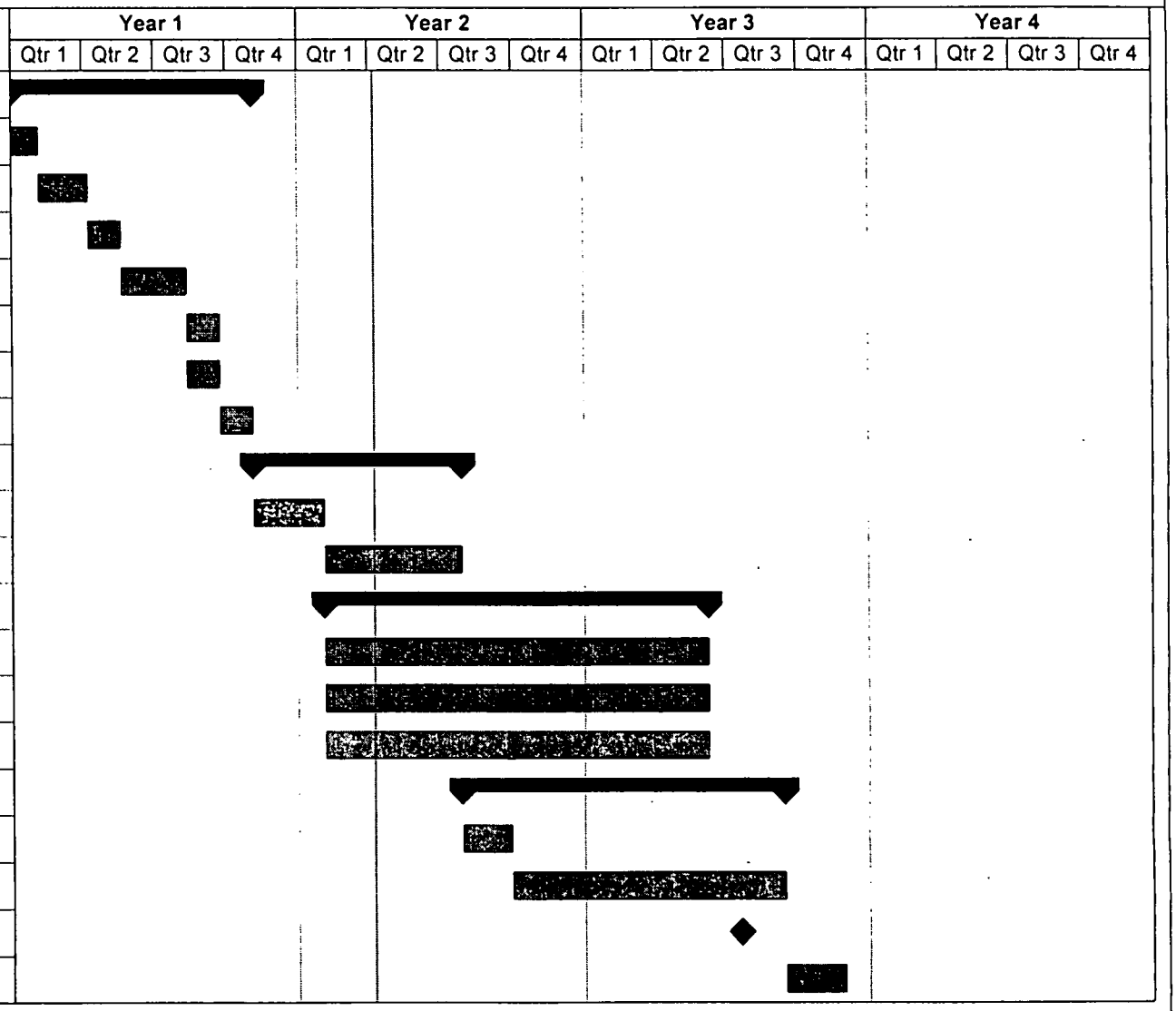
FIGURE 6-1: PROPOSED CONTAINERIZED STORAGE FACILITY SCHEDULE

Task Description	Dur
DECISION DOCUMENT	221d
PREPARE DECISION DOCUMENT (DD)	26d
CDPHE REVIEW DD	45d
MODIFY DD BASED ON CDPHE COMMENTS	30d
PUBLIC COMMENT PERIOD ON THE DD	60d
MODIFY DD BASED ON PUBLIC COMMENT	30d
PREPARE RESPONSIVENESS SUMMARY	30d
FINAL APPROVAL OF DD	30d
DESIGN	190d
PREPARE CONCEPTUAL DESIGN	65d
PREPARE DETAILED DESIGN	125d
OPERATIONAL AND MONITORING PLAN DEVELOPMENT	350d
PREPARE OPERATIONAL DOCUMENTATION	350d
PREPARE MONITORING PLAN	350d
OPERATIONAL PROCEDURES & TESTING	350d
CONSTRUCTION	295d
PREPARE SITE FOR CONSTRUCTION	45d
CONSTRUCTION OF PREFERED ALTERNATIVE	250d
BEGIN OPERATIONS	0d
PROJECT CLOSE-OUT	55d



PROPOSED CONTAINERIZED STORAGE FACILITY SCHEDULE

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

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7. REFERENCES

DOE, 1996a, *Final Rocky Flats Cleanup Agreement*, July 19.

DOE, 1996b, *Draft Ten Year Plan*, July 30.

Kaiser-Hill, 1996, Hazard Categorization Analysis for Waste Management Facility, January.

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Appendix A

Appendix A-1: Facility Drawings

Appendix A-2 : Preconceptual Design Narrative

Appendix A-3: Designation Support Documentation

Appendix A-4: Siting Study Figures

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APPENDIX A-1

Facility Drawings

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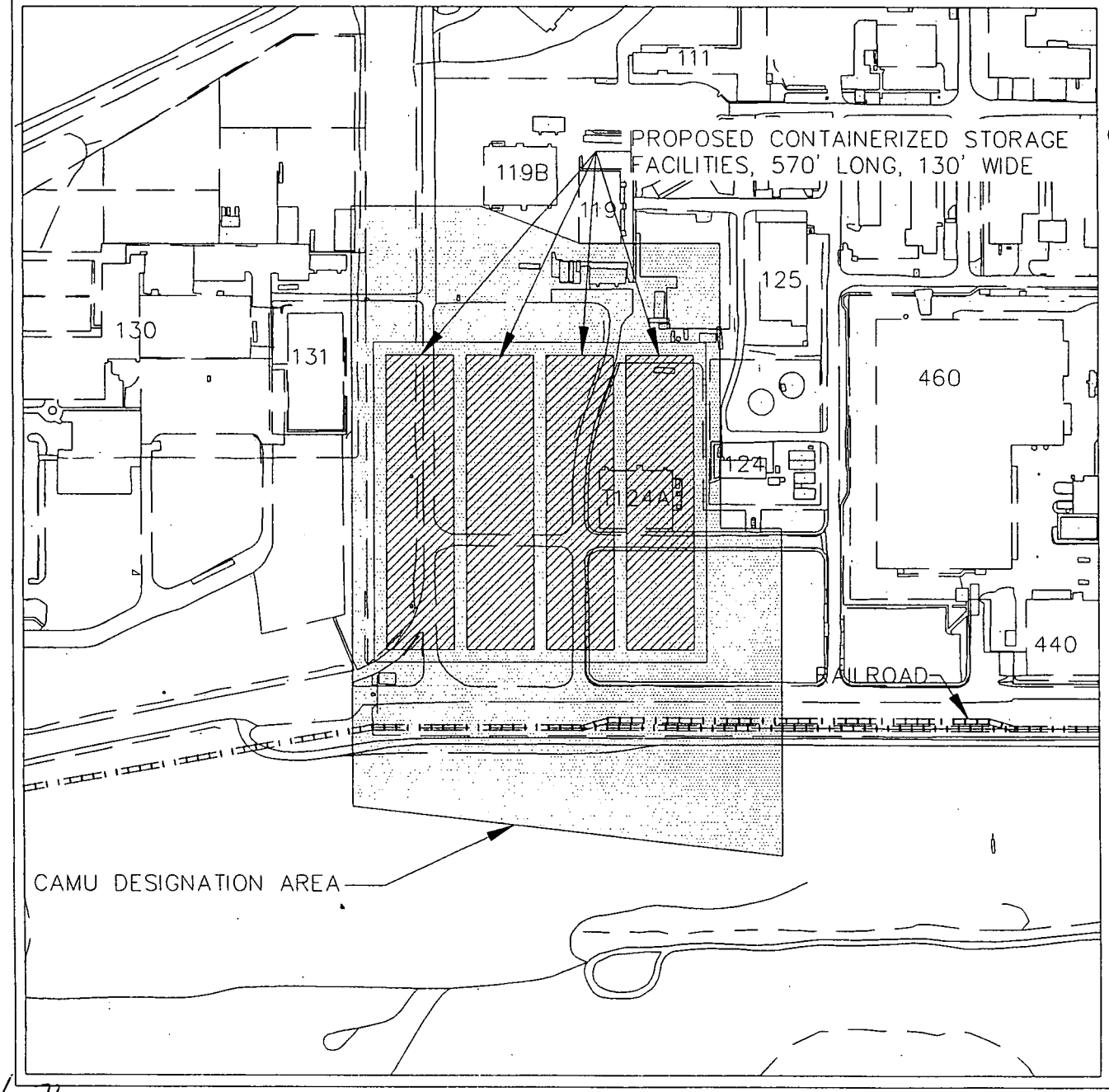


FIGURE A-1

CONTAINERIZED STORAGE FACILITY SITE PLAN

LEGEND

PROPOSED FEATURE

EXISTING FEATURE

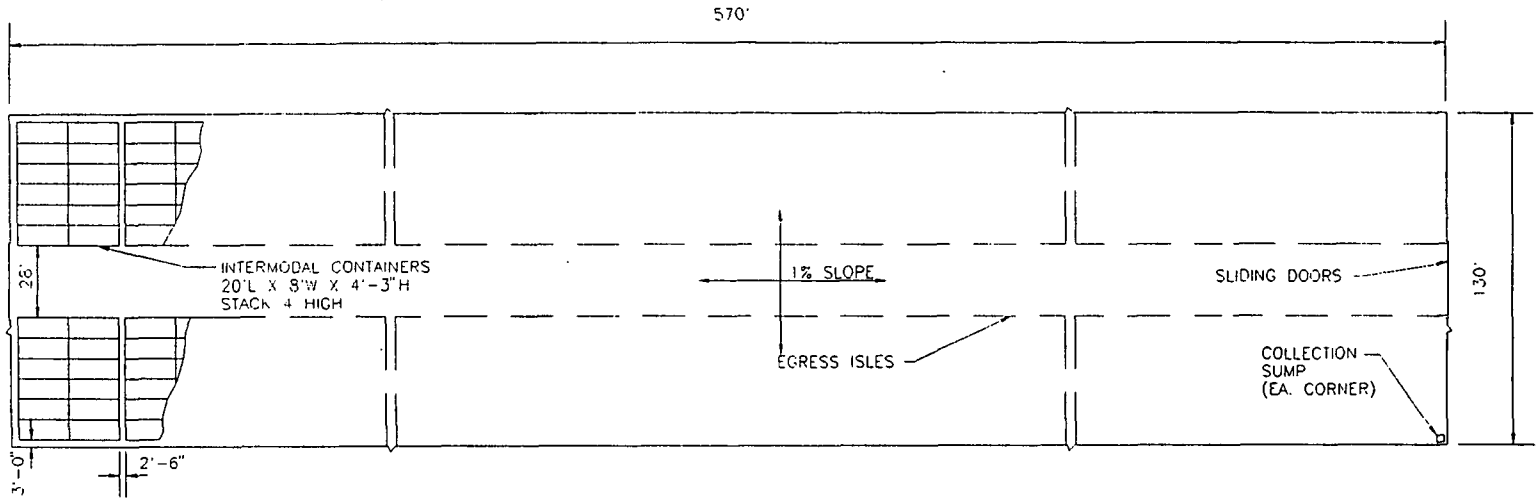
U.S. DEPARTMENT OF ENERGY

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

RMRS

300 200 100 0 300

GRAPHIC SCALE
1"=300'



FLOOR PLAN
SCALE: 1" = 70'-0"

NOTES:

1. WIDESPAN BUILLDING WITH NO INTERIOR COLUMNS.
2. CONCRETE FLOOR TO HAVE IMPERMEABLE EPOXY COATING. ALL CONCRETE JOINTS SHALL HAVE WATERSTOPS.
3. LIGHTING SHALL BE 75 FT-CANDLES MINIMUM AT 3 FT ABOVE FLOOR.
4. EMERGENCY EXIT LIGHTS SHALL BE PROVIDED.
5. MECHANICAL VENTILATION SHALL BE PROVIDED IN ACCORDANCE WITH UNIFORM BUILDING AND MECHANICAL CODES.
6. INSULATION AND HEATING WILL NOT BE PROVIDED.
7. AUTOMATIC FIRE-EXTINGUISHING SYSTEM WILL NOT BE PROVIDED.

CONTAINERIZED STORAGE FACILITY
FLOOR PLAN

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

RMRS

Figure A-2

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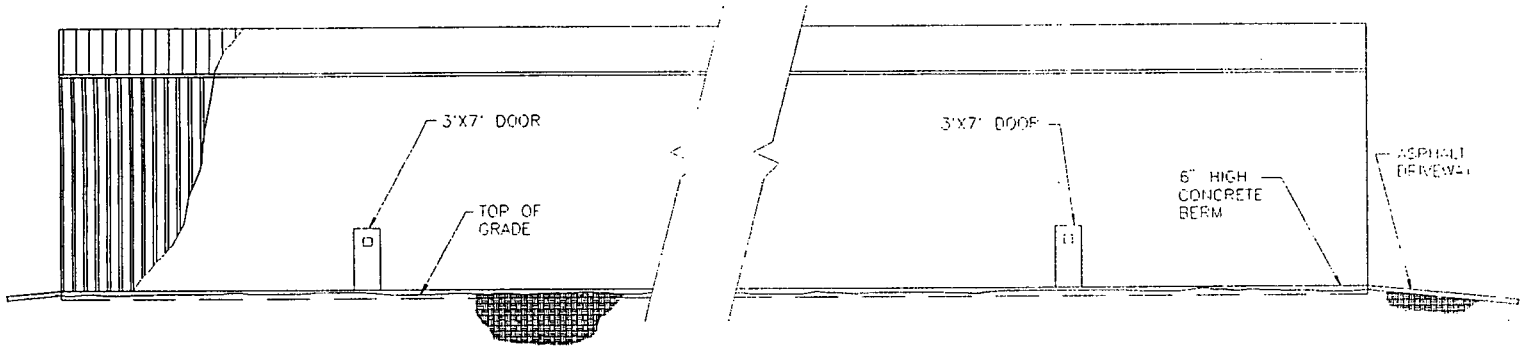
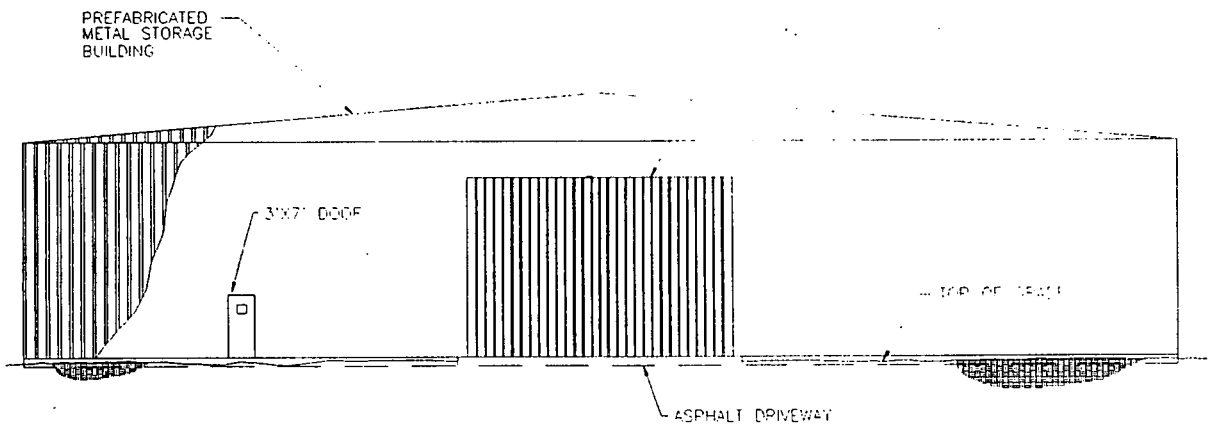


EAST ELEVATION (West Similar)
SCALE: 1" = 20'-0"



NORTH ELEVATION (South Similar)
SCALE: 1" = 20'-0"

CONTAINERIZED STORAGE FACILITY
ELEVATIONS

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

RMRS

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Figure A-3

APPENDIX A-2

Preconceptual Design Narrative

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APPENDIX A-2

DRAFT PRECONCEPTUAL DESIGN NARRATIVE

CORRECTIVE ACTION MANAGEMENT UNIT FOR CONTAINERIZED STORAGE OF REMEDIATION WASTE

Rocky Flats Environmental Technology Site
Golden, Colorado

Prepared by
Rocky Mountain Remediation Services, L.L.C.

for the

U.S. Department of Energy
Rocky Flats Field Office
Golden, Colorado

March, 1997

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Preconceptual Design Narrative
Corrective Action Management Unit for Containerized Storage of Remediation Waste

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Attachment II - Preliminary Design Parameters for CAMU for Containerized Storage
Attachment III - Preliminary List of Applicable Codes, Standards, and Guidelines
Attachment IV - Key Material Specifications and Requirements
Attachment V - Specifications for Roll-off Containers Used as a Design Basis

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EXECUTIVE SUMMARY

The Containerized Storage Facility (CSF) will be implemented as a Resource Conservation and Recovery Act (RCRA) Corrective Action Management Unit (CAMU). It will provide onsite retrievable, monitorable storage for hazardous, low-level, and low-level mixed remediation wastes at the Rocky Flats Environmental Technology Site (RFETS). Only remediation wastes generated at RFETS will be placed in the CSF. The CSF will be located west of building 440/460 in the CAMU Designation Area shown on Figure A-1 of Appendix A-1 of this decision document. The CSF will be designed and constructed per state and national codes and requirements of 6 CCR 1007-3, Part 264, Subpart S. CAMUs are exempted from the unit specific minimum technology requirements of Part 264. As an enhancement, the CSF will use the following as a guidance; Part 264, Subpart I, Use and Management of Containers and Subpart DD, Containment Buildings.

This Preconceptual Design Narrative evaluates geotechnical considerations, preconceptual design parameters, and preliminary specifications for the CSF. More detailed design specification and drawings will be prepared as part of the Title II design. A more thorough evaluation of geotechnical parameters will be also be incorporated into Title II design documentation.

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1.0 INTRODUCTION

1.1 PURPOSE OF PROJECT

The purpose of the Containerized Storage Facility (CSF) is to provide an onsite, retrievable and monitorable waste storage facility for low-level, low-level mixed, and hazardous waste generated by remediation activities at the Rocky Flats Environmental Technology Site (RFETS). Currently there is limited onsite storage capacity for these wastes. The CSF will provide a new facility with the initial capacity of 25,000 cubic yards (yd^3) expandable to 100,000 yd^3 through the construction of additional metal buildings.

The CSF may consist of four metal buildings within the Corrective Action Management Unit (CAMU) Designation Area. The preconceptual design described in this narrative would be utilized on the first metal building and any subsequent buildings in the CAMU designation area.

1.2 GENERAL DESIGN CONCEPT

The CSF will have a gross capacity of approximately 25,000 yd^3 per metal building and 100,000 yd^3 for the whole CSF complex. Twenty cubic-yard "Intermodal" roll-off containers were used as the initial basis for the facility design. The are 20 cu yd containers which are specially designed for materials of higher density such as soils. The CSF would be capable of accepting other types of containers and the capacity of the facility is dependent on the type of containers utilized. Each metal building, 570 feet long by 130 feet wide and with a 24 feet eave height, would store 1250 Intermodal roll-off containers for a total of 5000 containers for four metal buildings.

Construction of each metal building would be sequenced to match storage needs and to provide the greatest degree of flexibility in remediation waste management. The metal buildings would be constructed over a reinforced concrete floor which would be sealed with a polyurethane sealant. The metal buildings would have a central corridor, thirty foot wide, for accessing the roll-off containers. The containers are designed to be stacked four high in the facility. The metal building is designed to provide containment and leakage collection with a continuous curb around the perimeter of the building. In addition, the concrete slab would slope to the corners of the building which will have containment sumps. Liquids, if any, would be collected and transferred from the sumps for final treatment.

Because the Waste Acceptance Criteria (WAC) requires no free liquids and the fact remedial waste for storage will only be solids, a minimal quantity of liquids are anticipated. Liquids will be transferred by tanker truck to a treatment facility.

1.3 GENERAL DESIGN CRITERIA

All equipment and facility sizes, capacities and ratings, etc. listed in this preconceptual design narrative are preliminary, and are intended only to relay the general intent and scope of the project. Final sizing

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will be performed during the design phase and incorporated into subsequent submittals. All equipment will be sized to operate at the RFETS elevation of 6,000 ft above sea level. Design criteria are given in Attachment I, Preliminary Design Parameters for CAMU for Containerized Storage.

The CSF will be designed according to state and national codes and the requirements of the appropriate regulatory agencies and their permit conditions. The regulatory decision and approval process for the CSF will be conducted as a CAMU under the Rocky Flats Cleanup Agreement (RFCA) (DOE, 1996).

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2.0 SITE CHARACTERISTICS

2.1 SURFICIAL FEATURES

2.1.1 Surface Water Features

Surface water features of RFETS include three intermittent streams, several interceptor ditches, springs, several ponds (including stormwater storage ponds), and scattered wetlands. There are no surface water features on the CSF site itself.

The primary surface water features near the CAMU designation area is Woman Creek. Woman Creek flows into the RFETS C-1 pond but is diverted around pond C-2 and flows offsite to Mower Reservoir. The South Interceptor Ditch (SID) collects groundwater from the Industrial Area on the south side of RFETS and flows to pond C-2. Currently most of the surface water flows to the SID or to drains that flow into North Walnut Creek. North Walnut Creek flows into the "A" ponds.

2.1.2 Wetlands and Floodplains

The CAMU Designation Area is not within any wetlands or any 100 year floodplains based on the Rocky Flats Plant Drainage and Flood Control Master Plan (EG&G 1992a). See Figure 2 of Appendix A-4, Hydrogeological Conditions.

2.2 SITE GEOLOGY AND HYDROGEOLOGY

A detailed discussion of the RFETS Geology and Hydrogeology is provided in the Sitewide Geosciences Characterization Study consisting of the following:

Volume I	Geologic Characterization Report (EG&G 1995a)
Volume II	Hydrologic Characterization Report (EG&G 1995b)
Volume III	Groundwater Geochemistry Report (EG&G 1995c)

2.2.1 Site Geology

The CAMU designation area for the CSF is covered by the Rocky Flats Alluvium. The composition of the Rocky Flats Alluvium at the site is typical of most areas at RFETS, with clayey and silty sand and gravels comprising the bulk of the underlying unconsolidated material. Bedrock materials consist chiefly of weathered and unweathered claystone and silty claystone. The depth to bedrock ranges from approximately 25 feet along the eastern edge of the CSF to approximately 45 feet at the northwest corner. The thickness of the weathered bedrock at the site ranges from 25 to 40 feet. Figure 5 of Appendix A-4 of this decision document shows the surficial deposit thickness at the site.

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2.2.2 Site Hydrogeology

Ground water has been found in all hydrostratigraphic units underlying the site, however only the unconsolidated surficial deposits (Rocky Flats Alluvium and colluvium) and bedrock weathered zone are considered permeable enough to facilitate contaminant transport from the site. Ground water movement in the surficial deposits occurs mainly as intergranular flow, while fracture flow is assumed to predominate in weathered claystones and other consolidated fine-grained media.

The Rocky Flats Alluvium underlies the entire site, but is variably saturated. The lateral extent of saturated alluvium is seasonal, being more extensive during late spring and least extensive during late winter. Weathered bedrock is expected to play an increasingly important role as a contaminant pathway in areas of limited or no alluvial saturation. The weathered bedrock is assumed to be partially saturated and laterally continuous. Flow in fractured claystones is probably minimal due to low hydraulic conductivities and low horizontal hydraulic gradients.

The saturated thickness for surficial deposits at the CSF site area ranges from 10 to 30 feet. The depth to groundwater ranges from 2 feet to 30 feet.

Ground water at the CSF site flows predominantly to the east, with some flow to the northeast and northwest towards the Walnut and Woman Creek drainages.

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3.0 GEOTECHNICAL EVALUATION

3.1 GEOTECHNICAL INVESTIGATIONS

Numerous boreholes and monitoring wells have been drilled at the site. Most of these have been installed for environmental sampling and monitoring, rather than assessment of soil properties for geotechnical design. Attachment II to the Preconceptual Design Narrative provides a summary of existing geotechnical data. Geotechnical investigations performed for other projects in the vicinity of the CSF provided information on expected soil properties and conditions for the Preconceptual Design Narrative. The location of existing boreholes and monitoring wells are shown in Attachment II.

3.2 FAULTS AND SEISMICITY

The closest major fault to the RFETS is the Golden Fault , which is approximately two miles southwest of RFETS. Trenching across the Golden Fault by the Colorado Geological Survey (CGS) has shown that the Golden Fault has offset the Verdos Alluvium (approximately 610,000 years in age), as well as an overlying colluvium layer (believed to be older than 70,000 years) (Kirkham and Rogers, 1981). The Golden Fault is classified by the CGS as a potentially active fault.

Other possible faults in the area include the Walnut Creek "Fault" and the Rock Creek "Fault", both identified as lineaments on aerial photographs. Drilling has indicated subsurface faulting in the Walnut Creek area, which may or may not be linked with the surface lineament feature. The Walnut Creek Fault crosses the southeast corner of RFETS and the Rock Creek feature is located approximately 1/2 mile to the north of RFETS. Additional information on faults, landslides and mining activity is provided in the Sitewide Geosciences study (EG&G 1995a).

A series of bedrock faults have been inferred across RFETS, based on drill hole subsurface lithologic and geophysical logs and interpretation. One of these bedrock faults runs across the southeast corner of the CSF site (see Figure 3 of Appendix A-4). Trenching across the bedrock fault north of Building 371 in the Buffer Zone showed no deformation of the Rocky Flats Alluvium across the fractured area of the bedrock. Since the Rocky Flats Alluvium is believed to be approximately 1 million years in age, it is apparent that this particular fault has not suffered movement in at least this time.

RCRA 6 CCR 1007-3, Part 264.18 states that new hazardous waste treatment, storage, or disposal facilities cannot be located within 1000 feet of a fault which has had displacement in Holocene time (within the last 10,000 years). There is no evidence that the inferred fault has experienced movement in Holocene time.

3.3 EROSION

The CSF site is relatively flat with little evidence of severe wind or water erosion. The potential for severe water erosion during rare major storm events exists adjacent to the purported CSF site near the Woman Creek drainage. Adequate clearances or building setbacks and/or engineering controls will be

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provided to prevent unacceptable erosion. A drainage and erosion control plan will be prepared during Title II design to ensure storm water will be managed properly. The facility will be monitored and maintained during operations and prior to shipping waste offsite to correct any erosion potential.

3.4 SLOPE STABILITY

Landslide deposits exist directly south of the CSF site on the north slope of Woman Creek, (EG&G 1995a). These deposits include earth flows, earth slumps, debris flows, debris slumps, rock block slides, and complex landslides (Schroba and Cararra, 1994). Some of the landslide deposits are composed of both bedrock and overburden material (alluvium, colluvium, and soil). Those deposits derived from the bedrock may contain expansive clays. Landslides or soil slumps occur on the sides of valleys due to the hydration and lubrication of bedrock clay, especially in areas of seepage. Figure 3 of Appendix A-4 of this decision document shows areas adjacent to the site with slopes of greater than 15%. The site for the CSF is relatively flat and there is no evidence of landslides or slumps. The CSF will be located a sufficient distance from the Woman Creek drainage to avoid areas of potential slope instability.

3.5 SWELLING SOILS

The presence of expansive clay within the Rocky Flats Alluvium is highly variable across the RFETS. The Arapahoe and Laramie formations contain expansive clays (Van Horn, 1976), which have the potential to damage the CSF over time. Soil samples at Buildings 460 and 124 swelled less than 0.5% when wetted. Soil samples at Building 131 swelled up to 6%. Buildings 460, 124, and 125 were constructed with spread footings, and have not experienced any problems related to foundation heaving. Due to the high swell test results during the geotechnical investigation, Building 131 was constructed using drilled piers. While it was assumed spread footing will be used, the use of drilled piers would not present any problems if required to prevent potential damage from swelling or settlement. A more thorough investigation during Title II design will evaluate the soil conditions and the possible presence of expansive soils to recommend the best foundation structure for the metal buildings.

3.6 BEARING CAPACITY

The bearing capacity of the CSF site is estimated to be a minimum of 4,000 pounds per square foot (psf) based on previous geotechnical investigations in the vicinity. The facility rests on the Rocky Flats Alluvium which is 20-50 feet thick at the CSF site and consists primarily of clayey sands and gravels.

A geotechnical investigation will be performed as part of the Title II design to provide an accurate determination of the soil bearing capacity. The estimated loading of the CSF floor slab is 2200 psf. The building column footings will be sized based on the final bearing capacity, taking into account potential settlement and swelling.

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3.7 SETTLEMENT/THERMAL EXPANSION

Settlement of the CSF is expected to be minimal. The maximum consolidation of the soil at 4000 psf was two percent. The settlement of the CSF should not exceed 2 to 3 inches. Differential settlement should not be a problem, due to the fairly uniform surficial soils and the 20 foot minimum alluvium thickness. If the geotechnical investigation determines the site is susceptible to unacceptable settlement, the building can be constructed using a pier foundation. Most likely potential swelling will have more impact on the design than unacceptable settlement.

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4.0 PRECONCEPTUAL DESIGN

4.1 DESIGN PARAMETERS

The preliminary design parameters for CSF were incorporated as integral part of the preconceptual design process. At the request of the CDPHE, a table of design parameters has been provided as Attachment II to this narrative.

4.2 SITE WORK

4.2.1 Utilities Preparation

Figure A-1 in Appendix A-1 shows the location of the four CSF buildings. Only minimal site preparation will be required as most of the site is open or parking lot. The T124A trailers will require removal. First street which runs between Building 131 and the CSF will require closure or relocation. Primary electric power will be derived from the existing 13.8 kilovolt-amperes aerial lines for lighting and power in the buildings. The existing storm drains will be modified to properly handle the runoff from the footprint of the metal building.

4.2.2 Utilities

The only utilities required for the CSF are electric power and telephone. Both are easily accessible. Raw water is available at Building 124 if needed. Building 124 has an emergency shower. Emergency eye washes with self contained water tanks will be provided inside the CSF buildings. The CSF will not be heated as the waste will not contain free liquids. Ventilation will be provided as required by the Uniform Building Code (UBC) and Uniform Mechanical Code. Since all the waste is containerized, no special ventilation or filtration is required due to the storage of low level mixed waste. Some utilities that service the 130 Building Complex may require relocation. Utilities no longer in use will be abandoned-in-place by capping or grouting.

4.2.3 Earthwork

The grading design will provide existing and new contours, and spot elevations shown at grade changes and structure elevations. Cross sections will be provided where practical. The Title II Design will specify appropriate compaction requirements for approved material, moisture requirements, and general placement methods.

4.2.4 Site Access and Security

Existing RFETS roads will be used to access the CSF. Asphalt pavement will be placed between and adjacent to the building doors to provide vehicle access. A security fence will be constructed around the CSF to control access. The CSF is located within the RFETS Industrial Area and access to the site is already controlled. No additional requirements are necessary or warranted.

4.2.5 Landscaping

Seeding with a proper mixture of grasses or other plant material will be required for disturbed and bare areas, to provide erosion control and water conservation in accordance with the Soil Conservation Service requirements. Plant material will be selected as proven to be hardy in semi-arid climate adaptable to the RFETS area.

4.2.6 Site Drainage

A Drainage and Erosion Control Plan, and a Reclamation Performance Standard will be prepared during Title II design for construction, operation, and closure of the facility. A site drainage study will be prepared using the appropriate methods presented in the Denver Urban Storm Drainage Criteria Manual, Jefferson County Storm Drainage and Technical Criteria manual, and RFETS Standard SC-109, "Storm Sewer Design Criteria." Site drainage will be designed to accommodate the storm water as determined in the drainage calculations. Drainage must be designed to not allow flooding of the CSF from the 100-year, 24-hour event. All drainage analyses will use data from previous studies conducted for the RFETS where possible and appropriate (EG&G, 1992b and ASI, 1991). These studies will be verified for adequacy for the intended use.

Erosion control on steep slopes (defined as a 3:1 slope or steeper) will be provided with erosion fabric seeded with native grasses, rip rap surface, gravel surfaces, hard surface paving, or other approved methods to prevent erosion. Erosion control of other areas will be provided by use of silt fences and hay bales per Colorado Department of Transportation (CDOT) design criteria.

4.3 METAL BUILDING

4.3.1 Metal Building Description

The conceptual site plan and building layout are shown on Figures A-1 and A-2 of Appendix A-1. The metal buildings are 270 feet long by 130 feet wide with a 24 feet eave height. The CSF would consist of four metal buildings with a total footprint of approximately 6.8 acres. Each building would have a thirty foot wide central corridor for a large forklift to access in storing the containers. The floor plan and building elevations are shown in Figures A-2 and A- 3 of Appendix A-1. Each building will have a sliding door at each end to provide access for the containers. Doors will be provided at the ends and sides to provide personnel access and egress. The buildings will not have any interior columns which could restrict access and movement of containers. Inspection aisles will be provided to allow visual inspection of at least one side of every container. Wider aisles will be provided at the side doors for personnel egress.

The preconceptual design was based on Intermodal containers that are specially designed to accept bulk materials of higher densities such as soil. These containers 20 cubic yard capacity, measure 52" high by 82" wide by 227" long. Each full container will weigh approximately 35 tons. The containers have a variety of lids which provide a leak tight system. The selection of these containers was only for

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design purposes since the facility would be capable of accepting waste in other containers as long as the WAC were satisfied. As part of the design, it was assumed that the containers could be stacked four high in each metal building ultimately allowing the storage of up to 5000 containers. Reference Attachment V for more specific details on the containers.

4.3.2 Liquid Collection System

The metal buildings will have a continuous perimeter concrete curb six inches high for containment purposes. Ramps will be provided at all doorways to maintain the containment. All concrete slab joints and wall/slab joints will be constructed with bulb waterstops. The concrete slab and perimeter curb will be coated with a polyurethane coating to provide an impermeable surface. The floor slab will slope to the corners of the building which will have containment sumps to facilitate liquid removal. The liquids will be transferred by a tanker to Building 891 or 374 for treatment. The liquid containment system is provided as a best management practice. The WAC does not allow storage of waste with free liquids, and the metal building will prevent precipitation from entering the CSF.

4.3.3 Treatment of Collected Liquids

RFETS currently has two facilities for the treatment of low-level mixed waste waters from the CSF; the Building 374 Liquid Waste Treatment Facility and the Building 891 Sitewide Treatment Facility. Building 891 has the capability of treating the anticipated liquid leakage, which could contain organics, heavy metals and radionuclides. The maximum treatment capacity is 30 gallons per minute. Building 891 is equipped with a tanker truck unloading station and 30,000 gallons of influent storage capacity.

Building 374 can treat water with metals and radionuclides; however, the Building 374 processes do not treat organic contaminants. Since soils with high concentrations of organic contaminants will be treated by thermal desorption prior to storage, the recovered liquids should contain only small concentrations of volatile organic compounds.

4.3.4 Product Compatibility

All coatings, water stops and other materials will be evaluated for compatibility with the wastes. Compatibility will be evaluated during Title II design.

4.4 SUPPORT FACILITIES

The CSF will operate as required by the demand of the individual projects generating waste. The metal buildings will provide the storage for containers, however, other activities associated with waste management will be supported by other facilities.

4.4.1 Personnel Facilities

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The CSF will only be occupied during container movement and inspections. Adjacent existing buildings or trailers will be used for locker facilities, personnel protective equipment dress-out area, shower facilities and office/break space. If necessary a trailer will be installed to provide personnel facilities.

4.4.2 Equipment Decontamination

Equipment decontamination (e.g. large forklift) will be provided by the existing 903 Decontamination Pad.

4.5 STRUCTURAL DESIGN CRITERIA

The CSF is "Performance Category 1" in accordance with DOE-STD-1021, "Natural Phenomena Hazards Performance Categorization Criteria for Structures, Systems, and Components." The structural design will meet the requirements of the UBC and DOE-STD-1020, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities." The loads used in the structural design of buildings and other structures will comply with of ASCE 7, "Minimum Design Loads for Buildings and Other Structures." Dead loads will include the weights of all permanent materials and equipment supported in or on the structure including the structure's own weight and other permanent static loads. Live loads will include floor and roof area loads, moving vehicles, and impact loads.

Snow Loads: Minimum snow load will be 43 psf at ground level applied in accordance with ASCE 7.

Wind Loads: Wind load design will be in accordance with ASCE 7 with a basic wind speed of 109 mph. Exposure "C" will be used for all construction and the importance factor is 1.0.

Seismic Loads: Structures, equipment and tanks will be designed in accordance with the UBC and RFETS Standard SC-106, "Equipment Seismic Qualification."

4.6 SITE ELECTRICAL

4.6.1 General

Drawings generated during the Title II design phase will identify underground services and provide plan view dimensioning of service runs with locations of manholes, splice boxes and other pertinent features associated with them.

4.6.2 Power Supply

The Title II Drawings will detail the tapping of the existing 13.8 kV aerial line for providing a feeder to the pad mounted 13.8 kV-480Y/277 V, three phase, four wire transformer.

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4.6.3 Illumination

Illumination levels will be determined from applicable tables in the latest edition of the Illuminating Engineering Society (IES) Handbook for interior and exterior lighting. The energy conservation measures recommended in DOE Order 6430.1A and ASHRAE Standard 90 will be incorporated where cost effective.

4.6.4 Grounding

Appropriate grounding conductors will be routed within all power conduits. Conduits will not be relied upon for ground continuity. Lightning protection will be provided on the roof of buildings per NFPA 780 and NFPA 70.

4.7 ENERGY CONSERVATION

An Energy Conservation Analysis will be required per DOE Order 6430.1A for all new facilities/buildings. This analysis will be performed during Title II design.

4.8 OPERATIONAL EQUIPMENT

The CSF will only require a large industrial fork lift for handling the roll-off containers.

4.9 OPERATIONS

The CSF will accept remedial waste from environmental restoration and decontamination and decommissioning projects across the site. The following remediation waste streams will be accepted at the CSF:

- Investigation Derived Materials (IDM).
- Low-level mixed waste.
- Bulk remediation wastes such as soils and sludges.
- Demolition debris from remediation activities..

All waste will be prepared for storage and will meet the CSF Waste Acceptance Criteria (WAC) prior to transport to the CSF. No waste processing will be done at this facility. A waste staging area will be provided for unloading of containerized waste.

RFETS projects will transport the containers on flat-bed winch trucks to the CSF where the containers will be unloaded. Operations personnel will ensure that the containers comply with the WAC after which the containers will be moved into the facility with a large industrial forklift and stacked four high. The aisle spaces of the facility are laid out so that operations personnel can visually inspect and monitor each container.

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The current assumption is each project will manage any pre-treatment of organics, if required, and the packaging of their waste in containers before acceptance at the CAMU. This assumption may change if a decision is made to repackage waste to comply with specific waste acceptance criteria for an offsite disposal facilities.

One attribute for the location of the CSF is the proximity of the facility to the existing RFETS railroad. A short railroad spur could extend to the CSF where a loading facility could be constructed. The containers could easily be loaded on to rail cars and shipped offsite to a disposal facility in the future. Earlier studies and evaluations have shown rail shipment of remediation waste to be more efficient in cost and time because of the larger volumes which can be shipped. If the waste acceptance criteria for the offsite disposal facility required repackaging, the CSF could modify their procedures to repackage waste in order to meet offsite WAC's.

4.10 QUALITY ASSURANCE

The System Category Levels for this project based on COEM-DES-223 is a Category 3. Category 3 is defined as follows:

Category 3 - Systems not meeting the criteria for Categories 1, or 2. This system is relied upon for worker protection from radiological or toxicological hazards.

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5.0 APPLICABLE CODES, STANDARDS, GUIDELINES, AND SPECIFICATIONS

A preliminary list of applicable codes, standards and guidelines has been generated and has been attached to this Preconceptual Design Narrative as Attachment III. This list will be further modified as part of Title II design.

A list of specifications for key elements of the preconceptual design have been attached to this Preconceptual Design Narrative as Attachment IV. This is a preliminary list of specifications. Changes in plant specifications or as part of the design process will be incorporated into the Title II design documentation.

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6.0 REFERENCES

ASI, 1991, Storm-Runoff Quantity for Various Design Events, Advanced Sciences Inc., January 1991.

DOE, 1996, Final Rocky Flats Cleanup Agreement, July 16.

EG&G, 1992a, Floodplain Delineation, Hydrologic Analysis, prepared by U.S. Army Corps of Engineers, September 1992,

EG&G, 1992b, Rocky Flats Plant Drainage and Flood Control Master Plan, prepared by Wright Water Engineers, April 1992.

EG&G, 1994, RFP Wetlands Mapping and Resource Study, prepared by U.S. Army Corps of Engineers, December 1994.

EG&G, 1995a, Geologic Characterization Report for the Rocky Flats Environmental Technology Site, Volume I of the Sitewide Geoscience Characterization Study, March 1995.

EG&G, 1995b, Hydrogeologic Characterization Report for the Rocky Flats Environmental Technology Site, Volume II of the Sitewide Geoscience Characterization Study, April 1995.

EG&G, 1995c, Groundwater Geochemistry Report for the Rocky Flats Environmental Technology Site, January 1995.

Kirkham, R.M. and W.P. Rogers, 1981, Earthquake Potential in Colorado: A Preliminary Evaluation, Colorado Geological Survey Bulletin 43, 171p.

Schroba, R.R and P.E. Cararra, 1994, Preliminary Surficial Geologic Map of the Rocky Flats Plant and Vicinity, Jefferson and Boulder counties, Colorado, U.S. Geological Survey Open File Report 94-162, U.S. Geological Survey, Denver, Colorado.

Van Horn, R., 1976, Geology of the Golden Quadrangle, U.S. Geological Survey Professional Paper 172.

Attachments to Preconceptual Design Narrative for the Corrective Action Management Unit for Bulk Storage of Remediation Waste

Attachment I -	**Preliminary Design Parameters for CAMU for Containerized Storage**
Attachment II -	**Geotechnical Data**
Attachment III -	**Preliminary List of Applicable Codes, Standards, and Guidelines**
Attachment IV -	**Key Material Specifications and Requirements**
Attachment V -	**Specifications for Roll-Off Containers Used as a Basis of Design**

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Attachment I - Preliminary Design Parameters for CAMU for Containerized Storage

ATTACHMENT I - Preliminary Design Parameters for CAMU for Containerized Storage

Design Item	Component	Performance Standard[1]	Design Guidance[3]	Design Parameter Demonstration[3]	Resultant Design Criteria[4]
1. Layout of CSF CAMU Designation Area	CSF layout and size	Provide for flexible facility expansion within CAMU designation area Provide adequate space for waste storage volumes. Design must support waste generation rates and offsite disposal capabilities.	CAMU Regulations and past practices	This type of facility has been proven in the past. RFETS has several existing storage facilities such as the Centralized Waste Storage Facility. Buildings will constructed as needed. The layout presented in preconceptual design will be reevaluated during Title II design	The four buildings' footprint are approximately 6.8 acres. Each bldg. has 30' central corridor for access in handling the containers. Containers specifications allow stacking up to four high per building. Layout to be reevaluated during Title II Design analysis.
2. Foundations	Site Geology / Engineering Characterization			Geotechnical evaluation will be performed during Title II Design	
	Settlement	Prevent failure of containment system/ foundation from settlement		Geotechnical engineering evaluation during Title II Design	Allowable settlement to be selected during geotechnical evaluation
	Bearing Capacity	Prevent failure of containment system/ foundation from loading		Geotechnical engineering evaluation during Title II Design	Allowable settlement to be selected during geotechnical evaluation
	Seismic Considerations	Prevent failure of containment system/ foundation		Geotechnical engineering evaluation during Title II Design	Criteria to be selected during geotechnical evaluation
	Slope Stability	Prevent foundation failure		Geotechnical engineering evaluation during Title II Design	Criteria to be selected during geotechnical evaluation
	Structural Strength	Foundation must of sufficient strength to support contents and to prevent failure due to physical conditions and the stresses of daily operations (§264.1100)	Concrete foundations demonstrated by past practice	Standard Practice - utilize facility design in used for RCRA TSD facilities and use Industry standards (ACI, ASTM, etc..)	To be selected following analysis during Title II Design.
	Primary Barrier	Must have a primary barrier that is sufficiently durable to withstand the movement of personnel, wastes, and heavy equipment (264.1100)	Concrete foundations have been demonstrated by past practices	Standard Practice - utilize facility design in used for RCRA TSD facilities	Design criteria to be refined during analysis for Title II Design
	Compatibility	Primary barrier must be appropriate for physical and chemical compatibility characteristics of waste		Confirmation of compatibility to be determined during Title II Design phase through vendors	Criteria be selected during Title II Design.

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ATTACHMENT I - Preliminary Design Parameters for CAMU for Containerized Storage

Design Item	Component	Performance Standard[1]	Design Guidance[3]	Design Parameter Demonstration[3]	Resultant Design Criteria[4]
	Containment system	Facility must be design and operated to ensure containment and prevent tracking of materials from unit by personnel or equipment (264.1100)		Use of berms been demonstrated by past practices	To be selected following analysis during Title II Design.
3. Leak Collection System	General	Prevent failure due to clogging	Design system to maintain one percent slope and control clogging.	Standard Practice - utilize facility design in used for RCRA TSD facilities	Criteria be selected during Title II Design.
	Compatibility	Leak Collection System must be appropriate for physical and chemical compatibility characteristics of waste		Confirmation of compatibility to be determined during Title II Design phase through vendors	Criteria be selected during Title II Design.
	Spill Control	The building structure/ containers will be capable of providing a barrier for spills/leaks.	Based on past practices and demonstrated technologies	Floor coatings and containers are commercially available and have demonstrated industrial effectiveness.	To be selected following analysis during Title II Design.
4. Metal Building Shell	General	Structure must be completely contained and self - supporting (§264.1100)	Metal buildings have been demonstrated through past practice	Standard Practice - utilize facility design in used for RCRA TSD facilities	To be selected following analysis during Title II Design.
	General	Designed in a manner that assures protection of human health and environment.	The waste is isolated from the environment by the containers and the building structure.	This type of facility has been proven in the past. RFETS has several existing storage facilities such as the Centralized Waste Storage Facility.	Criteria be selected during Title II Design.
	General	Containment building must be completely enclosed with a floor, walls, and a roof (§264.1101)		These design components are incorporated into metal building design. RFETS has several existing storage facilities such as the Centralized Waste Storage Facility.	Additional criteria are not needed to meet the performance standard.
	Structural Strength	Structure must of sufficient strength to support contents and to prevent failure due to physical conditions and the stresses of daily operations (§264.1100)	Metal buildings have been demonstrated through past practice	Standard Practice - utilize facility design in used for RCRA TSD facilities and use Industry standards (ACI, ASTM, etc..). RFETS has several existing storage facilities such as the Centralized Waste Storage Facility.	To be selected following analysis during Title II Design.

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ATTACHMENT I - Preliminary Design Parameters for CAMU for Containerized Storage

Design Item	Component	Performance Standard[1]	Design Guidance[3]	Design Parameter Demonstration[3]	Resultant Design Criteria[4]
	Dust Control	Has controls sufficient to prevent fugitive dust emissions to meet the visible emission standard. (264.1100)		Potential for dust emission will be analyzed in the design phase	To be selected following analysis during Title II Design.
5. Run-On/ Run-Off	General	Provide control for Run-On/Run-off. Prevent flow into facility during peak discharge of 100-year event		Drainage and water control will be evaluated as part of the Title II Design	Criteria to be evaluated during Title II Design

ACI - American Concrete Institute
ASTM - American Society of Testing Materials
CSF - Containerized Storage Facility
TSD - Treatment and Storage Facility

1. Performance Standard: An objective for design that is based on a regulatory requirement, regulatory guidance, and/or regulatory guidance.
2. Design Guidance: Standard engineering practice reference manuals and design elements that have identified in regulatory guide or have been demonstrated by past practice to meet the performance standards
3. Design Parameter Demonstration: Analysis required to demonstrate that the design criteria will provide conformance with the design guidance and the performance standard.
4. Resultant Design Criteria: Specific elements of design that have shown by supporting analytical demonstration to meet related performance standard.

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Attachment II - Geotechnical Data

ATTACHMENT II

SUMMARY OF EXISTING GEOTECHNICAL DATA

Boring Number	Depth (ft)	Soil Class. (USCS)	SPT Blow Count[1]	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Unconfined Compressive (psf)	Dry Density (pcf)	California Bearing Ratio (%)
E1-1	5	SP-SM	33							
"	10	GC	60/6							
E1-2	5	GC	3							
"	10	GC	12							
E1-3	5	GC	50/7							
"	10	GC	50/9							
E1-4	5	SC	50/6							
"	10	SC	50/11							
E2-6	2.5	SM		12.7						
"	4	CL	34	13.8	55	30	21			
"	8.5	GW-SW	50/0							
E2-7	4	CL	34							
"	9	CL	32	8.9						

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Boring Number	Depth (ft)	Soil Class. (USCS)	SPT Blow Count[1]	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Unconfined Compressive (psf)	Dry Density (pcf)	California Bearing Ratio (%)
E2-8	4	CL/CH	32							
J2-1	4	GM-SM	21	7.1						
"	7	GM-SM	23/6	11.4						
"	14	GM-SM	36/6	6.3						
J2-2	4	GM-SM	30/6							
"	7	GM-SM	42/6							
"	14	GM-SM	32.2					6600	113	
J2-3	4	GM-SM						4480	112	
"	5	"	28							
"	7	"	60/9							
"	14	"	32/6							
J2-5	5	GM-SM	50/6							
"	10	"	33/6							
"	14	"	35/6	14.9	38.9	18.4	20.5	4890	113	
L1-10	9	GC	55/9	9					111	
"	19	CL-CH	40	19.9					105	

Boring Number	Depth (ft)	Soil Class. (USCS)	SPT Blow Count[1]	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Unconfined Compressive (psf)	Dry Density (pcf)	California Bearing Ratio (%)
L1-P1	2	GC	38							22.5
"	5	"	50/4							
L1-P2	2	GC	51							
"	5	"	30/0							
L1-P3	2	GC	36							
"	4	"	50							
L1-P4	2	GC	24							
"	4	"	64							
L1-P5	2	GC	16							
"	4	"	22							
L1-P7	2	GC	56							
"	4	"	42							
L1-P8	2	GC	16							
"	4	"	54							
L1-P9	2	GC	16							
"	4	"	25							

Boring Number	Depth (ft)	Soil Class. (USCS)	SPT Blow Count[1]	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Unconfined Compressive (psf)	Dry Density (pcf)	California Bearing Ratio (%)
L1-P10	2	GC	36	11.4						
"	4	"	23							
N-4	5	SC		13	37.9		24.4			
U1-2	4	GC	30	16.8	52	28	24		111.9	
"	9	GC	28	9.0						
"	14	GC	47	14.0						
U1-3	4	GC	26	17.0					114.3	
"	9	GC	31	8.9						
U1-4	3	GC								28.7
"										

1. Standard Penetration Test - Number of Blows/Inches of Displacement (12 if not listed)

SUMMARY OF EXISTING SWELL-CONSOLIDATION TEST DATA

Borehole No.	Depth (ft)	Confining Pressure (psf)	Swell (%)	Final Pressure (psf)	Consolidation (%)
J2-5	13.5	1000	0.5	8000	1.7
U1-2	4	100	6.0	3000	0.3
U1-3	4	100	0	6000	3.6
L1-10	19	500	0.2	10,000	3.7

RECOMMENDED BEARING CAPACITY

Geotechnical Investigation	Maximum Bearing Capacity (psf)
J2	4500
L1	4000
U1	5000

Sources:

E1. Aguirre Engineers, Inc., Subsurface Investigation and Engineering Analysis Report, Electrical Systems Upgrade, Phase I, July 26, 1988.

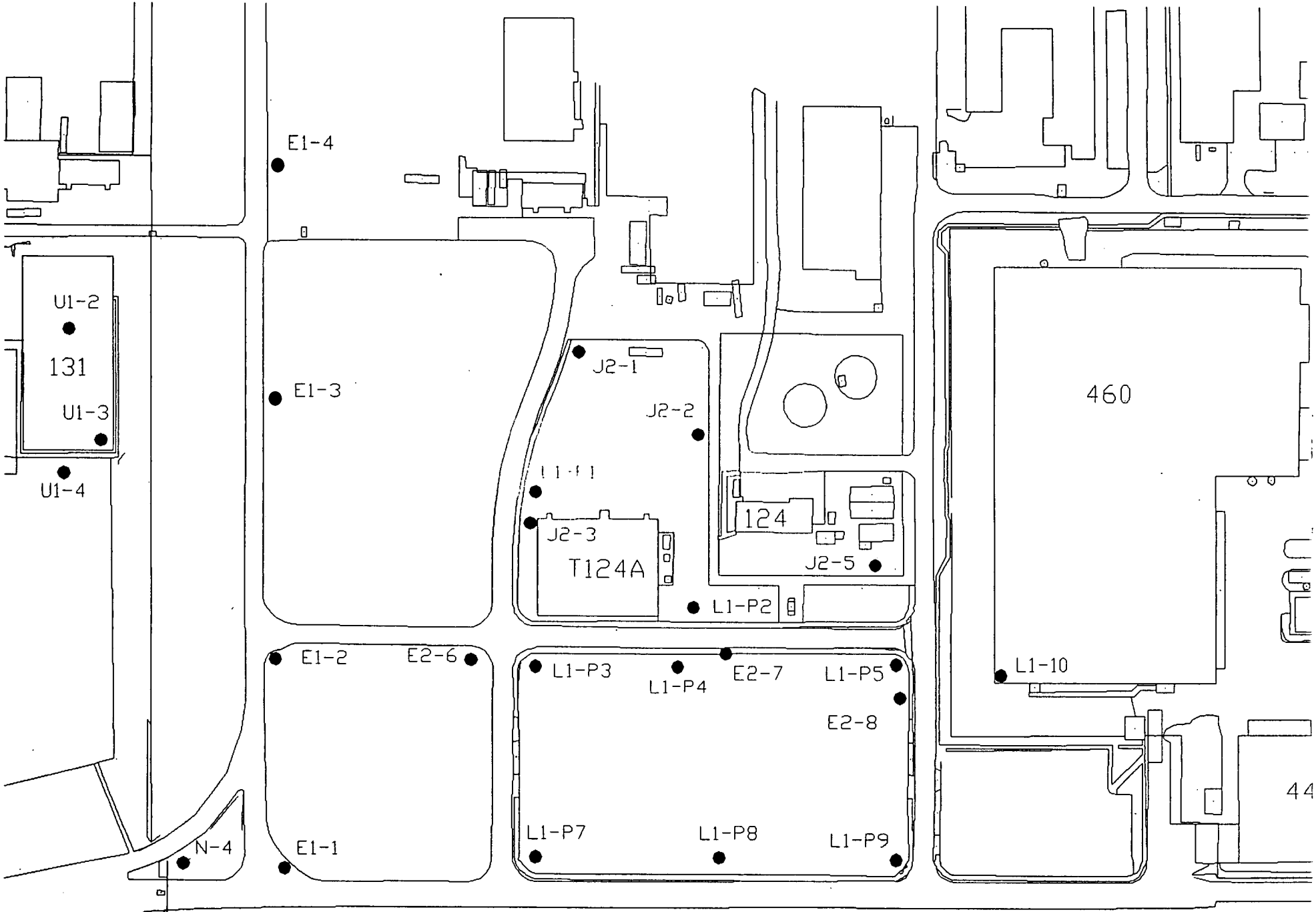
E2. Aguirre Engineers, Inc., Subsurface Investigation and Engineering Analysis Report, Electrical Systems Upgrade, Phase II, December 19, 1988.

J2. Empire Laboratories, Inc., Soils and Foundation Investigation, Backwash Storage Tanks, Building 124, January 1974.

L1. Chen and Associates, Soil and Foundation Investigation , Proposed New Consolidated Nonnuclear Manufacturing Building, November 17, 1982.

N. Woodward Clyde and Associates, Soil and Foundation Investigation for Proposed Parking Lot Construction and Changing Road Curvature at Intersection on Entrance Road, April 1, 1965.

U1. Foundation Engineering Company, Subsurface Investigation and Engineering Analysis Report, Proposed Building 131, July 23, 1986.


E1-4
U1-2
131
U1-3
U1-4
E1-3
J2-1
J2-2
460
124
J2-3
T124A
J2-5
L1-P2
E1-2
E2-6
L1-P3
L1-P4
E2-7
L1-P5
E2-8
L1-10
44
N-4
E1-1
L1-P7
L1-P8
L1-P9

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Attachment III -
Preliminary List of Applicable Codes, Standards, and Guidelines

ATTACHMENT III

PRELIMINARY LIST OF APPLICABLE CODES, STANDARDS, AND GUIDELINES

The most current revision or controlled copies of the following codes, standards and guidelines apply to the design of this project.

General

1. **Department of Energy (DOE) Order 6430.1A, United States Department of Energy, General Design Criteria.**

2. **DOE Order 5820.2A, Radioactive Waste Management, Chapter III, Management of Low Level Waste.**

3. **DOE Order 4700.1A, Department of Energy Project Management System.**

4. **RFETS Conduct of Engineering Manuals, Volumes 1, 2, 3, 4 and 5.**

5. **RFETS Configuration Change Control Program Manual.**

6. **RFETS Standards, Volumes I, II, III, IV, V and VI.**

7. **RFETS Health and Safety Practices Manual.**

8. **RFETS Radiological Control Manual**

9. **DOE Environmental Protection, Safety and Health Protection Standards, DOE Order 5480.4.**

10. **ASTM Standards as applicable**

Civil

1. **Manual on Foundation Investigations, American Association of State Highway and Transportation Officials.**

2. **Subsurface Investigation for Design and Construction of Foundations of Buildings, American Society of Civil Engineers.**

3. **American Society of Civil Engineers - Manual No. 37, "Design and Construction of Sanitary and Storm Sewers."**

4. **American Water Works Association - "Standards."**

5. American Association of State Highway and Transportation Officials - "Geometrics Design and Highway Standards."

6. Colorado State Highway Department - "Standard Specifications for Road and Bridge Construction."

7. Jefferson County, Storm Drainage Design and Technical Criteria.

8. Colorado Division of Water Resources, Revised and Amended Rules and Regulations for Water Well Construction and Pump Installation, 1988.

9. American Association of State Highway and Transportation Officials - "Policy on Design of Urban Highway and Arterial Streets."

10. Asphalt Institute - "Asphalt Paving Manual," "Thickness Design Manual," "Soils Manual for Design of Asphalt Pavement Structures."

11. RFETS Standard SC-0102 - Security Fencing

12. RFETS Standard SC-0109 - Storm Sewer Design Criteria

13. RFETS Standard SF-0100, Fire Protection

14. Denver Regional Council of Governments, Urban Storm Drainage Criteria Manual.

Environmental

1. Colorado Department of Public Health and Environment, Colorado Hazardous Waste Regulations, Code of Colorado Regulations, 6 CCR 1007-3

2. Colorado Department of Public Health and Environment - Air Pollution Control Division, Colorado Air Pollution Control Regulations, Code of Colorado Regulations, Title 5, Chapter 1001, Regulations #1, 2, 3, 8).

3. Colorado Department of Public Health and Environment - Air Pollution Control Division, Colorado Ambient Air Quality Standards and New Source Performance Standards (Colorado Code of Regulations, Volume 5, Parts 14, 8).

4. Colorado Department of Public Health and Environment - Water Quality Control Division, Colorado Water Quality Control Regulations and Discharge Permit System Regulations, (Code of Colorado Regulations, Title 5, Chapter 1002, Articles 2, 3, 6).

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5. Colorado Department of Public Health and Environment - Water Quality Control Division, Colorado Water Quality Standards, Groundwater Standards (Code of Colorado Regulations, Title 5, Chapter 1002, Article 8).

6. U.S. Environmental Protection Agency/Colorado Department of Health - Water Quality Control Division, Stormwater Discharge Regulations (40 CFR 122.26).

7. U.S. Department of Energy, National Environmental Policy Act Compliance, National Environmental Policy Act, 40 CFR Parts 1500 - 1508 (CEQ regulations to implement NEPA); DOE 5440.1C; 10 CFR 1021 (incorporates requirements for compliance with Endangered Species Act, Fish and Wildlife Coordination Act, National Historic Preservation Act).

8. RFETS Standard FO.5 - Handling of Purge and Development Water.

9. RFETS Standard FO.7 - Handling of Decontamination Water and Wash Water.

10. RFETS Standard FO.8 - Handling of Drilling Fluids and Cuttings.

11. RFETS Standard FO.13 - Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples.

12. RFETS Standard GW.1 - Water Level Measurements in Wells and Piezometers.

13. RFETS Standard GW.2 - Well Development.

14. RFETS Standard GW.5 - Field Measurement of Groundwater Field Parameters.

15. RFETS Standard GW.6 - Groundwater Sampling.

16. RFETS Standard GT.1 - Logging Alluvial and Bedrock Material.

17. RFETS Standard GT.2 - Drilling and Sampling Using Hollow Stem Auger Techniques.

18. RFETS Standard GT.6 - Monitoring Wells and Piezometer Installation.

<u>Architectural</u>

1. NFPA-101 Life Safety Code, and NFPA Life Safety Code Handbook.

2. RFETS Standard SC-0100, Hollow Metal Doors and Frame

3. RFETS Standard, Builders Hardware

4. RFETS Standard, SC-0104, Standard for Glass and Glazing

Structural

1. AISI Specification for the Design of Cold-Formed Steel Structural Members.

2. AISC Steel Construction Manual, American Institute of Steel Construction,

3. ASCE 7, Minimum Design Loads for Buildings and Other Structures.

4. AWS D1.1, Structural Welding Code-Steel, American Welding Society.

5. RFETS Standard SC-0106, Equipment Seismic Qualification

6. SEAC, "1984 Structural Survey of Colorado Building Department and 1971 Snow Load Design Data for Colorado." (1984 Reprint), Structural Engineers Association of Colorado, December 1984.

7. DOE-STD-1021, "Natural Phenomena Hazards Performance Categorization Criteria for Structures, Systems, and Components"

8. DOE-STD-1020, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities".

9. ACI 318, Building Code Requirements for Reinforced Concrete, American Concrete Institute

10. Uniform Building Code (UBC), International Conference of Building Officials (ICBO).

Mechanical/Process

1. Uniform Plumbing Code, published by the International Association of Plumbing and Mechanical Officials (IAPMO).

2. Uniform Mechanical Code, published by the International Association of Plumbing and Mechanical Officials (IAPMO) and the International Conference of Building Officials (ICBO).

3. Energy Conservation in New Buildings, ASHRAE Standard 90, administered by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

4. Ventilation for Acceptable Indoor Air Quality, ASHRAE Standard 62, administered by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

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6. RFETS Standard SMU-0100, Safety Showers

7. RFETS Standard SMU-0101, Safety Eye/Face Washes

8. RFETS Standard SMU-0302, Ventilation Design

9. RFETS Standard SMU-0303, Heating, Ventilation and Air Conditioning Standard

10. RFETS Standard SMU-0304, Standard for Fans

Electrical

1. MIL-HDBK- 1004/4, Electric Utilization Systems

2. NFPA 780, Lightning Protection Code

3. NFPA 70, National Electric Code (NEC)

4. NFPA 101, Life Safety Code.

5. ANSI/IEEE 142, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.

6. ANSI/IEEE 241, IEEE Recommended Practice for Electric Power Systems in Commercial Buildings.

7. ANSI/IEEE 242, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.

8. ASHRAE 90A, Energy Conservation in New Building Design

9. RFETS Standard SAM-0103, Instrumentation & Alarms

10. RFETS Standard SAM-0104, Level Sensors

11. RFETS Standard SC-0107, Sealing Building Penetrations & Electrical Conduit

12. RFETS Standard SE-0103, Standard for Electrical Wiring

13. RFETS Standard SE-0105, Motor Control 3 Wire P/B Standards

14. RFETS Standard SE-0107, Quality Control of Molded Case Breakers

15. **RFETS Standard SE-0112, Building Electrical Raceway Systems**

16. **RFETS Standard SE-0205, Emergency Exit Signs**

17. **RFETS Standard SE-0301, Emergency Lighting Equipment**

18. **RFETS Standard SE-0401, Audible Warning Devices for Life Safety/Disaster Warning System**

19. **RFETS Standard SE-0550, Telephone Conduit and Equipment Installation,**

20. **RFETS Standard SE-0701, Alarm System Cables**

21. **RFETS Standard SX-0164, Plant System and Component Identification System and Labelling**

22. **UL 96, Lightning Protection Components.**

23. **UL 96A, Lightning Protection Installation Practices.**

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Attachment IV - Key Material Specifications and Requirements

This list of standards and requirements are provided to give enough information to designate the CAMU. Modifications might be necessary to address issues as part of the more detailed Title II Design. These specifications are RFETS standards.

SPEC # SPEC TITLE

DIVISION 1 - GENERAL REQUIREMENTS

01100 Special Contract Requirements
01300 Submittals
01400 Quality Assurance/Quality Control
01500 Temporary Facilities, Controls and Special Project Requirements
01610 Material Handling and Waste Disposal
01700 Subcontractor Safety

DIVISION 2 - SITEWORK

02070 Installing, Plugging, and Abandoning Monitoring Wells
02110 Site Clearing
02200 Earthwork, Grading and Excavation
02220 Trenching, Back-filling & Compaction for Pipelines
02221 Excavation for Pavement
02231 Aggregate Base Course
02380 Caissons
02510 Asphaltic Concrete Paving
02520 Portland Cement Concrete Paving
02660 Water Mains
02687 Site Gas Lines
02720 Site Storm Sewer Systems
02781 Site Grounding
02800 Signage
02830 Chain-Link Fencing
02900 Topsoil and Revegetation
02930 Erosion Control Measures
02936 Rip Rap

DIVISION 3 - CONCRETE

03100 Concrete Formwork
03200 Concrete Reinforcement
03300 Cast-in-Place Concrete
03346 Concrete Floor Finishing
03370 Concrete Curing
03600 Grout

DIVISION 4 - MASONRY

Not Used

DIVISION 5 - METALS
05500 Metal Fabrications
05520 Handrails and Railings

DIVISION 6 - WOOD AND PLASTICS
06200 Finish Carpentry

DIVISION 7 - THERMAL AND MOISTURE PROTECTION
07190 Vapor Retarders
07212 Rigid Insulation
07900 Joint Sealers

DIVISION 8 - DOORS AND WINDOWS
08111 Standard Steel Doors
08112 Standard Steel Frames
08331 Overhead Coiling Doors
08360 Sectional Overhead Doors
08710 Door Hardware

DIVISION 9 - FINISHES
09705 Epoxy Seamless Liner and Floor Finish
09900 Painting

DIVISION 10 - SPECIALTIES
10440 Interior and Exterior Signage/Graphics
10522 Fire Extinguishers and Accessories

DIVISION 11 - EQUIPMENT
11140 Miscellaneous Equipment
11500 Emergency Eyewash Station

DIVISION 12 - FURNISHINGS
Not Used

DIVISION 13 - SPECIAL CONSTRUCTION
13121 Pre-Engineered Buildings

DIVISION 15 - MECHANICAL
15050 Basic Mechanical Materials and Methods
15100 Valves
15135 Meters and Gages
15145 Hangers and Supports

15170 Motors
15240 Vibration Isolation
15250 Mechanical Insulation
15410 Plumbing Piping
15430 Plumbing Specialties
15451 Diaphragm Pumps
15452 Vertical Sump Pumps
15453 Horizontal End Suction Pumps
15454 Regenerative Turbine Pumps
15488 Propane Gas Piping Systems
15575 Metal Vents
15620 Fuel Fired Heaters
15782 Packaged Air Terminal Units
15852 Axial Fans
15870 Power Ventilators
15891 Metal Ductwork
15910 Duct Accessories
15932 Air Outlets and Inlets
15971 Electric Control Systems
15990 Testing, Adjusting and Balancing

DIVISION 16 - ELECTRICAL

16010 Electrical Basic Requirements
16050 Basic Electrical Methods and Materials
16111 Conduit
16121 Medium Voltage Cable
16123 Building Wire and Cable
16130 Boxes
16140 Wiring Devices
16160 Cabinets and Enclosures
16170 Grounding and Bonding
16190 Supporting Devices
16195 Electrical Identification
16311 Unit Substation
16365 Medium Voltage Switch and Fuses
16370 Overhead Power Distribution
16426 Distribution Switchboards
16441 Enclosed Switches
16461 Dry-Type Transformers
16470 Panelboards
16481 Enclosed Motor Controllers
16482 Motor Control Center
16496 Enclosed Isolation Bypass, Automatic Transfer Switch

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16510	**Interior Luminaries**
16530	**Site Lighting**
16641	**Cathodic Protection**
16670	**Lightning Protection System**
16741	**Telephone System, Pathways and Wiring**
16770	**Life Safety and Disaster Warning System**
16902	**Electric Controls and Relays**

Attachment V - Specifications for Roll-Off Containers Used as a Design Basis

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McClain of OKLAHOMA
4000 S.W. 113th
Oklahoma City, OK 73173
(405) 691-6311 • Fax (405) 691-4441
McClain E-Z Pack EPCO

ADDITIONAL INTERMODAL INFORMATION

- General Standards and Approvals
  The containers shall meet the requirements of the Association of American Railroads M-930-88 and be fitted with an approval plate. In addition, the containers are Container Safety Convention (CSC) approved.

Welding Specifications . . .

- Bulkhead..Bulkhead area is welded 100% inside and out. Vertical tubes skip welded; Placard plate angles skip welded. Micro Seal applied to areas along vertical tubes and angles.

- Rear Door..Rear door pan is one piece, no welding required on interior or exterior. Corner gussets on exterior of door are welded 100%; Placard angles skip welded; Horizontal tubes skip welded; Vertical tubes' skip welded. Micro Seal applied to areas along vertical and horizontal tubing, and placard angles.

- Hinge..Top hinge assembly welded 100%

- Roof..(Roof Panels) Exterior welded 100%

- Walls..(Side Walls) Top rail insert welded 100%; Ratchet plates welded 100%; All vertical wall tubes are skip welded, micro seal applied.

- Floor..Two piece (Rectangular Style), 100% welded, interior.
  Floor..One piece (Bathtub Style)

- Skid..(Understructure) Vertical crossmembers skip welded to underside of floor pan.

- Fork Tubes..Fork tubes (formed 1/4" plate) skip welded to floor pan. Fully welded to outside perimeter of floor pan.

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Oklahoma City, OK 73173
(405) 691-6311 • Fax (405) 691-4441
McClain E-Z Pack EPCO

ADDITIONAL INTERMODAL INFORMATION
continued . . .

Surface Preparation and Painting . . .

After each container is manufactured, it is water tested, before any further steps are taken. Once the container passes this inspection it goes to cleanup. Before containers are primed and painted, each container is cleaned. Our shop uses air and electric sanders along with grinders on all rough areas such as weld slag, etc. Each container is wiped down with an environmentally safe neutralizing wash, before primer is applied. We use a red oxide primer for a base coat, with an industrial grade enamel for the finish coat. Note: Underside of containers are primed only.

Stenciling . . .

- McClain to stencil information required on all "CSC" containers. (If applicable)
- McClain to furnish M-930 American Association of Railroads plate.
- Unit price(s) quoted include stenciling, using spray paint. Additional charge if 2 mil vinyl graphics are required.

Warranty . . .

Structure...	1 year (Material and workmanship)
Paint System...	Under normal Exterior environment this coating system can be expected to last 3-5 years.
Markings...	(Optional) ... Hi-performance 2 mil vinyl graphic will last 5-7 years.

Additional Information . . .

All material purchased is prime hot roll material meeting A36 / C1018 chemistry. We buy our material in coil form directly from the mill and level as needed. This eliminates any sheet goods being stored outside, which allows rusting to occur.

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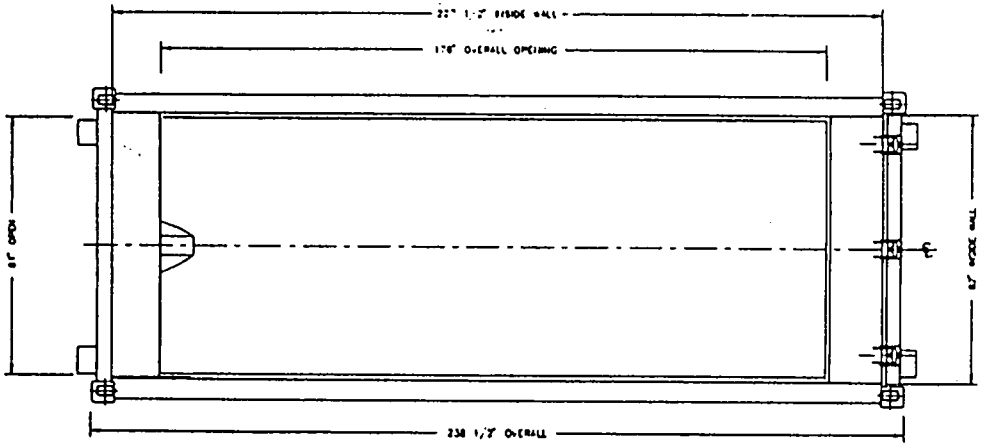

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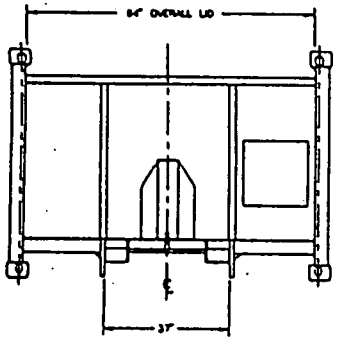
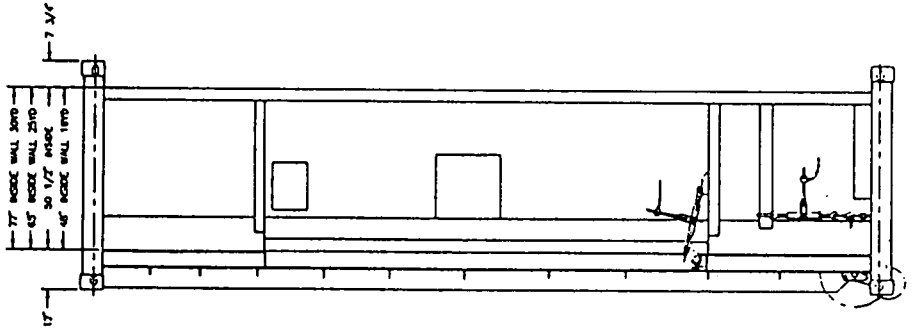
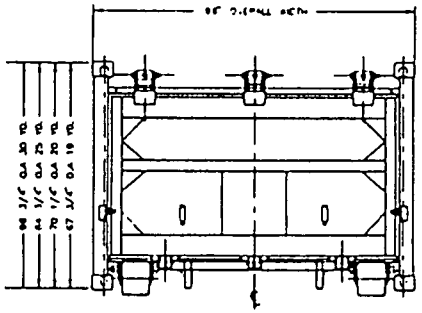


FRONT VIEW
BULKHEAD



INTERMODAL CONTAINER
LEFT SIDE VIEW



END VIEW
DOOR

McCLAIN OF OKLAHOMA

INTERMODAL

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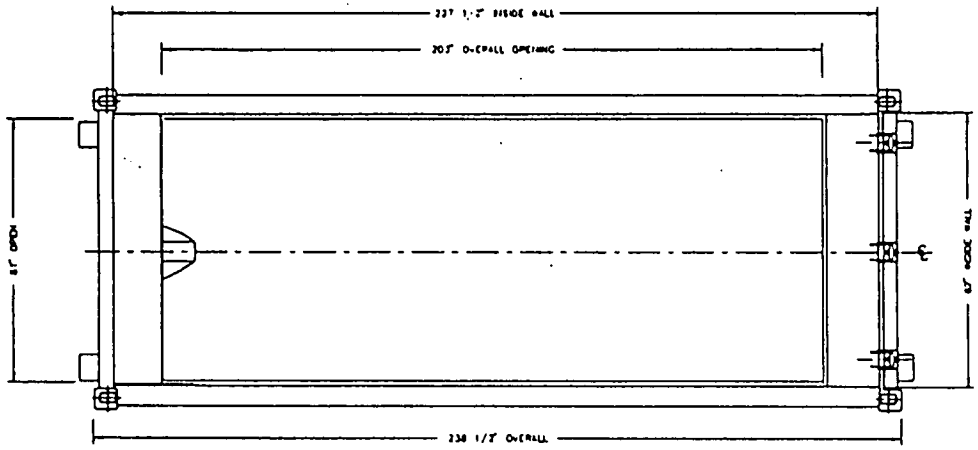

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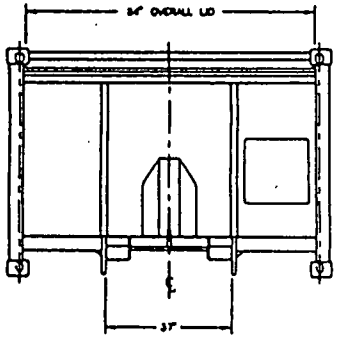
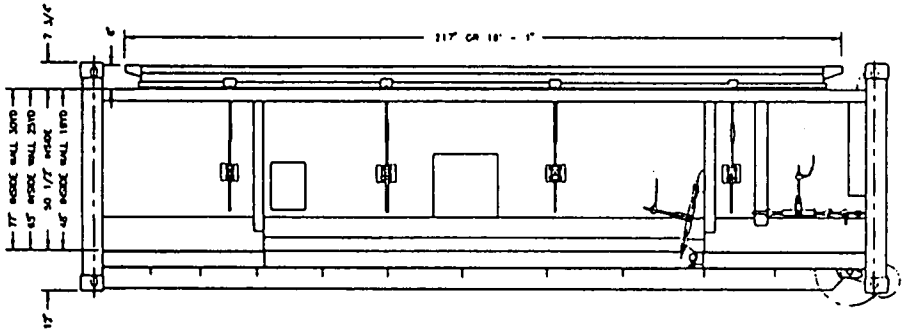
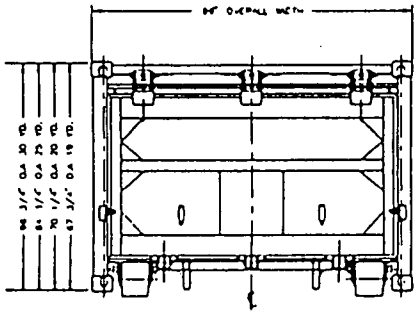


FRONT VIEW
BULKHEAD



INTERMODAL CONTAINER
LEFT SIDE VIEW



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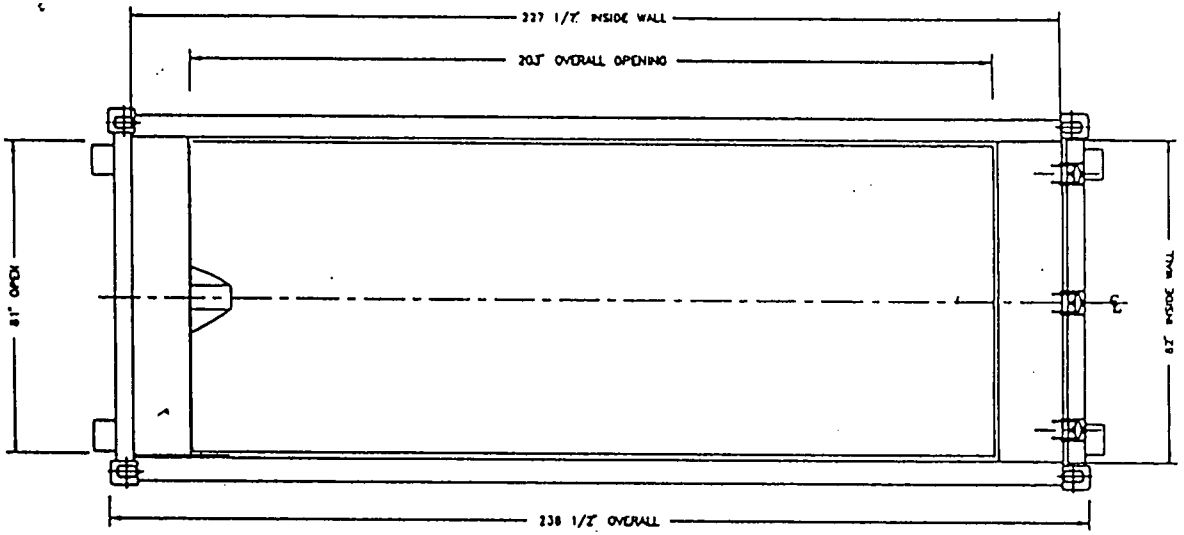
SALES



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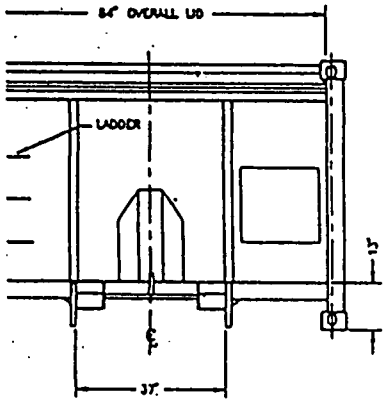

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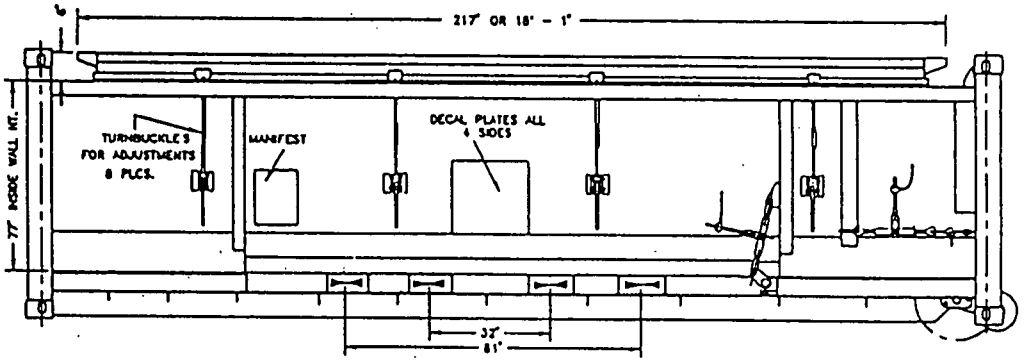
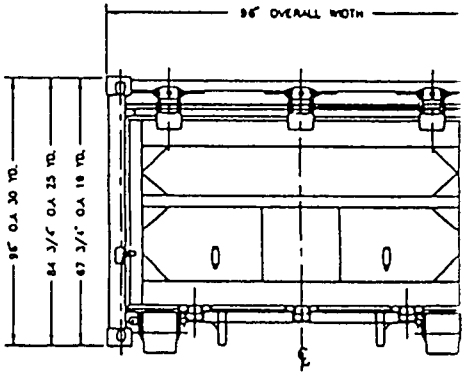


INTERMODAL CONTAINER
LEFT SIDE VIEW



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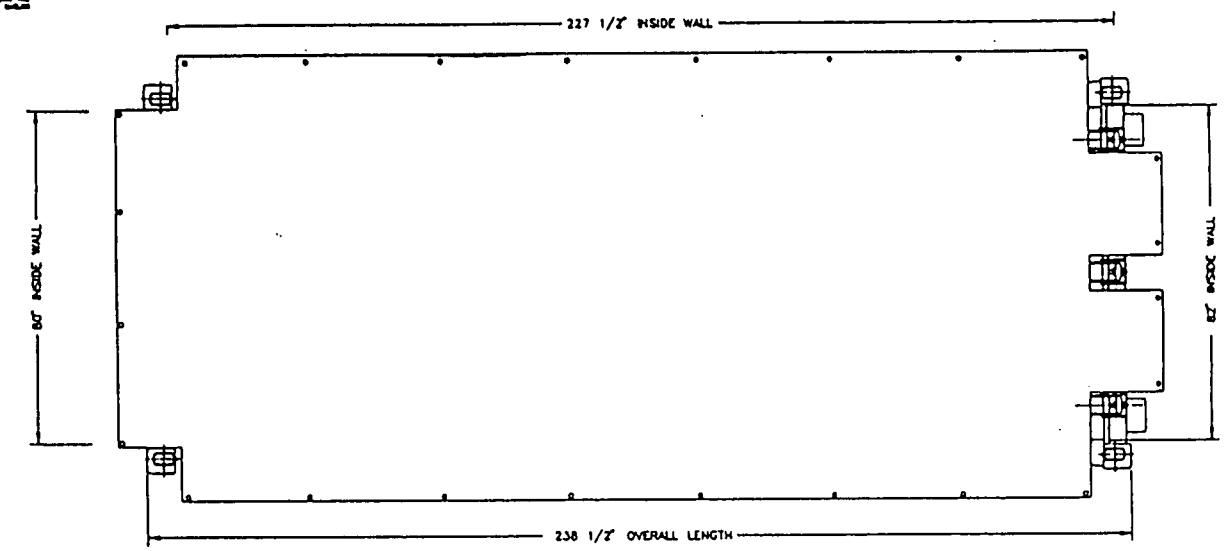

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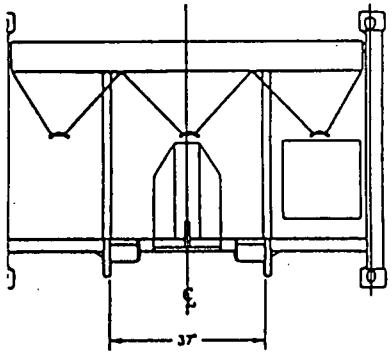

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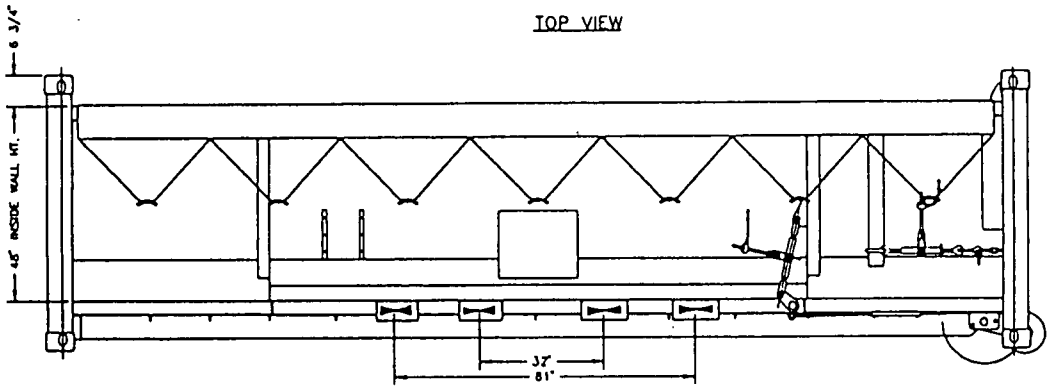
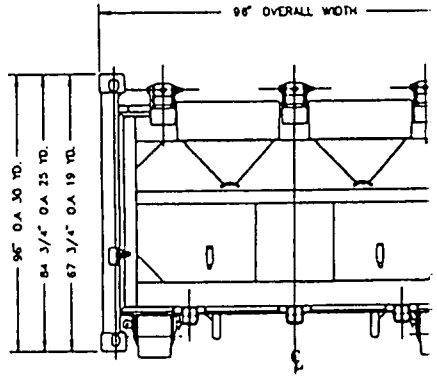


INTERMODAL CONTAINER
LEFT SIDE VIEW



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McClain of OKLAHOMA
4000 S.W. 113th
Oklahoma City, OK 73173
(405) 691-6311 • Fax (405) 691-4441
McClain E-Z Pack EPCO

November 29, 1995

SPECIFICATION SHEET

"BATHTUB STYLE INTERMODAL ROLL-OFF SLUDGE CONTAINER"

INSIDE DIMENSIONS: **19 YARD:** 48" T x 82" W x 227" L **20 YARD:** 52" T x 82" W x 227" L
25 YARD: 65" T x 82" W x 227" L **30 YARD:** 77½" T x 82" W x 227" L
35 YARD: 89" T x 82" W x 227" L

SIDE WALLS:
- (1) piece - 10 Ga. SIDE WALL W/FORMED TOP RAIL
- WALL FORMS AN INTERIOR BAFFLE (FULL LENGTH)
- (2) VERTICAL SIDE WALL TUBES (PER SIDE)
- (2) RATCHET MOUNTS - 4 X 2 X 3/16 STRUCTURAL TUBE
- 10 Ga. ROOF PANELS (FRONT/REAR)
- ALUMINUM MANIFEST BOX (WATER TIGHT)

CORNER POST:
- 6 X 4 X 3/8 TUBE W/ISO CORNER CASTING W/CORNER STIFFENER

REAR DOOR:
- (1) piece - 10 Ga. FORMED DOOR PAN
- (1) HORIZONTAL (2) VERTICAL - 4 X 2 X 3/16 TUBE
- (2) HORIZONTAL - 4 X 4 X ¼ STRUCTURAL TUBE
- TOP HINGED REAR DOOR "8" POINT CLOSURE SYSTEM
- (3) ADJUSTABLE TOP HINGES W/ PIN-UP FEATURE
- (3) ADJUSTABLE GRAB HANDS (SAFETY RELEASE) / RATCHET LOCATED APPROX 5' FROM REAR CORNER POST
- (2) RATCHET ADJUSTMENT LATCHES
- RATCHETS ARE RATED @ 40,000# to 46,000# MINIMUM
- DOOR SEAL: 1 X 2 CLOSED CELL GASKET (SKINNED)
- GASKET LOCATED IN CONTAINER vs REAR DOOR

BULKHEAD:
- (1) piece 10 Ga. BULKHEAD / (2) 4 X 2 X 3/16 VERTICAL TUBES

FLOOR:
- (1) piece - 7 Ga. FORMED FLOOR PAN
- CROSSMEMBERS - 3" STRUCTURAL CHANNEL ON 16" CENTERS
- RAILS ARE (1) piece - 6 X 2 X ¼ TUBE
- SOLID BULL NOSE - 1¼" A36 PLT - SLID INTO RAILS (FULLY WELDED)
- ROLLERS ARE 4" dia X 6½" lg - W/GREASE ZERKS
- 1/4" GUSSETS ON EVERY CROSSMEMBER
- HOOK - 1¼" A570 PLT - INSERTED AND FULLY WELDED TO BASE

WHEELS:
- REAR PIN-UP WHEELS (FOR EASE IN LOADING & UNLOADING)
- 8" OD X 7¼" WIDE - AXLE - 1 7/8" CR ROUND
- WHEELS EQUIPPED W/ 1" dia., X 12" long PIN

INTERIOR:
- HYDRO TESTED FOR LEAKS

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*Containers built and tested to meet AAR specification M-930.
**Note: Open Top & Containers W/Fiberglass Lids Available W/2" Taper

McClain of OKLAHOMA
4000 S.W. 113th
Oklahoma City, OK 73173
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McClain E-Z Pack EPCO

November 29, 1995

SPECIFICATION SHEET

"BATHTUB STYLE INTERMODAL ROLL-OFF SLUDGE CONTAINER" WITH FORK TUBES

INSIDE DIMENSIONS: **19 YARD:** 48" T x 82" W x 227" L **20 YARD:** 52" T x 82" W x 227" L
25 YARD: 65" T x 82" W x 227" L **30 YARD:** 77½" T x 82" W x 227" L
35 YARD: 89" T x 82" W x 227" L

SIDE WALLS:
- (1) piece - 10 Ga. SIDE WALL W/FORMED TOP RAIL
- WALL FORMS AN INTERIOR BAFFLE (FULL LENGTH)
- (2) VERTICAL SIDE WALL TUBES (PER SIDE)
- (2) RATCHET MOUNTS - 4 X 2 X 3/16 STRUCTURAL TUBE
- 10 Ga. ROOF PANELS (FRONT/REAR)
- ALUMINUM MANIFEST BOX (WATER TIGHT)

CORNER POST:
- 6 X 4 X 3/8 TUBE W/ISO CORNER CASTING W/CORNER STIFFENER

REAR DOOR:
- (1) piece - 10 Ga. FORMED DOOR PAN
- (1) HORIZONTAL (2) VERTICAL - 4 X 2 X 3/16 TUBE
- (2) HORIZONTAL - 4 X 4 X ¼ STRUCTURAL TUBE
- TOP HINGED REAR DOOR "8" POINT CLOSURE SYSTEM
- (3) ADJUSTABLE TOP HINGES W/ PIN-UP FEATURE
- (3) ADJUSTABLE GRAB HANDS (SAFETY RELEASE) / RATCHET LOCATED APPROX 5' FROM REAR CORNER POST
- (2) RATCHET ADJUSTMENT LATCHES
- RATCHETS ARE RATED @ 40,000# to 46,000# MINIMUM
- DOOR SEAL: 1 X 2 CLOSED CELL GASKET (SKINNED)
- GASKET LOCATED IN CONTAINER vs REAR DOOR

BULKHEAD:
- (1) piece 10 Ga. BULKHEAD / (2) 4 X 2 X 3/16 VERTICAL TUBES

FLOOR:
- (1) piece - 7 Ga. FORMED FLOOR PAN
- CROSSMEMBERS - 5" STRUCTURAL CHANNEL ON 16" CENTERS
- FORK TUBES (4) 14" L X 5" T
- RAILS ARE (1) piece - 6 X 2 X ¼ TUBE
- SOLID BULL NOSE - 1¼" A36 PLT - SLID INTO RAILS (FULLY WELDED)
- ROLLERS ARE 4" dia X 6½" lg - W/GREASE ZERKS
- 1/4" GUSSETS ON EVERY CROSSMEMBER
- HOOK - 1¼" A570 PLT - INSERTED AND FULLY WELDED TO BASE

WHEELS:
- PIN-UP WHEELS (FOR EASE IN LOADING & UNLOADING)
- 8" OD X 7¼" WIDE - AXLE - 1 7/8" CR ROUND
- WHEELS EQUIPPED W/ 1" dia., X 12" long PIN

INTERIOR:
- HYDRO TESTED FOR LEAKS

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*Containers built and tested to meet AAR specification M-930.

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■ LID DESCRIPTIONS FOR INTERMODAL CONTAINERS ■

OVER-UNDER LID ASSEMBLY:

- (2) 7' X 7'7" Fill doors.
- 12 Ga., HR Sheet with 4 X 2 X 3/16 tube welded the full perimeter.
- (3) Ratchets per side - each rated @ 7,750# minimum.
- (6) 4" Rollers w/ grease zerk axles per "OVER LID" and (4) rollers per "UNDER LID".
- (10) Springs to assist in lifting action.
- Lids sealed with 1" X 1" gasket (skinned)
- Lids seal by means of compression.
- This cover is designed to allow lids to be located either at Rear Door End or Bulkhead End. Allowing a 7' X 7'7" fill area at both ends, therefore the container can be filled completely.

ROLL-TOP LID ASSEMBLY:

- (2) 4'5" X 7' Fill Doors.
- 12 Ga., HR Sheet with 4 X 2 X 3/16 tube welded the full perimeter.
- Each lid has (4) ratchets; (4) lid support roller assemblies; (4) interior rollers; (4) springs to assist in lifting action.
- Each lid is sealed with 1" X 2" closed cell (skinned) gasket.
- Lids seal by means of knife edge.
- This cover is designed so that one (1) lid rolls to bulkhead end and one (1) lid will roll to rear door end, therefore allowing access to the center of the container.

SPRING ASSISTED LID ASSEMBLY:

- (2) Fill doors (2) 5' X 7' doors.
- 10 Ga., W/4" Structural channel the full perimeter.
- (4) Lid assist springs per door.
- (2) Positive door latch assemblies per fill door.
- Sealed w/ 1" X 2" gasket (skinned). • Lids seal by means of knife edge.

"ALUMINUM" ROLL-OVER LID:

- (1) 7' X 18'1 1/2" Fill door.
- Lid panel fabricated from .032 Aluminum sheet. Aluminum extrusion welded the full perimeter; (8) Aluminum roof bows (extrusions) running across the width.
- Lid panel has (2) crossbraces running diagonally the full length for added strength, plus corner gussets.
- (2) Grab handles per side.
- (4) Quick release over-center lid latches per side.
- (4) 3" Rollers made of hard rubber w/an internal bearing; (4) 1 1/2" bearings to assist in rolling of lid.
- (4) Springs to assist in lifting action.
- Lids sealed with 1" X 2" gasket (skinned)
- This cover is designed to allow quick and easy operation. The "Roll-Over" lid can be rolled to the passenger or driver side, allowing access to an opening measuring 6'9" x 16'11".
- Approximate weight of "Aluminum" "Roll-Over" lid - 250#

Note:

- For further information on the fiberglass lids and tarps, please call.

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SPECIFICATION SHEET

EFFECTIVE
OCTOBER 1, 1994

"TARP ASSEMBLY"
Intermodal Container

SPECIFICATIONS:

TARP:
- 18 ounce - Coated Nylon [20-ounce available upon reqest]
- Weatherproof Nylon Based Fabric
- Bursting Strength: 20 lbs per square inch
- Temperature Ratings: -55 deg F / 180 - 190 deg F
- Approximate Weight - 35#
- Color: Customer To Determine - Overall Size: 118" W x 225" L
- (3) Cut-Outs On Door End
- Mounted (Bolted) On Bulkhead End W/2" Steel Strip x 85" long

[HARDWARE]

RATCHETS:
- Qty (3) / 2" Wide / Rated @ 12,000# Capacity
- Location: Rear Door

STRAPS:
- Qty (3) / 2" Nylon Webbing / (With Loop (1) End)
- Location: Rear Door

CROSSBOWS:
- Zinc Chromate Round Tube (1.09" O.D. x 14 Ga.,Wall)
- Formed with a 3" Rise
- Bow Ends . . . 3/4" Hot Roll Round Bar
- Crossbow Sleeves . . . 3/4" O.D. Round Tube

CRANK HANDLE:
- Qty (1) - Located Rear Door End
- Note: Crank Handle To Have Pocket For Storage When Not In Use

O-RINGS TO RUN LENGTH OF TARP / DRIVER & PASSENGER SIDES TO BE FASTENED BY (14) RUBBER STRAPS (BUNJI CORDS) - 12" long.

Note: The above tarp system is designed for heavy duty wear. These particular tarps are used quite extensively in Montana and N. Dakota, in the trucking industry.

- Description Of Intermodal Tarp Assembly Installed:
  - Rear Door End Has Three (3) Cut Outs for Straps & Hooks
  - Bulkhead End Is Permanently Mounted
  - Crank Handle (Located Rear Door End) Allowing Tarp To Be Rolled From Front to Back

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"SLUDGE GASKET"

GASKET SPECIFICATION: 1" x 2" and 1" x 1" CLOSED CELL EXTRUDED
COMPOUND NUMBER: #NS-10-P-S
TYPE: NEOPRENE SPONGE - SKINNED (4) SIDES
DUROMETER: 60 ± 10 / SHORE 00 - 50

PHYSICAL PROPERTIES

	Results
COMPRESSION/DEFLECTION	
Test Method: D1056	
3/4" Diameter Specimens Deflected 25% @ 0.5 Inch Per Minute.	
Load Required To Deflect Specimens 25% PSI	15.5
COMPRESSION SET	
Test Method: ASTM D 395, Method B	
Twenty-Two Hours @ 158°, 25% Deflection & 1/2 Hour Recovery.	
Compression Set Percentage:	43.5
HEAT AGED COMPRESSION DEFLECTION	
Test Method: ASTM D 865, D1056	
Specimens Deflected 25% @ 0.5 Inch Per Minute.	
Change In Load To Deflect Specimens 25% PSI:	+12.9
DIMENSIONAL STABILITY	
Test Method: ASTM D 865	
Specimen Aged 70 Hrs @ 212°F In A Forced Air Oven.	Width Change: 8.6%
	Length Change: 5.2%
OZONE RESISTANCE	
Test Method: ASTM D 1149	
Test Specimens Per ASTM D 518, Method A.	
Specimens Exposed For 72 Hours PPHM @ 104°F, 40% Elongation:	
Hours Of Exposure: 72	0
LOW TEMPERATURE BRITTLENESS	
Test Specimens: ASTM D 412, Die C.	
Specimens Aged Five House @ -40°F In Air	No Cracks
WATER ABSORPTION	
Eighteen Inch Specimens Immersed For A Period Of 24 Hours @ 73°F	
In Distilled Water. Weight Change Percentage As Follows:	+0.7
FLAME PROPAGATION	
One And One-Half Inch Flame Height. Five Minute Flame Application.	0.5
FLAME RESISTANCE	Pass
MIGRATION STAINING	
Test Method: ASTM D 925, Method B.	
Specimen Exposed For 48 Hours @ A 10" Distance From 275w,	
Type S Bulb. Test Surface: White Automotive	Non-Staining
FLUID AGING	
Test Method: ASTM D471	
70 Hours @ Room Temperature #3 Oil Immersion	
% Dimensional Change Length	± .102%
% Dimensional Change Width	± 1.47%
% Dimensional Change Thickness	± 5.78%

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APPENDIX A-3

Designation Support Documentation

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Appendix A-3:
Designation Support Documentation

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SECTION A-3.1

CLOSURE AND POST CLOSURE PLAN OUTLINE FOR THE CONTAINERIZED STORAGE FACILITY

Revision 0

March, 1997

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OUTLINE

1.0 INTRODUCTION

1.1 Purpose and Scope

2.0 FACILITY DESCRIPTION

2.1 General Description
- 2.1.1 Facility Description
- 2.2.2 Operations Summary

2.2 Physical Setting

2.3 Hydrogeologic Information
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2.4 Current Groundwater Monitoring Program

2.5 Remediation Wastes Associated with the CAMU

2.6 Description of Areas and Facilities Undergoing Closure
- 2.6.1 Containerized Storage Facility
- 2.6.2 Waste Staging/Consolidation Areas
- 2.6.3 Decontamination Facilities

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- 3.1.1 Decommissioning Phase
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- 3.1.3 Post-Closure Phase

3.2 Procedures for Removing Remediation Wastes
- 3.2.1 Disposal
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3.3 Decontamination of Facilities

3.4 Demolition of Facilities

3.5 Regrading and Revegetation

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3.7 Spill Prevention and Response

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4.0 CLOSURE SCHEDULE

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5.0 POST-CLOSURE CARE PLAN

5.1 Post-Closure Monitoring and Maintenance Plan
5.1.1 Monitoring Plan
5.1.2 Maintenance Plan

5.2 Certification of Post-Closure Care

5.3 Notation in the Deed

6.0 ACRONYMS

7.0 REFERENCES

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INTRODUCTION

This Closure and Post-Closure Plan Outline has been prepared as an appendix to the Corrective Action Management Unit (CAMU) Decision Document (DD) for containerized waste storage in support of the designation of a CAMU to facilitate the final remedy of offsite disposal for cleanup of the Rocky Flats Environmental Technology Site (RFETS), located in Jefferson County, Colorado. This facility is anticipated to be clean closed by removal and offsite disposal of all remediation wastes and contaminated structural material. Although a closure plan outline is being submitted, this does not preclude the conversion of the facility to other uses as part of other RFETS closure activities, economic conversion, or privatization. Minimal post-closure care, if any, is anticipated.

PURPOSE AND SCOPE

This outline presents the Closure and Post-Closure Plan Outline for the CAMU at RFETS. This Closure and Post-Closure Plan was prepared in accordance with the Colorado Hazardous Waste Regulations found at 6 Code of Colorado Regulations (CCR) 1007-3, Section 264.552. Although not specifically required by 6 CCR 1007-3, Section 264.552, this Closure Plan uses as guidance many of the elements for closure and post-closure care specified in 6 CCR 1007-3, Part 265, Sub-part G (Closure and Post Closure).

This Closure Plan will include post-closure care activities, as necessary, for the CSF. The language in 6 CCR 1007-3 Section 264.552 requires that areas within the CAMU where remediation wastes remain in-place after closure of the CAMU be managed and contained to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment. The CSF will not have hazardous waste remain in place after closure. The facilities within the CAMU will not likely require post-closure care because waste and contaminated facility material will be removed from these facilities and the facilities will be decontaminated during closure.

Section 2.0 of this Closure Plan will present a general description of the CSF facility and the facilities within the CAMU undergoing closure. Section 3.0 will present a general discussion of the closure procedures and the associated waste management activities that will occur during closure. Section 4.0 will describe the anticipated schedule for closure activities, and Section 5.0 will provide a Post-Closure Plan if necessary. Section 6.0 will provide a list of acronyms, and Section 7.0 will provide the reader with a list of references used in the document.

This Closure and Post-Closure Plan Outline provides a framework for the final closure and post-closure of facilities within the CAMU. The final closure and post-closure plan will be developed in the future as closure is required. All future closure and post-closure plans will be submitted to CDPHE for approval.

CLOSURE PROCEDURES

It is the intent that closure activities will be performed to meet the closure standards specified in 6 CCR 1007-3, Section 264.552. The components of closure procedures presented in this section use as guidance many of the elements for closure specified in 6 CCR 1007-3, Part 265, Sub-part G. The closure of the CSF will be conducted in a manner that:

- Minimizes the need for further maintenance; and
- Control, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents,

contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.

The components of closure described in this Closure Plan Outline and further developed during design will provide long-term protection of human health and the environment. Closure of the CAMU will include the following:

- Removal of wastes stored in the CSF
- Decontamination of the CSF
- Requirements for removal and decontamination of equipment, devices, and structures used in remediation waste management activities within the CAMU.

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SECTION A-3.2

PRELIMINARY WASTE ACCEPTANCE CRITERIA FOR THE CONTAINERIZED STORAGE FACILITY

Revision 0
March, 1997

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OUTLINE

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7.0 REFERENCES

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1.0 PURPOSE

This document specifies waste acceptance criteria (WAC) for wastes to be stored of at the Containerized Storage Facility (CSF) Corrective Action Management Unit (CAMU). These criteria were established by the Environmental Protection Agency (EPA), Colorado Department of Public Health and Environment (CDPHE), Department of Energy (DOE), and Department of Transportation (DOT). Compliance with the WAC ensures that storage of wastes meets all applicable requirements. Using the WAC ensures the following goals are achieved:

a. Hazardous and radioactive remediation wastes are effectively isolated from potential natural environmental pathways to protect the public health and environment,

b. Only specified wastes are accepted for storage,

c. Compliance by CSF operating personnel and generators to requirements,

d. Characteristics of the disposed wastes are known, certified, and available.

The central purpose for a CAMU designation is to allow safe and protective storage of hazardous and radioactive remediation wastes without treatment to meet Land Disposal Restrictions criteria. A CAMU is established to facilitate the implementation of reliable, effective, protective, and cost-effective remedies by providing an appropriate location for storage of hazardous and radioactive remediation wastes to facilitate offsite disposal. As such, certification of stored wastes will normally be via process knowledge from the specific remediation projects. A sampling and analysis plan can be used if process knowledge is not sufficient to certify the waste.

2.0 SCOPE

This document applies to all Rocky Flats Environmental Technology Site (RFETS) contractors, subcontractors, and Department of Energy, Rocky Flats Field Office (DOE,RFFO) remediation waste generators.

The CSF will only accept waste in containers meeting the definition of remediation wastes; typically wastes derived from environmental remediation (ER) cleanup and decontamination and decommissioning (D&D) activities at the RFETS.

Treatment of wastes, including size reduction, to meet storage criteria will be the responsibility of the waste generator and will not be done at the CSF.

SECTION A-3.3

PROPOSED GROUNDWATER MONITORING PLAN OUTLINE FOR THE CONTAINERIZED STORAGE FACILITY

Revision 0
March, 1997

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OUTLINE

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1.3 Environmental History
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- 2.2.2 Definition of the Uppermost Aquifer for the Site
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- 2.2.5 Hydraulic Conductivities

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- 4.2.2 Identification and Control of Contaminant Sources
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  - 4.2.2.2 Storage Tanks and Sumps

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4.2.2.3 Other Potential Contamination Sources
4.2.3 Identification of Potential Contaminant Pathways
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4.4 CSF Quality Control Objectives for Collection of Groundwater Samples
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4.4.1 Program Components
4.4.1.1 Sampling and Analysis
4.4.1.2 Measurement of Groundwater Elevations
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5.0 REFERENCES

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1.0 INTRODUCTION

The outline for the CSF Groundwater Monitoring Plan is based on the current draft outline for the Rocky Flats Environmental Technology Site (RFETS) Integrated Monitoring Plan (IMP). It is intended that the CSF specific groundwater monitoring requirements would be incorporated into the IMP once the groundwater monitoring requirements for the CSF have been established during the design phase.

It is also intended that the current RFETS groundwater monitoring network be utilized to the greatest extent possible to satisfy background, upgradient, and downgradient monitoring requirements for the CSF. This would be established through development of CSF data quality objectives for groundwater monitoring during the design phase of the project.

The following attachments provide brief descriptions of the processes to be used to support development of a groundwater monitoring network for the CSF.

Attachment 1.
General Decision Criteria for
Groundwater Monitoring Network Efficiency Analysis

Analysis of efficiency of existing monitoring wells and the evaluation of the need for additional wells will generally be based upon the following process:

1. Down gradient well placement

   Step 1. Assess 50% Title II design
   Step 2. Identify groundwater flow paths relative to facility placement within the CAMU
   Step 3. Assess vertical component of groundwater flow.
   Step 4. Assess seasonal and temporal factors affecting groundwater flow.
   Step 5. Identify potential contaminant pathways.
   Step 6. Determine spatial relationship to existing groundwater monitoring network.
   Step 7. Select additional monitoring well sites as appropriate.

2. Up gradient well placement

   Step 1. Assess 50% Title II design
   Step 2. Identify groundwater flow paths up gradient relative to facility placement within the CAMU
   Step 3. Assess seasonal and temporal factors affecting groundwater flow.
   Step 4. Assess historical data for area surrounding the CAMU.
   Step 5. Determine spatial relationship to existing groundwater monitoring network.
   Step 6. Determine data adequacy of existing data and upgradient wells.
   Step 7. Select additional monitoring well sites as appropriate.

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Attachment 2.
Release Reporting Assessment Criteria

Problem Statement:

The problem statement for RCRA Monitoring wells is: Have concentrations in downgradient monitoring wells exceeded mean concentrations in upgradient monitoring wells at RCRA units?

Problem Scope:

RCRA monitoring is conducted to detect potential excursions of contamination below the point of compliance established for RCRA units on Site. RCRA units are considered to be any units that are regulated under 6 CCR 1007-2 solid waste requirements, such as the CSF CAMU, Present Landfill, and the New Sanitary Landfill, and any future waste repositories.

Decision Statement:

IF	Mean concentrations in any downgradient wells exceed the mean concentration in upgradient wells,
AND	Concentrations at that well show an upward trend with time,
THEN	Report to appropriate agencies and initiate investigation into possible causes,
ELSE	Continue Monitoring.
Inputs:	Unit Specific Potential Contaminent Of Concerns (PCOCs) Field Parameters Water Levels
Boundaries:	Spatial - Decisions are based on pooled results of upgradient wells and on a well head basis in downgradient wells. Temporal - Data will be reviewed quarterly and decisions will be made on an annual basis.

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SECTION A-3.4

COMPREHENSIVE CONSTRUCTION QUALITY ASSURANCE PLAN OUTLINE FOR THE CONTAINERIZED STORAGE FACILITY

Revision 0
March, 1997

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OUTLINE

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1.2 Plan Users
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- 2.1.1 Definitions - General
- 2.1.2 Definitions - Contractor
- 2.1.3 Definitions - Design Engineer/Construction Quality Assurance Subsontractor
- 2.1.4 Definitions - Construction Subcontractor

2.2 Project Organization and Responsibilities
- 2.2.1 Owner
- 2.2.2 Contractor
- 2.2.3 Design Engineer/Construction Quality Assurance Subcontractor
- 2.2.4 Construction Subcontractor

3.0 PROJECT MEETINGS

3.1 Pre-Construction Meeting
3.2 Progress Meetings
3.3 Problem/Deficiency Meetings

4.0 DOCUMENT CONTROL

4.1 Scope
4.2 Responsibilities
4.3 Basic Requirements
4.4 Supplementary Requirements

5.0 CONTROL OF NONCONFORMANCE REPORTS

6.0 CONTROL OF PURCHASED ITEMS AND SERVICES

7.0 CONTROL OF MEASURING AND TEST EQUIPMENT

7.1 Scope
7.2 Responsibilities
7.3 Basic Requirements
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8.0 SURVELLANCES

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8.3 Basic Requirements
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9.0 RECORDS

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9.2 Basic Responsibilities
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9.6 Training Statement
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10.0 EARTHWORK

10.1 General
10.2 Common Fill
10.3 Soils Construction Evaluation
10.4 Topsoil and Revegetation

11.0 PIPING - PLASTIC

12.0 PIPING - METALLIC

13.0 GENERAL CIVIL - CONCRETE

14.0 STRUCTURAL

15.0 MECHANICAL

16.0 ELECTRICAL - WIRE CABLE

17.0 ELECTRICAL - RACEWAYS

18.0 ELECTRICAL - GROUNDING

19.0 INSTRUMENTATION

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CONTROL OF COMPREHENSIVE CONSTRUCTION QUALITY ASSURANCE PLAN

The Comprehensive Construction Quality Assurance Plan (CCQAP) document is for the use of all quality assurance and quality control staff, project engineers, construction engineers, and all construction subcontractors site personnel involved with the construction of the Containerized Storage Facility (CSF) project at the Rocky Flats Environmental Technology Site. The corporate quality assurance manager will maintain a record of the recipients of the manual.

Controlled copies of this manual will be issued to appropriate project personnel involved in the supervision of work performed to the requirements of this manual.

From time to time, it may become necessary to prepare revisions to this manual. When a revision is prepared, the change shall be noted by a vertical line in the left-hand margin. If later a revision is made to the same sheet, the line indicating a previous change will be removed. Revisions shall be distributed with a new index showing the effective revision of the applicable section. When a complete re-write of the CCQAP is issued, no margin lines will be used. Revisions will receive a review and approval equivalent to the original.

When it becomes necessary to define project-specific activities and/or delete those activities which are not applicable to that project, an addendum to this manual, it is understood that reference to a specific individual will include the individual's designee, provided they are in the same department and are qualified to perform the designated function. In all cases, the quality requirements shall be verified and docmented by persons not directly performing the work, and responsibility for the work remains with the designated individual.

1.1 Purpose of Plan

This CCQAP establishes the construction quality assurance program, supervision, inspection and testing of all items of work, including those of suppliers and subcontractors, which will demonstrate compliance with subcontract documents, applicable standards, and permitting requirements related to the construction activities for the Rocky Flats CSF at the Department of Energy's Rocky Flats Environmental Technology Site (RFETS), Golden Colorado. Implementation of the CCQAP will help to provide quality work, cost and schedule control, and regulatory compliance.

The CCQAP has been developed as one documents. Within this document there are two main parts. The first part is the general section covering the project as a whole. Part 2 will focus on specifics of the CSF facility, such as earthwork, building construction, mechanical systems, and electrical and instrumentation systems.

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In Part 2 of the CCQAP, the construction requirements of the facility quality assurance requirements are identified. In this Part, the sections of the CCQAP are focussed on the standard construction industry practices for the types of construction associated with the general site development, the building and mechanical systems, electrical power distribution and various other systems as shown on the Construction Drawings and Specifications for the complete CSF.

Construction quality assurance for the following components are contained in the Part 2 of the CCQAP portion of the project. This portion of the total project quality assurance for the project is designated to cover:

- Earthwork for general site grading and structural foundation
- Underground and overhead utilities (water, electrical, instrumentation, etc.)
- Building structural and mechanical systems
- Equipment decontamination facilities
- Personnel decontamination facilities
- Roadway and storm drainage components

The construction subcontractor, along with the contractor and contractor's representatives shall be knowledgable of all requirements for the Project QA procedures.

The elements contained within all parts of this CCQAP include:

(1) Defining responsibility and authority of all organizations and key personnel,

(2) Qualifications of construction quality assurance personnel,

(3) Summary of the activities used to document the installation,

(4) Presenting sampling requirements for key components, and

(5) Description of the documentation to be completed and archived.

1.2 Plan Users

The quality assurance and quality control staff, project engineers, construction engineers, and all Construction Subcontractor site engineers, managers, and foreman are required to become familiar with all parts of this document. All parties are required to review this document with particular attention to those sections applicable to their responsibilities.

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SECTION A-3.5

HEALTH AND SAFETY PLAN OUTLINE FOR THE CONTAINERIZED STORAGE FACILITY

Revision 0
March, 1997

717

OUTLINE

The outline below has been prepared to describe the general content of the Health and Safety Plan for the Containerized Storage Facility (CSF). During or after design, the outline should be reviewed for applicability and revised as necessary.

1.0 INTRODUCTION

1.1 Purpose and Scope

1.2 Implementation and Modification of the Site Safety and Health Plan

1.3 Organization

2.0 SITE AND CSF FACILITY INFORMATION

2.1 General Site Description
- 2.1.1 Site Status
- 2.1.2 Site History
- 2.1.3 Climate
- 2.1.4 Locations of Resources Available to Onsite Personnel

2.2 Potential Chemicals Detected in Wastes Received at the Facility

2.3 Site Zones
- 2.3.1 Support Zones
- 2.3.2 Contamination Reduction Zones
- 2.3.3 Exclusion Zones

2.4 Site Control

3.0 PROJECT ORGANIZATION AND PERSONNEL REQUIREMENTS

3.1 Organization and Safety Responsibilities

3.2 Personnel Requirements

4.0 HEALTH AND SAFETY PROGRAMS

4.1 Required Personnel Training
- 4.1.1 CSF Personnel
- 4.1.2 RFETS Personnel
- 4.1.3 Occasional Site Personnel Potentially Exposed to Hazardous Substances Below Permissible Exposure Limits
- 4.1.4 Management and Supervisory Training
- 4.1.5 Refresher Training
- 4.1.6 Documentation
- 4.1.7 Exempt Personnel
- 4.1.8 Tailgate Safety Meetings
- 4.1.9 Safety Inspections and Audits

4.2 Medical Monitoring

4.3 Respiratory Protection Policy

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4.4 Hazard Communication
4.4.1 Container Labeling
4.4.2 Material Safety Data Sheets

5.0 PROJECT HAZARD IDENTIFICATION AND MIGRATION

5.1 General Health and Safety Work Practices

5.2 Project Hazard Analyses

5.3 Hazard Mitigation

5.4 Required Personnel Protective Equipment and Related Safety Equipment
5.4.1 Levels of Personal Protective Equipment
5.4.2 Unknown Situations
5.4.3 Anticipated Personal Protective Equipment Levels by Site Activity

5.5 Air Monitoring for Project Operations
5.5.1 Gases and Vapors
5.5.2 Explosion Hazard
5.5.3 Oxygen Deficiency in Confined Spaces
5.5.4 Miscellaneous Equipment

5.6 Hazardous Pathways and Engineering Controls

6.0 DECONTAMINATION AND DISPOSAL PROCEDURES

6.1 Equipment Decontamination

6.2 Personnel Decontamination

6.3 Operations-Derived Material Disposal
6.3.1 Wastewater
6.3.2 Personal Protective Equipment
6.3.3 Solid Waste

7.0 EMERGENCY PROCEDURES

7.1 Emergency Information
7.1.1 Telephone Numbers
7.1.2 How to Report an Emergency
7.1.3 Emergency Routes
7.1.4 Emergency Signals

7.2 Contingency Plan

8.0 ACRONYMS

9.0 REFERENCES

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ATTACHMENTS

Attachment 1 Hazardous Property Information

Attachment 2 Personnel Acknowledgements

Attachment 3 Accident Investigation

Attachment 4 Equipment Calibration and Maintenance

Attachment 5 First-Aid and Emergency Care

Attachment 6 Personnel Information

SECTION A-3.6

SECURITY PLAN OUTLINE FOR THE CONTAINERIZED STORAGE FACILITY

Revision 0
March,1997

721

OUTLINE

1.0 PURPOSE

1.1 Activity Overview

The plan will cover the operations of the Remediation Waste Storage Facility (RWSF). Operations include but are not limited to :

- The handling and placement of containers of remediation wastes within the facility,
- Associated maintenance activities,
- Required inspections,
- Waste staging and shipment,
- Health and safety monitoring and oversight,
- Additional required monitoring,
- Facility access control, and
- Leachate collection and treatment activities

1.2 Security Plan Objective

This plan prescribes security measures to protect human health and the environment from wastes stored within the facility and any classified matter received, used, and stored by employees.

2.0 SCOPE

2.1 Activity Description and Management Organization

This plan addresses any required security measures required while work is performed or the facility remains in operation.

- Construction Manager,
- Operations Manager,
- Contractor Technical Representative,
- Facility Security Officer (FSO), and
- Operations personnel.

2.2 Target Description

This plan describes the security measures implemented to ensure the protection of human health and the environment from any release or threat of release of remediation wastes from the RWSF. This program protects classified matter and unclassified but sensitive matter used to direct work that may be used or is applicable to personnel at the RWSF.

2.3 Threat Description

2.4 Limitations

3.0 RESPONSIBILITIES

3.1 All Employees

All employees have the responsibility to:

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- Follow all operational, health and safety, and other applicable work control procedures.
- Identify issues of concern relating to violation of procedure or any other potential health and safety, operational, or security concern.
- Comply with all RFETS Safeguards and Security Program requirements including those stated in the RWSF Security Plan.

3.2 Operations Manager

3.3 Contractor Technical Representative, Kaiser-Hill

3.4 Facility Security Officer

3.5 Security Custodian

4.0 SAFEGUARDS AND SECURITY PROGRAM REQUIREMENTS

The target identified by this plan and all other items of Department of Energy, Rocky Flats Environmental Technology Site safeguards and security interest are protected by an integrated system of safeguards and security program activities applied with a graded approach.

4.1 Physical Protection Program

The physical protection program is directed by DOE-5632.1C, Protection and Control of Safeguards and Security Interests.

4.2 Protection Force Program

The program is directed by DOE-5632.7A, Protective Forces.

4.3 Nuclear Material Control Program

4.4 Personnel Security Program

The program is directed by DOE-5631.2C, Personnel Security Program.

4.5 Information Security Programs

4..5.1 Classified Matter Protection & Control (CMPC)

The CMPC program is directed by DOE-5639.1, information Security Program.

4.5.2 Classified Automated Information Systems (AIS) Security Program

The classified AIS program is directed by DOE-5639.6A, Classified Automated Information Security Program.

4.5.3 Operations Security (OPSEC) Program

The OPSEC program is directed by DOE-5639.7, Operations Security Program. Additional direction is provided by the DOE-OPSEC Master Plan, RFFO Instruction 5639.7, and the Kaiser-Hill Implementation Plan.

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4.5.4 Counterintelligence (CI) Program

The CI program is directed by DOE-5670.3, Counterintelligence Program.

4.5.5 Technical Surveillance Countermeasures (TSCM) Program

The TSCM program is directed by DOE-5639.5, Technical Surveillance Countermeasures Program.

4.5.6 Violations of Law, Losses, and Incidents of Security Concerns (VOLLI) Program

The program is directed by DOE-5639.3, Violations of Law, Losses, and Incidents of Security Concerns.

4.6 Security Awareness Program

The program is directed by DOE-5631.1C, Safeguards and Security Awareness Program.

4.7 Physical Protection of DOE Property and Unclassified Facilities

Program direction is included in DOE-5632.1C, Protection and Control of Safeguards and Security Interests.

4.8 Safeguards and Security Evaluation Program

Employees, facilities, and procedures are subject to audit to evaluate compliance with the requirements stated in this security plan.

4.9 Security Plan Review Process

SECTION A-3.7

PROPOSED SURFACE WATER MONITORING PLAN OUTLINE FOR THE CONTAINERIZED STORAGE FACILITY

Revision 0
March, 1997

125

OUTLINE

1.0 INTRODUCTION

1.1 Purpose of the Surface Water Monitoring Program

1.2 Site Description

1.3 Environmental History
- 1.3.1 Definition and Description of Contaminated Sites
- 1.3.2 Brief History of Surface Water Monitoring Activities

2.0 PHYSICAL AND HYDROLOGIC SETTING

2.1 Local Hydrology
- 2.1.1 Woman Creek Drainage
  - 2.1.1.1 Woman Creek
  - 2.1.1.2 Standley Reservoir
- 2.1.2 Walnut Creek Drainage
  - 2.1.2.1 North Walnut Creek
  - 2.1.2.2 South Walnut Creek
  - 2.1.2.3 Great Western Reservoir

2.2 Interaction with Groundwater

2.3 Interaction with Site Ecology

3.0 DESCRIPTION OF THE RFETS SURFACE WATER MONITORING PROGRAM

3.1 Current Status of the Surface Water Program

3.2 Integrated Monitoring Plan

4.0 SURFACE WATER MONITORING

4.1 Monitoring Objectives
- 4.2.1 Identification of Potential Contaminants
- 4.2.2 Identification of Data Quality Objectives
- 4.2.3 Identification and Control of Contaminant Sources
- 4.2.4 Identification of Potential Contaminant Pathways
- 4.2.5 Identification of Monitoring Locations
- 4.2.6 Surface Water Control

4.2 Monitoring
- 4.2.1 Monitoring Locations
- 4.2.2 Field Data Collection
  - 4.2.2.1 Sampling and Analysis
  - 4.4.2.2 Quality Assurance
- 4.4.3 Data Management
- 4.4.4 Surface Water Assessment/Reporting
- 4.4.5 Non-Point Of Compliance Monitoring

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4.3 Surface Water Control
4.3.1 Pond System
4.3.2 Drainage and Flow impacts
4.3.3 National Pollutant Discharge Elimination System Permit
4.3.4 Community Assurance

5.0 EVALUATION OF CSF IMPACTS ON SURFACE WATER

5.1 Impact on Site Surface Water Data Quality Objectives
5.2 Additional Monitoring Requirements
5.3 Impact to Surface Water Control Systems
5.4 Impact To Offsite Discharges

6.0 REFERENCES

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1.0 INTRODUCTION

The outline for the CSF Surface Water Monitoring Plan (SWMP) is based on the draft Rocky Flats Environmental Technology Site (RFETS) Integrated Monitoring Plan (IMP) for surface water. It is expected that all surface water monitoring for the CSF and the area surrounding it would be conducted as part of the integrated site program described in the IMP and that additional site specific monitoring outside the IMP would not be necessary since the proposed location is in the Industrial area of RFETS and would fall under existing or planned monitoring and surface water control systems.

1.1 Purpose of the Surface Water Monitoring Program

The objective of the SWMP is to demonstrate that RFETS surface water monitoring program as described by the IMP provides reasonable assurance that surface water associated with the CSF is monitored and controlled and will not impact downstream receptors. It will achieve this objective by :

- Determining contaminant types and migration pathways that could impact surface water including interactions with other media
- Evaluating the impacts of CSF in meeting RFETS Data Quality Objectives (DQOs) for surface water
- Determining any additional monitoring requirements necessary to meet RFETS DQOs
- Evaluating changes in run-off and flow patterns on the existing drainage system
- Evaluating the impact on offsite discharges of surface water

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SECTION A-3.8

CONTINGENCY PLAN OUTLINE FOR THE CONTAINERIZED STORAGE FACILITY

Revision 0
March, 1997

729

OUTLINE

The outline below has been prepared to describe the general content of the Containerized Waste Storage Facility Contingency Plan. During or after design, the outline should be reviewed for applicability and revised as necessary.

1.0 INTRODUCTION

1.1 Purpose and Scope

1.2 Organization

2.0 EMERGENCY COORDINATORS

3.0 IMPLEMENTATION OF THE CONTINGENCY PLAN

3.1 CSF Containers
- 3.1.1 Containment Failure or Failure Due to External Forces
- 3.1.2 Human Exposure
- 3.1.3 Reportable Quantities

3.2 Decontamination Areas
- 3.2.1 Containment Failure or Failure Due to External Forces
- 3.2.2 Human Exposure
- 3.2.3 Reportable Quantities

3.3 Waste Staging/Handling Areas
- 3.3.1 Containment Failure or Failure Due to External Forces
- 3.3.2 Human Exposure
- 3.3.3 Reportable Quantities

3.4 Floor Drainage Collection System
- 3.4.1 System Failure or Failure Due to External Forces
- 3.4.2 Human Exposure
- 3.4.3 Reportable Quantities

4.0 EMERGENCY RESPONSE PROCEDURES

4.1 Pre-Incident Phase (Preparedness)

4.2 Incident Phase
- 4.2.1 Notification
- 4.2.2 Identification and Compatibility of Hazardous Wastes
- 4.2.3 Wind Rose
- 4.2.4 Assessment
- 4.2.5 Control Procedures
  - 4.2.5.1 Fire and/or Explosion
  - 4.2.5.2 Spills or Material Releases

4.3 Post-Incident Phase
- 4.3.1 Recording Procedures
- 4.3.2 Field Investigation
- 4.3.3 Clean-up and/or Reconstruction/Modification
- 4.3.4 Resumption of Normal Operations

5.0 RESPONSIBILITIES OF INCIDENT RESPONSE PERSONNEL

5.1 Emergency Coordinator

5.2 Field Incident Commander

5.3 Incident Safety Officer

5.4 Response Teams

6.0 EMERGENCY EQUIPMENT

6.1 Fire Fighting Equipment

6.2 Spill Control Equipment

7.0 EVACUATION PLANS

8.0 ADMINISTRATION CONTINGENCY PLAN

9.0 ACRONYMS

10.0 REFERENCES

Attachment 1 - Emergency Contacts

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SECTION A-3.9

INSPECTION PLAN OUTLINE FOR THE CONTAINERIZED STORAGE FACILITY

Revision 0
March, 1997

132

OUTLINE

The outline below has been prepared to describe the general content of the Inspection Plan for the Containerized Storage Facility. During or after design, the outline should be reviewed for applicability and revised as necessary.

1.0 INTRODUCTION

1.1 Purpose and Scope

1.2 Organization

2.0 INSPECTION REQUIREMENTS

2.1 CSF Containers

2.2 Floor Drainage Collection System

2.3 Decontamination Areas

2.4 Waste Staging/Handling Areas

2.5 Emergency Response Systems

2.6 Other Areas

3.0 INSPECTION SCHEDULE

3.1 Daily Inspections

3.2 Weekly Inspections

3.3 Monthly Inspections

3.4 Quarterly Inspections

3.5 Annual Inspections

4.0 DEFICIENCY CORRECTION REQUIREMENTS

5.0 RECORD KEEPING REQUIREMENTS

5.1 Inspection Logs

5.2 Deficiency Correction Logs

6.0 ACRONYMS

7.0 REFERENCES

B4

SECTION A-3.10

OPERATING RECORD SYSTEM PLAN OUTLINE FOR THE CONTAINERIZED STORAGE FACILITY

Revision 0
March,1997

735

OUTLINE

The outline below has been prepared to describe the general content of the Operating Record System Plan. During or after design, the outline should be reviewed for applicability and revised as necessary.

1.0 INTRODUCTION

1.1 Purpose and Scope

1.2 Organization

2.0 WASTE DESCRIPTION, QUANTITIES, AND DISPOSITION

3.0 WASTE ANALYSES

4.0 CONTINGENCY PLAN IMPLEMENTATIONS

5.0 INSPECTION RECORDS

6.0 MONITORING, TESTING, AND ANALYTICAL DATA

7.0 RECORDS OF CORRECTIVE ACTION

8.0 ANNUAL CERTIFICATION OF WASTE MINIMIZATION

9.0 RECORD RETENTION, AVAILABILITY, AND DISPOSITION

10.0 BIENNIAL REPORTING REQUIREMENTS

11.0 ADDITIONAL REPORTING REQUIREMENTS

12.0 ACRONYMS

13.0 REFERENCES

SECTION A-3.11

PERSONNEL TRAINING PLAN OUTLINE FOR THE CONTAINERIZED STORAGE FACILITY

Revision 0
March, 1997

737

OUTLINE

The outline below has been prepared to describe the general content of the Personnel Training Plan for the Containerized Storage Facility. During or after design, the outline should be reviewed for applicability and revised as necessary.

1.0 INTRODUCTION

1.1 Purpose and Scope

1.2 Organization

2.0 GENERAL

2.1 Instructor Qualifications

2.2 Training Schedule
- 2.2.1 On-the-Job Training
- 2.2.2 Classroom Training

3.0 CURRICULUM

3.1 Emergency Response
- 3.1.1 Spill Response
- 3.1.2 Fires and Explosions
- 3.1.3 Natural Forces
- 3.1.4 Other Emergencies
- 3.1.5 Emergency Shutdown Procedures

3.2 Emergency Equipment

3.3 Alarm and Communication Systems

3.4 Waste Management

4.0 RECORD KEEPING

4.1 Job Descriptions

4.2 Training Descriptions

4.3 Training Records

5.0 ACRONYMS

6.0 REFERENCES

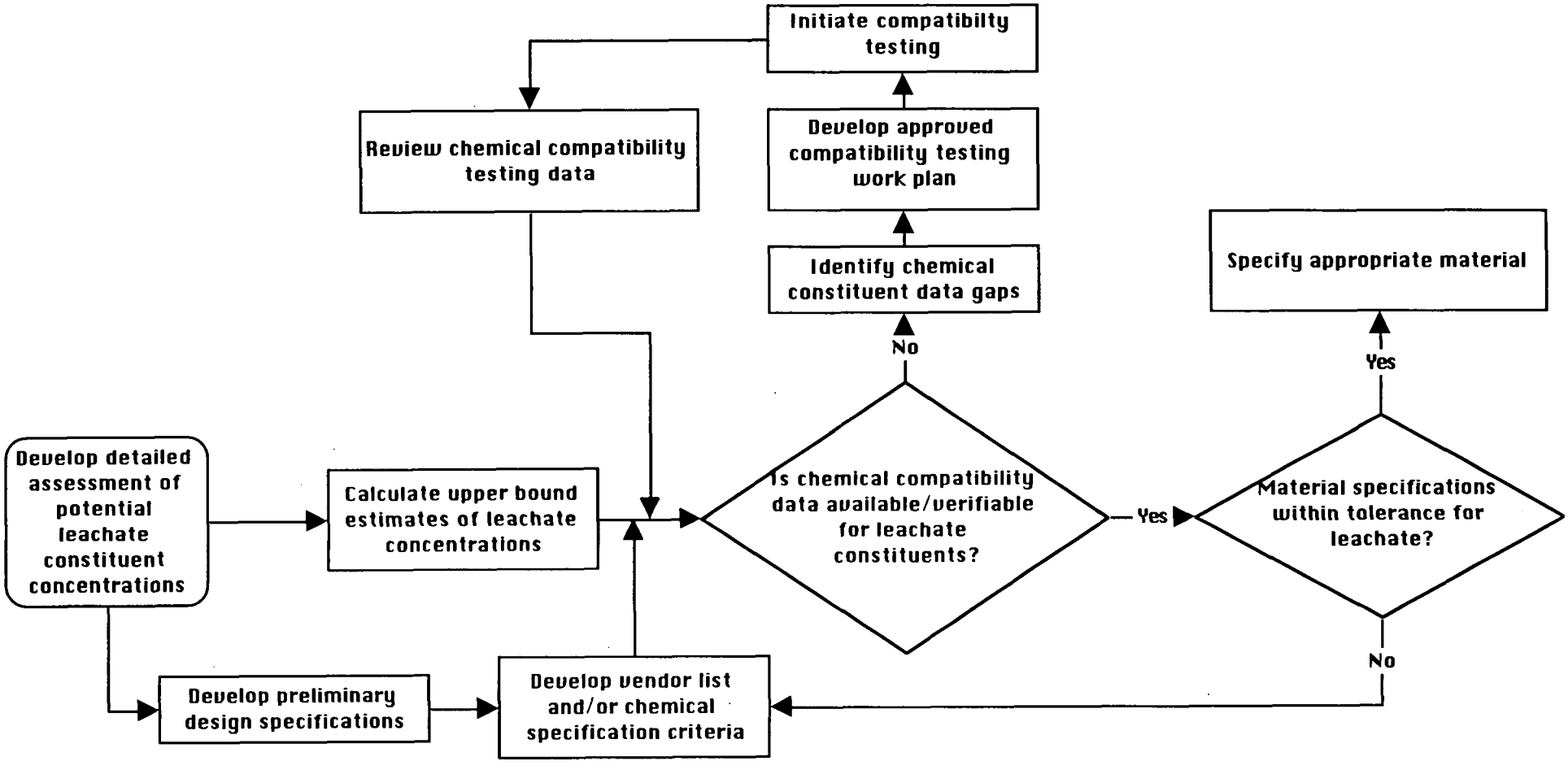
SECTION A-3.12

CHEMICAL COMPATABILITY TESTING DECISION PROCESS

Revision 0
March, 1997

739

Chemical Compatibility
Testing Decision Process



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APPENDIX A-4

Siting Study Figures

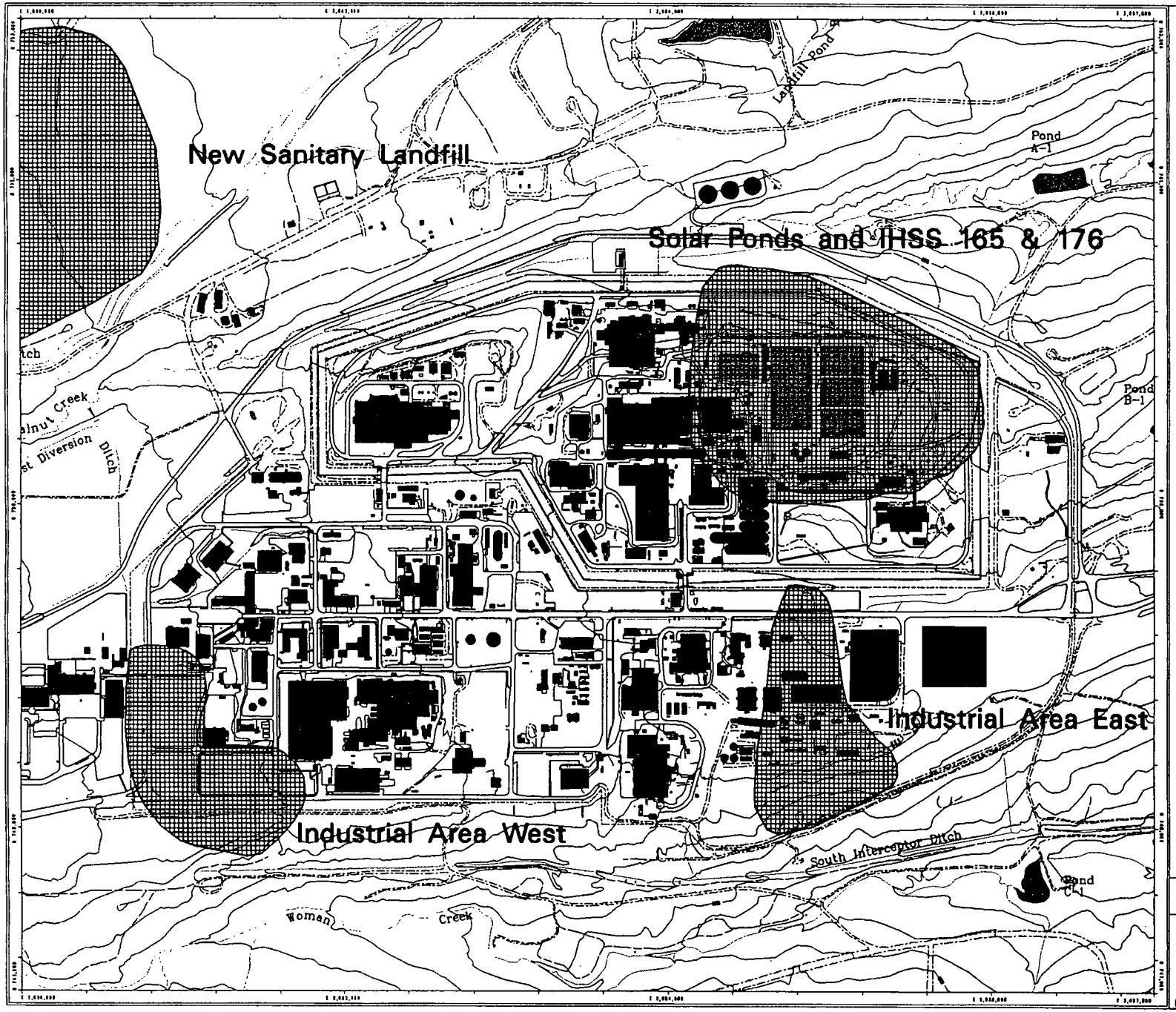

Figure 1
Location Map

EXPLANATION

Potential RWSF Sites

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' intervals)
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE
Buildings, roads, and fences provided by Facilities Engr. EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 10360
1 inch represents approximately 863 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:
RMRS Rocky Mountain Remediation Services, L.L.C.
Geographic Information Systems Group
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: 97-0014

February 28, 1997

742

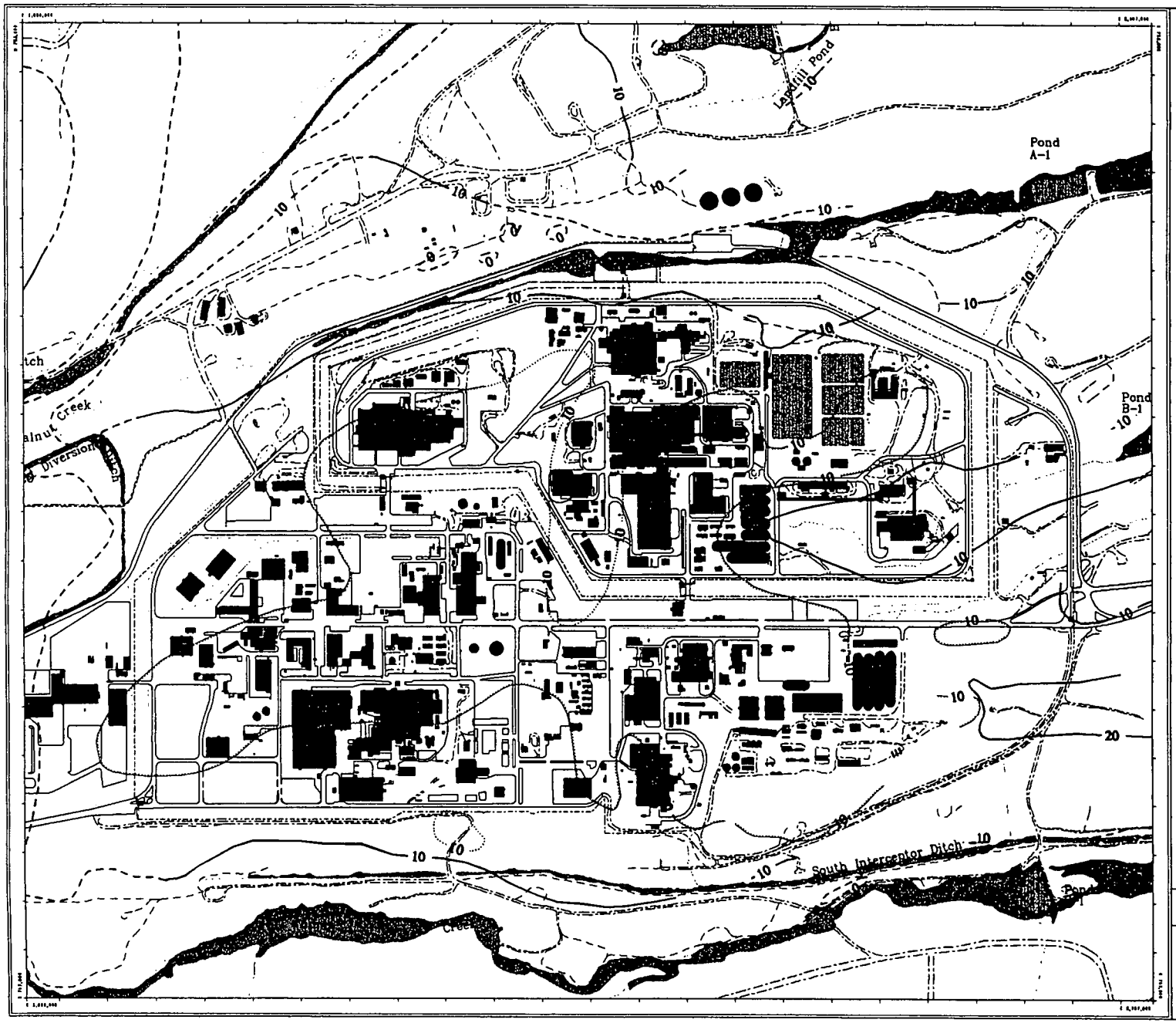

Figure 2
Hydrogeological Conditions

EXPLANATION

- Line of Equal Depth to Water (in feet)
- (dashed where inferred)
- Decreasing Line of Equal Depth to Water (in feet)
- (dashed where inferred)

Standard Map Features

- Buildings or other structures
- 100 year floodplain
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Dept., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - Mass unknown

Scale = 1 : 10770
1 inch represents approximately 898 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:
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MAP ID: Draft

February 24, 1997

743

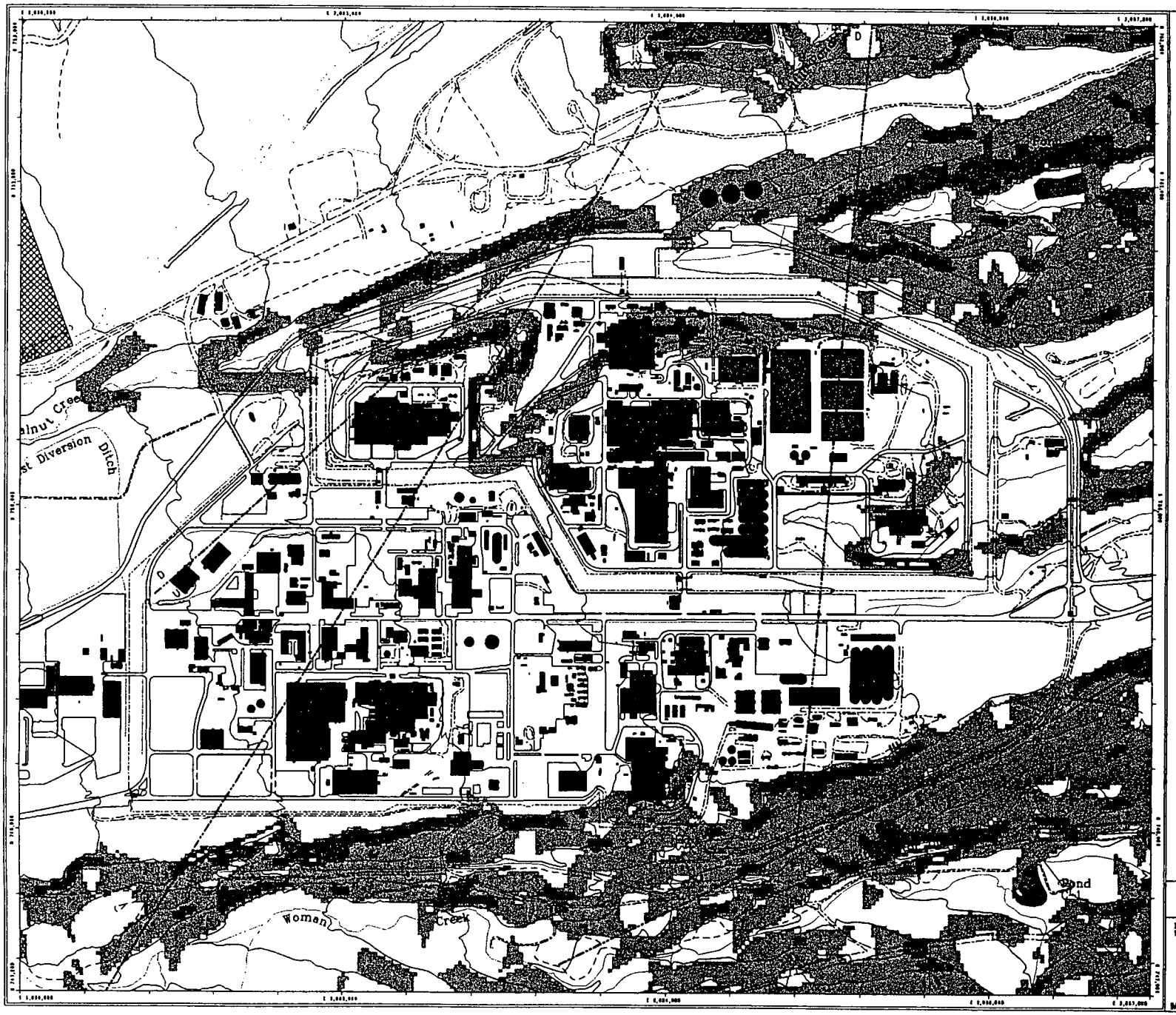

Figure 3

Geological and Geotechnical Conditions

EXPLANATION

Fault line - dashed where inferred

Slope Categories

- Slope = 15% - 20%
- Slope = 20% - 30%
- Slope > 30%

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE
Buildings, roads, and fences provided by Facilities Engr. EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 10360
1 inch represents approximately 863 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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MAP ID: Draft

February 25, 1997

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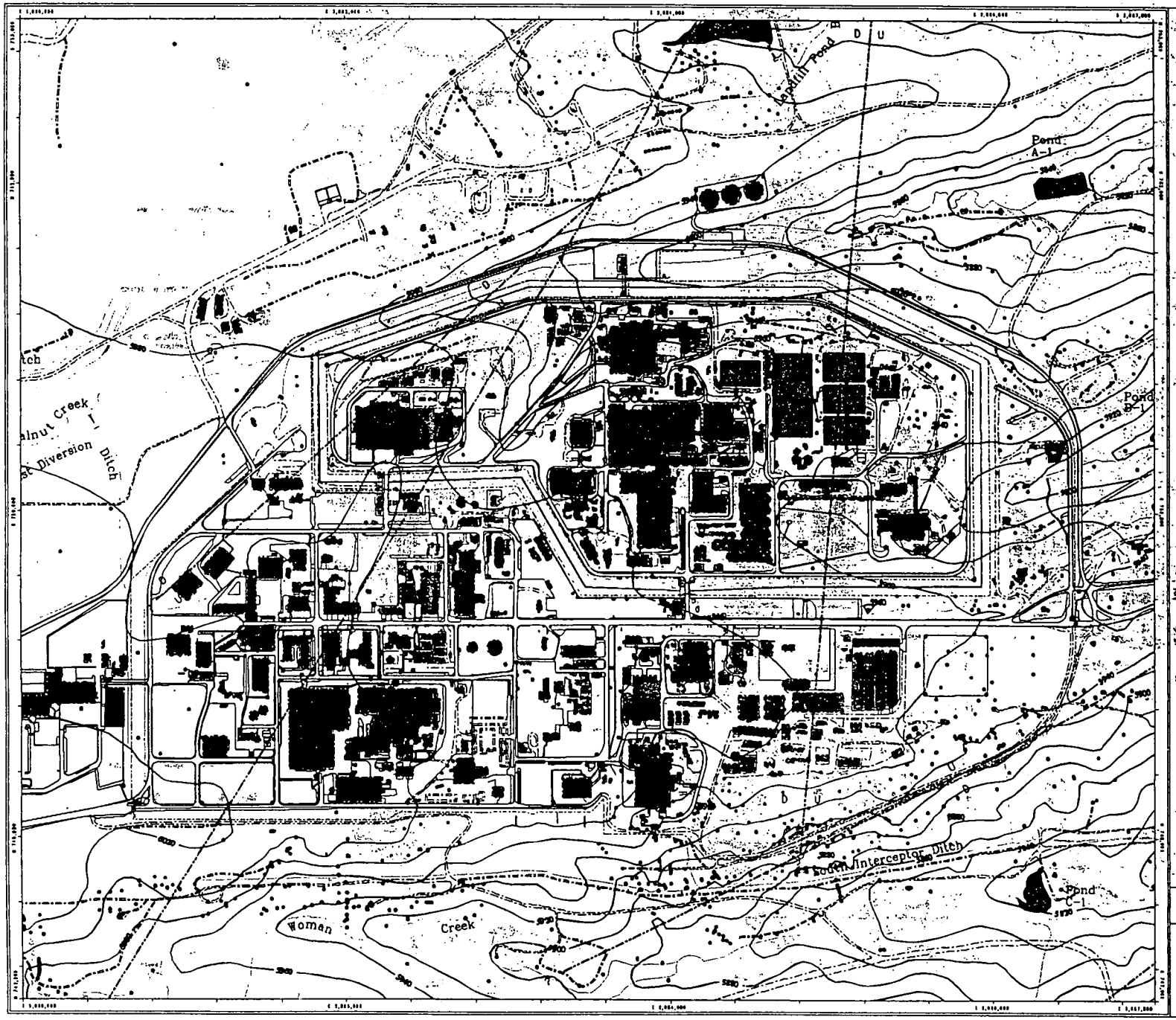

Figure 4
Structure Base of Alluvium

EXPLANATION

- Structure base of alluvium (top of bedrock elevation)
- Fault line - dashed where inferred
- Groundwater wells
- Boreholes

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt roads
- Dirt Roads
- Trails

DATA SOURCE
Buildings, roads, and fences provided by Facilities Dept. EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - Date unknown

Scale - 1 : 10380 -
1 inch represents approximately 863 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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MAP ID: Draft

February 28, 1997

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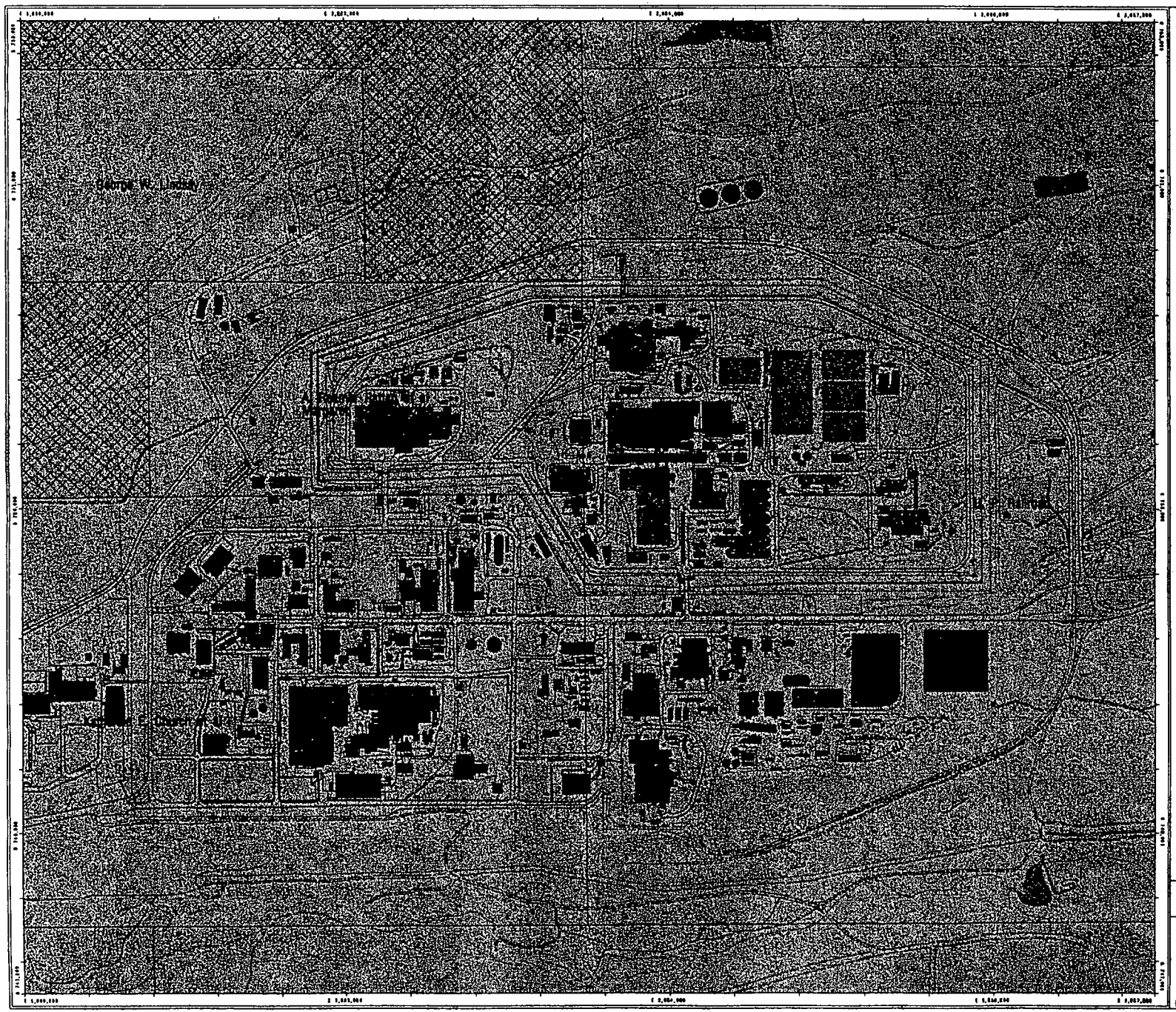

Figure 8
Mineral Ownership Map

EXPLANATION

- Private
- Government
- Both Government and Private

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE
Buildings, roads, and fences provided by Facilities Engr. FEMO Rocky Flats, Inc. - 1992.
Hydrology provided by USGS - (date unknown)

Scale - 1 : 10360
1 inch represents approximately 863 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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RMRS Rocky Mountain Remediation Services, L.L.C.
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Golden, CO 80402-0464

MAP ID: Draft

February 25, 1997

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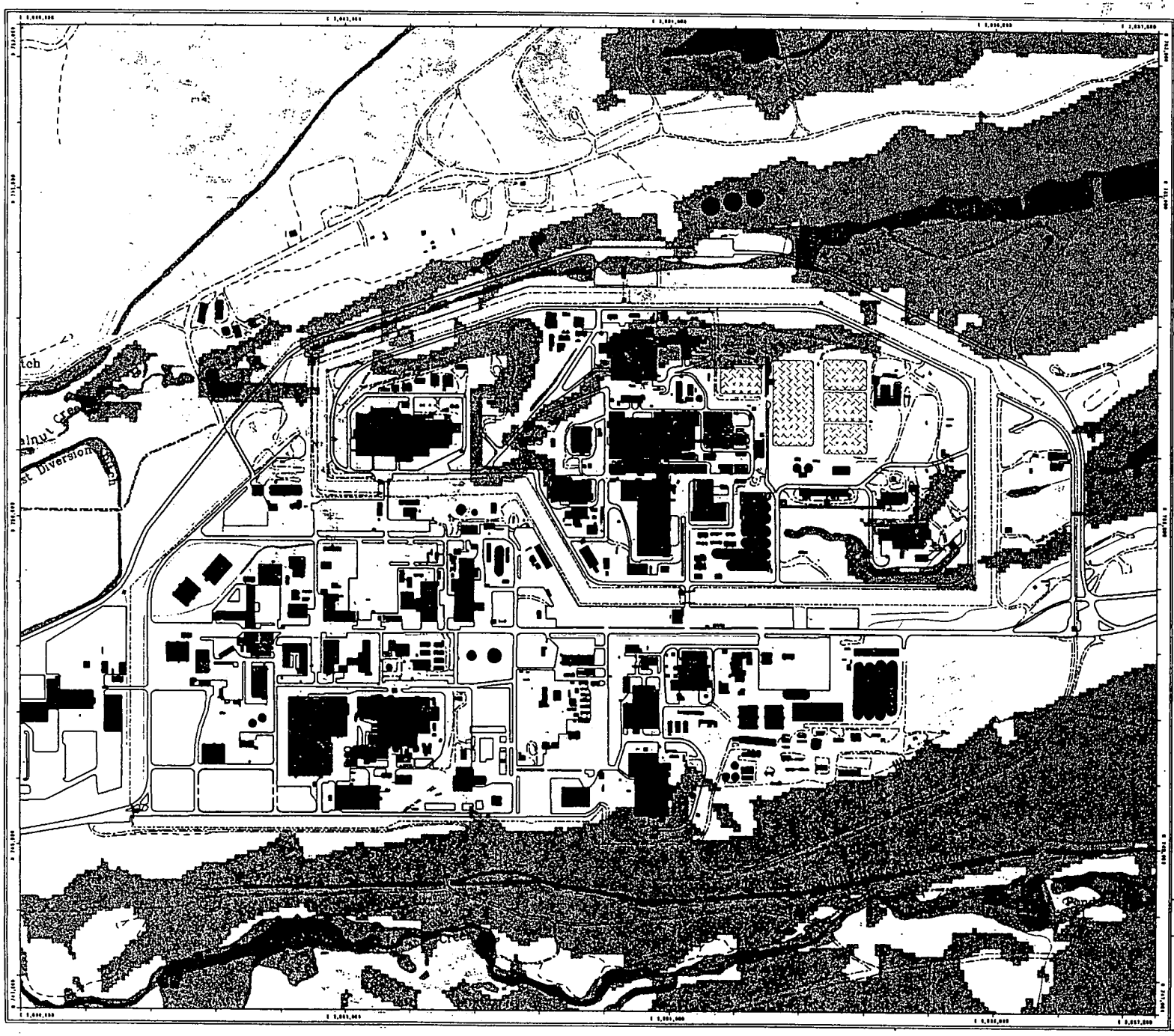

Figure 7
Adverse (for RWSF siting) Conditions Map

EXPLANATION

NOTE:
This map was created using the analytical capabilities of ARC/INFO. Three data layers (coverages's) were combined, representing physical restraining criteria, each given an equal weighting factor: wetlands, 100-year floodplain, and slopes greater than 15%. The surface was color coded based on the number of criteria present.
Point and line wetland features have a 50 feet buffer around them for better visibility.

- Lands best suited for the placement of a Waste Management Facility, based on criteria stated above
- One criterion present
- Two criteria present
- Three criteria present (least suitable location)

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

BASE SOURCES:
Buildings, roads, and fences provided by Rocky Flats Plant, Inc.
Rocky Flats Plant, Inc.
Hydrology provided by USGS - Arvada quadrangle

N

Scale - 1 : 10380
1 inch represents approximately 863 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:
RMRS Rocky Mountain Remediation Services, L.L.C.
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P.O. Box 464
Golden, CO 80402-0464

MAP ID: x7707

February 25, 1997

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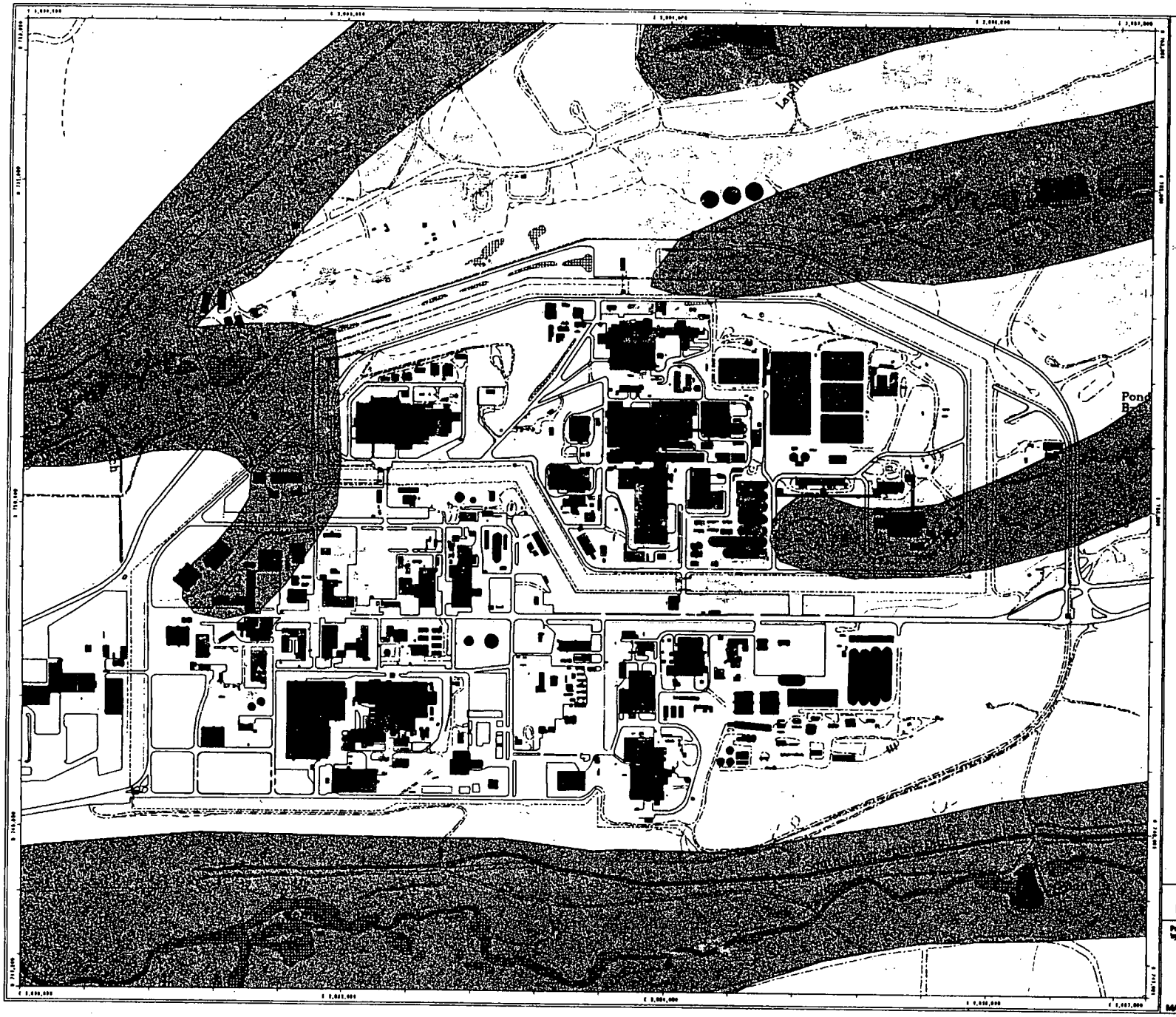

Figure 6
Ecology and NEPA Map

EXPLANATION

Wetland Features

- Wetlands
- Point Wetlands (< 10ft Diameter)
- Linear Wetlands (< 10ft wide)

Preble's Meadow Jumping Mouse

- Probable Range

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCES
Buildings, roads, and fences provided by Facilities Engr, 1990 Rocky Flats, Inc. - 1991.
Hydrology provided by "LEGS". (date unknown)

Scale - 1 : 10360
1 inch represents approximately 863 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:
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MAP ID: Draft

February 05, 1997

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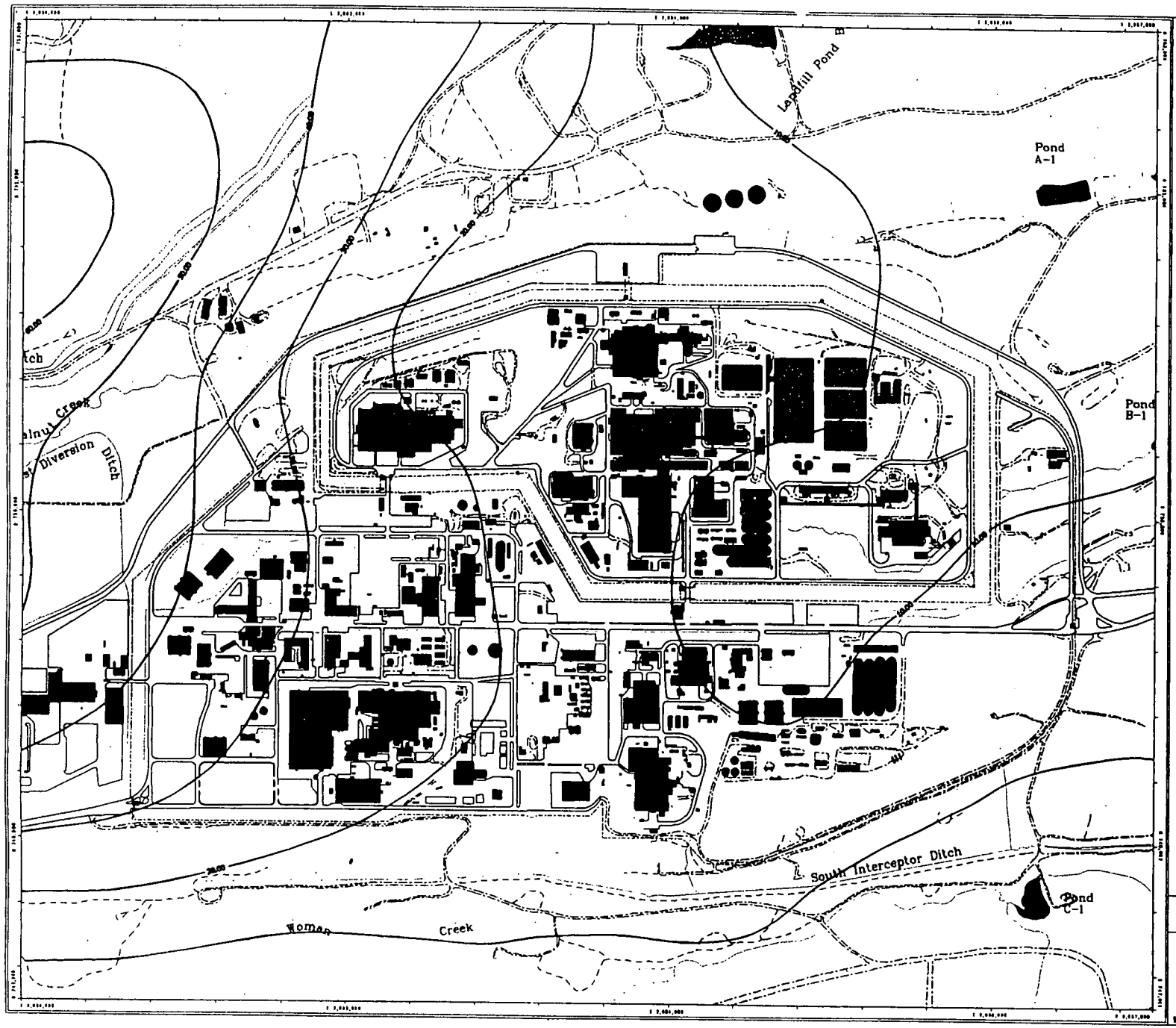

Figure 5
Thickness of Alluvium

EXPLANATION

- Thickness of alluvium
- Alluvium thickness greater than or equal to 40 Ft.

NOTE:
Potential economic thickness is 40 feet plus

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE
Buildings, roads, and fences provided by Facilities Engineering, EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by "LRSS" - (date unknown)

Scale - 1 : 10380
1 Inch represents approximately 863 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared for:
RMRS Rocky Mountain Remediation Services, L.L.C.
Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, CO 80402-0464

MAP ID: DnR

February 26, 1997

/home/shd12960/projects/rfs/dnr/dnr.dwg

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KAISER•HILL
COMPANY

October 17, 1996

96-RF-05996

Regina Sarter
Environmental Restoration
DOE, RFFO

TRANSMITTAL OF DRAFT INTERIM MEASURE/INTERIM REMEDIAL ACTION (IM/IRA) CORRECTIVE ACTION MANAGEMENT UNIT (CAMU) DESIGNATION REQUEST - JLU-001-96

Four copies of the draft IM/IRA CAMU designation request are attached for review. This document is in the final draft stage. After review by DOE this document will be revised and transmitted to CDPHE on November 4, 1996.

Kaiser-Hill and RMRS will provide an overview of the application to DOE on Monday, October 21, 1996. In order to meet the schedule for submittal of the CAMU designation request to CDPHE, we would appreciate comments by COB Friday, October 25, 1996. A meeting time can be scheduled on October 21 to discuss DOE's comments, if necessary. Please feel free to contact me at ext. 5976 with any questions or concerns.

Tim G. Hedrick for
J.L. Uhland
Management Integrator
ER/WM & I Operations

bag

Orig. and 1 cc - R. Sarter

Attachment:
As Stated

Kaiser-Hill Company, L.L.C.
Courier Address: Rocky Flats Environmental Technology Site, State Hwy. 93 and Cactus, Rocky Flats, CO 80007 • 303.966.7000
Mailing Address: P.O. Box 464, Golden, Colorado 80402-0464

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Regina Sarter copy

RF/ER-95-0105.UN, Rev. 0

DRAFT
CORRECTIVE ACTION MANAGEMENT UNIT INTERIM MEASURE/INTERIM REMEDIAL ACTION DECISION DOCUMENT AND APPLICATION SUPPORT DOCUMENT

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

October 21, 1996

751

RF/ER-95-0105.UN, Rev. 0

Draft
Corrective Action Management Unit Interim Measure/Interim Remedial Action Decision Document and Application Support Document

Rocky Flats Environmental Technology Site

Rocky Mountain Remediation Services, L.L.C.

752

October 21, 1996

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ABBREVIATIONS , ACRONYMS, AND INITIALISMS

AEC	United States Atomic Energy Commission
ALARA	as low as reasonably achievable
Am	americium
ARAR	applicable or relevant and appropriate requirements
BMP	Best Management Practices
CAB	Citizens Advisory Board
CAMU	Corrective Action Management Unit
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHWA	Colorado Hazardous Waste Act
cm/sec	centimeters per second
cy	cubic yards
Decision Document	Interim Measure/Interim Remedial Action Decision Document
D&D	Deactivation and Decommissioning
DOE	United States Department of Energy
DOT	United States Department of Transportation
ER	Environmental Restoration
ERDA	Energy Research and Development Administration
ft	feet or foot
FY	fiscal year
HW	hazardous waste
IA	Industrial Area
IA-East	Industrial Area-East
IA-West	Industrial Area-West
IDM	Investigation-Derived Material
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
in.	inch or inches
ITS	Interceptor Trench System
LDR	Land Disposal Restrictions
LLW	low-level waste
LLMW	low-level mixed waste
nCi/g	nanocuries per gram
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination
NSL	New Sanitary Landfill
NTS	Nevada Test Site
OU	Operable Unit

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QA/QC	quality assurance/quality control
QAT	Quality Action Team
PA	Protected Area
PAC	potential areas of concern
PCB	polychlorinated biphenyls
PCE	tetrachloroethene
PPRG	programmatic preliminary remediation goals
Pu	plutonium
RCRA	Resource Conservation and Recovery Act
RWSF	Remediation Waste Storage Facility
SE Quad	southeast quadrant
Site	Rocky Flats Environmental Technology Site
Site Vision	Rocky Flats Conceptual Vision
SW Quad	Southwest Quadrant
TBC	to-be-considered
TCE	trichloroethene
TRU	transuranic
TSCA	Toxic Substance Control Act
U.S.	United States
VOC	volatile organic compounds
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant

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Regina Sarter, ~~SCDH~~ ~~Surroundings~~ copy

EXECUTIVE SUMMARY - State from RFCA on potential future disposal conversion.

The Department of Energy is requesting the State of Colorado to designate a corrective action management unit (CAMU) for storage of remediation wastes at the Rocky Flats Environmental Technology Site (RFETS). This CAMU designation is being requested as an option to facilitate risk reduction activities in support of site closure at RFETS. This designation will serve as a contingency in the event assumptions in the Ten Year Plan regarding offsite disposal capabilities prove to be invalid and onsite storage capabilities are necessary to facilitate risk reduction. In addition, clean up levels for radionuclides in soils, still being negotiated at this time, may require additional storage capabilities. The CAMU designation request is presented in the form of this Interim Measures/Interim Remedial Action (IM/IRA) Decision Document and Application Support Document. The facility to be constructed and managed under the CAMU designation would be the Remediation Waste Storage Facility (RWSF).

The CAMU-designated RWFS provides the basis for a cost-effective, flexible, and achievable remediation waste management strategy for RFETS. The overall objective of this designation request is to provide a rationale and proposed alternative that supports the goals of the Rocky Flats Cleanup Agreement (RFCA) and preamble. The CAMU will support the RFCA goal (Preamble, B2(a)) of initially controlling sources of contamination as a priority over off-site shipment. The RWSF CAMU will allow early cleanup to proceed by supplying an on-site destination for remediation wastes.

sounds final

Only remediation wastes will be managed in this facility. Remediation waste types include contaminated soil collected from cleanup actions, treated and untreated sludge and sediments, Toxic Substance Control Act waste, such as asbestos and PCBs, treatment by-products from groundwater, surface water, and/or soil remedial actions, investigation derived materials (i.e. drill cuttings) from past and future characterization activities and decontamination waste which has been characterized as hazardous, low- level radioactive, or low-level mixed waste. It is the intent of DOE to request a CAMU for storage only, and that all waste will be removed from the RWFS prior to closure. The request that CDPHE make a finding of fact as to whether the proposed facility also meets the requirements for a disposal facility, as describe in paragraph 80 of the RFCA, is deferred. A determination has not been made on the period of operation, of the RWSF, or on the closure configuration. The closure configuration is dependent on the final decision for permanent disposal in the CAMU or offsite shipment, and cannot be addressed at this time.

including Pond sludge?

remove?

until future . . . .

This ~~CAMU~~ IM/IRA decision document details how the CAMU-designated RWSF supports risk reduction and eventual site closure in the following ways:

- Focuses limited funding resources on immediate risk reduction;

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- Defers unnecessary treatment costs by not requiring treatment unless it is necessary to protect human health or the environment, while concentrating funding on actual cleanup;

- Provides an option for additional source removals at selected Individual Hazardous Substance Sites IHSSs); and

- Allows DOE to achieve economies of scale, making treatment and eventual disposal less costly and more practical. - what of we have to treat to LOR

This decision document identifies and provides information on how the RWSF will meet all applicable regulatory criteria for CAMU designation by the State of Colorado Department of Public Health and Environment (CDPHE). In addition, this document identifies and implements the other ?? appropriate criteria supporting the selection of the CAMU location and conceptual design. The proposed selection was identified thorough a multi-phase alternatives analysis that evaluated several locations and technologies in order to achieve the objective of supplying a ~~remediation waste storage facility~~ (RWSF). National Environmental Policy Act (NEPA) values were also addressed within this selection process. Preliminary waste acceptance criteria, closure requirements, and a timeline are also included.

Several appendices supporting the decision process and the selected proposed alternative are attached to this document. These include siting studies, design descriptions, risk evaluations, NEPA values, and selection criteria.

Based on the initial screening and the comparison of alternatives, the best approach for a CAMU was determined to be an above-grade, concrete lined cell with primarily bulk placement, to be located in the eastern portion of the Protective Area near the former OU 4 Solar Ponds. This CAMU cell will be designed with a double composite liner and a final composite liner system equivalent to the Resource Conservation and Recovery Act (RCRA) Subtitle "C" requirements, as stated in the Code of Colorado Regulations (CCR) 6 CCR 1007-3, Part 264 Subpart N. Primary and secondary leak detection and collection systems between the two liners will provide further protection. An operational cover will provide isolation of the waste materials during operations + non ops ? The conceptual design includes features that will allow the CAMU to function as a retrievable storage facility include placement of the waste on a concrete floor; interior placement modules; waste containerization as appropriate; and waste mapping.

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1.0 INTRODUCTION

This Decision Document provides the ~~United States Department of Energy's (DOE)~~ RFETS technical justification and decision-making process for the option of siting and construction of a bulk storage remediation waste storage facility (RWSF) at the Rocky Flats Environmental Technology Site (the RFETS or Site) (see Figure 1-1). The document also serves as the initial application for designation of the proposed RWSF as a Resource Conservation and Recovery Act (RCRA) Corrective Action management Unit (CAMU). The CAMU designation is available as a regulatory alternative to facilitate the implementation of reliable, effective, protective and cost-effective remedies. The designation of the facility as a CAMU means more rapid cleanup for a larger volume of waste in a safer manner than the conventional RCRA approach allows. Instead of treating each contaminated area individually, the RWSF CAMU contingency allows for bulk remediation waste to be brought to one centralized facility for management and storage. The CAMU designation of a bulk storage RWSF is necessary as a contingency to achieve the targeted ten-year cleanup goal. The need for a bulk storage CAMU facility is dependent on the final action levels agreed to for radionuclide cleanup objectives.

The type of wastes to be managed in the facility would consist ~~primarily~~ of low-level, low-level mixed, and hazardous ~~remediation~~ remediation and deactivation and decommissioning (D&D) waste which is amenable to bulk handling and storage. Low-level waste refers to waste with less than 100 nCi/g of alpha radiation and D&D is what?

Within this Decision Document is the information necessary for the Colorado Department of Public Health and Environment (CDPHE) to designate a CAMU with the RWSF being the facility used for storage. This CAMU designation by the CDPHE is required so that the CAMU and RWSF can be included as a regulated unit at the Site. By having a CAMU designation, the ~~DOE~~ RFETS can meet the waste management objectives consistent with the recently signed Rocky Flats Cleanup Agreement (RFCA), July 19, 1996 (DOE 1996a). The importance of the CAMU option is also recognized by the State of Colorado's Hazardous Waste Commission when it stated in the introduction of the CAMU Statement of Basis that a CAMU "can facilitate corrective actions" (i.e., environmental cleanups at facilities like the RFETS). Clearly, with the accelerated schedules proposed in the RFCA and Site Vision, the need for the type of flexibility provided by the CAMU approach is required as a contingency.

In addition to RFCA, the Draft RFETS 10 Year Plan (TYP) (DOE, 1996b) has been developed to describe how accelerated cleanup and closure of RFETS would be achieved. The TYP addresses the management of remediation waste without a CAMU. Included in the TYP, as Major Decision 5, are assumptions for waste storage and offsite disposal capabilities. Cleanup levels for radionuclides in soils based on future site land use scenarios, are still being negotiated. The outcome of these negotiations will significantly impact the volumes of remediation waste that will be generated at RFETS. The CAMU designation is a contingency in the event a waste storage alternative is needed to effectively conduct the accelerated cleanup of the Site and meets the requirements of RFCA.

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&DOD

The CAMU area being sought through this Decision Document is to be located within the eastern portion of the Protected Area (PA) of the Site (see Section 7.1). Within this CAMU area, an above-grade concrete-lined storage cell serving as the RWSF will be constructed to store remediation waste primarily in bulk form. The 4.12 acre concrete-lined cell will be designed to hold 100,000 cubic yards (cu yd) of remediation waste; however, the actual capacity can be adjusted because of the conceptual modular design. This RWSF incorporates retrieval and monitoring aspects.

up to 400,000 cu yds.

RFETS Statement from RFCA

It is the intent of the ~~DOE~~ to request a CAMU for storage only, and that all waste will be removed from the RWSF prior to closure. The request that CDPHE make a finding of fact as to whether the proposed facility also meets the requirements for a disposal facility, as described in Paragraph 80 of the RFCA, is deferred until future . . . .

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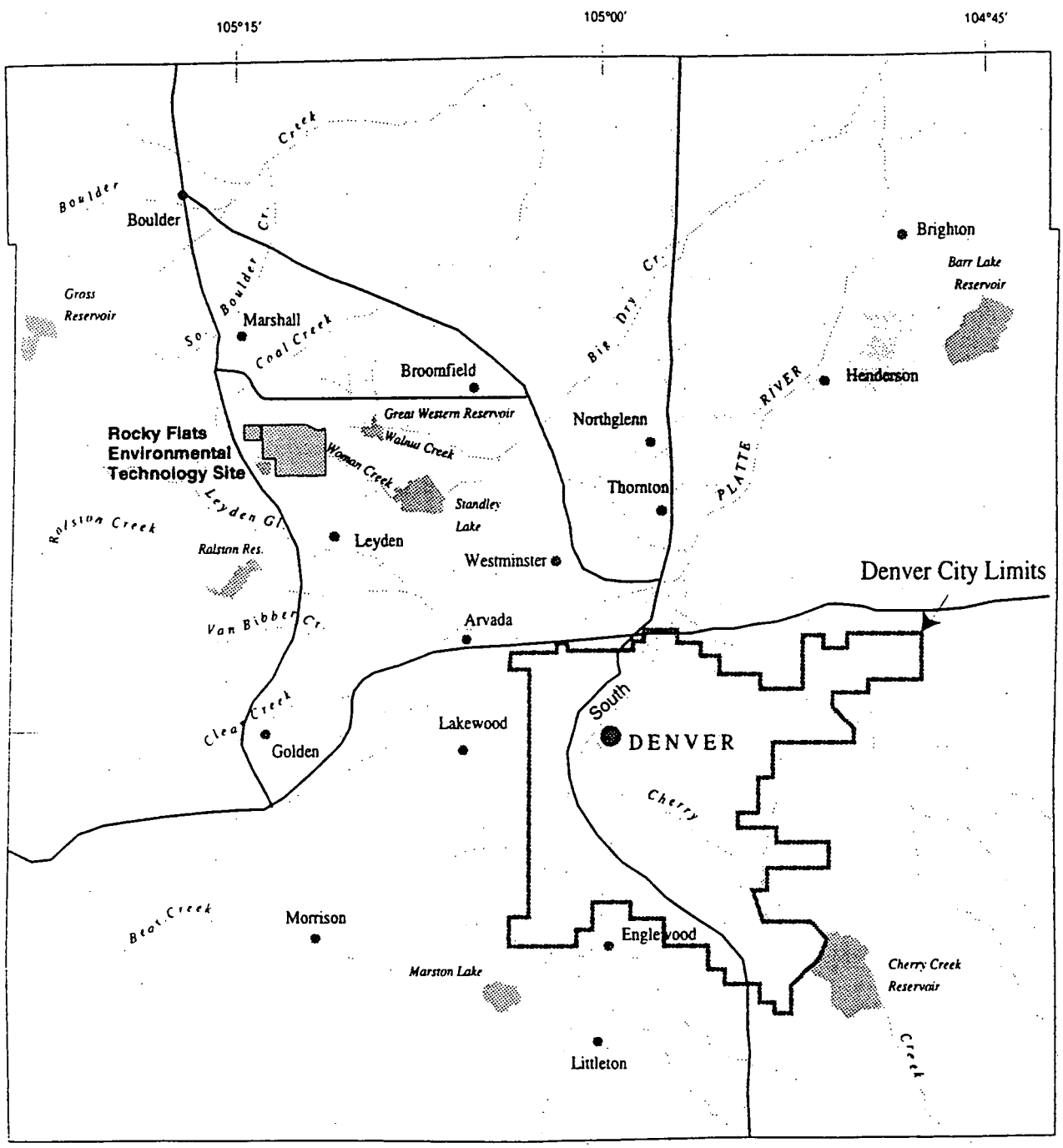

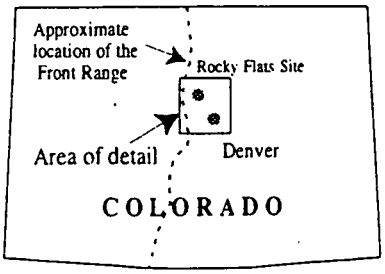

0 5 10 Miles

0 5 10 Kilometers

Figure 1-1

LOCATION OF THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

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1.1 Decision Document Organization

RFETS

This document is divided into nine sections with six appendices. In total, this Decision Document is structured to provide the information required to support the technical justification of the CAMU and to provide sufficient information for the CDPHE to designate the CAMU. This document also provides the decision-making process used by the DOE to arrive at the conclusion that a RWSF is required as a contingency to meet RFCA and Site Vision objectives. With the final selection of the concrete-lined waste cell, this document addresses each of the seven decision-making criteria contained in the State of Colorado's Hazardous Waste Regulations under 6 CCR 1007-3 Part 264.552. By responding to these seven criteria, the DOE has demonstrated and documented the rationale for CDPHE to approve a CAMU. This is followed by an identification of the requirements that a CAMU will need to meet. This, in turn, is followed by an evaluation and recommendation of the specific type of CAMU needed to meet the requirements identified.

sounds like they are separate

This Introduction presents the objectives of the Decision Document, the role of the CAMU and RWSF at the Site, a general discussion of the Site description as well as the Site history. Section 2 provides a point-by-point discussion of how the proposed CAMU and RWSF meet each of the seven decision criteria under RCRA for the CAMU. It is these criteria which will be used by the CDPHE to make a CAMU determination. Waste characteristics of the material to be stored in the CAMU are presented in Section 3.0.

what about DOE?

The development of alternative actions and selection of the preferred alternative for the management of low-level ~~and~~ low-level mixed, and hazardous remediation waste is presented in Section 4.0 through Section 6.0. Section 4.0 addresses substantive criteria as described in paragraphs 80 and 109 of RFCA and regulatory requirements spelled out in 6 CCR 1007-3, Subpart S, Part 264, to obtain CDPHE approval for a CAMU. Section 5.0 describes how the final alternatives for a CAMU were developed. It includes a description of the screening methodology and the description and results of the two screening phases: the facility siting study and the facility design screen. Section 6.0 describes the final comparison of alternatives and the rational for the selected remedy. Section 7.0 is a detailed discussion of the selected remedy (i.e., the concrete lined waste cell located in the eastern portion of the Protected Area). These details include a risk evaluation, waste acceptance criteria, facility operations, National Environmental Policy Act (NEPA) values, and a summary of the value engineering study. The schedule for the design and construction of the RWSF is presented in Section 8.0.

1.2 CAMU DECISION DOCUMENT SCOPE AND OBJECTIVES

- stated in paragraph 1.1

The following two sections discuss the scope and objectives for both this Decision Document and the CAMU. The primary objective of this CAMU Decision Document is to provide the CDPHE with sufficient documented justification for the need of a CAMU at the RFETS. In order to meet this primary objective, this document provides information on how the use of a CAMU can meet

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each of the seven decision criterion identified in the CAMU regulations (6 CCR 1007-3, Part 264, Subpart S) as well as the criteria included in paragraph 80 and 109 of the RFCA. This document also provides a description of the decision-making process leading to the conclusion by DOE that a CAMU with a RWSF is critical to the DOE's meeting the objectives of RFCA and the Site Vision.

1.2.1 Scope Description

In discussing the need for a storage facility, this document develops and evaluates the various alternatives available to manage remediation waste, including offsite disposal and various long-term storage options. Offsite disposal is evaluated as the "no action" alternative because the "action" described by this document is CAMU designation and construction of the RWSF. In the decision-making process, a screening phase is used to narrow the various options and a final selection process is used to conclude that the Concrete Lined Waste Cell east of the Solar Ponds is the best approach.

The two screening phases presented are:

1. Siting study to select a suitable location for onsite options.
2. A facility design analysis to evaluate design alternatives for onsite storage.

From the possible locations identified in the siting study, the best location was selected and then used as a basis for the facility design screen. In support of the RFCA, and in order to support the DOE objective of minimizing the area of contamination at RFETS, as well as maximizing to the extent practicable, offsite disposal, the DOE is requesting a CAMU designation for storage only. Any disposal option for the CAMU, as discussed in paragraphs 80 and 109 of RFCA, is currently deferred. All criteria and alternatives selected were developed based upon onsite storage followed by offsite disposal. The exception was a no-action alternative that examined the impact of immediate offsite disposal.

Pretreatment of remediation waste for specific Individual Hazardous Substance Sites (IHSS's) is not included in the scope of this document except for the purpose of cost estimating. The reason for this approach is that pretreatment is very specific to an IHSS action and specific waste types. Currently unresolved issues relative to radionuclide cleanup levels in soil also impact this assessment. This pretreatment discussion for each accelerated cleanup action will be included in Proposed Action Memorandum, Interim Measures/Interim Remedial Action Decision Documents, and Proposed Plans, or Remedial Action Plans for each specific IHSS or group of IHSS's; allowing treatment to be tailored to the specific action.

stated ml.

Waste acceptance criteria for the proposed RWSF will be addressed based on applicable RCRA and CERCLA requirements as well as applicable DOE policies. The types of requirements are described in Section 7.6, Conceptual Waste Acceptance Criteria. Waste acceptance criteria and operational details will be submitted during the design review and approval process. The scope of the Decision Document does not provide complete details of design, construction, startup, or

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operations; that information will be covered in subsequent documents following CDPHE designation of the CAMU.

The ability to retrieve and monitor the remediation waste was considered an important part of the decision process, especially in terms of community acceptance. Specific details of environmental monitoring are not in the scope of this document; however, groundwater monitoring is addressed in Section 7.1, and in accordance with 6 CCR 1007-3, Part 264, Subpart F, a groundwater monitoring plan will be prepared. Air monitoring will be addressed in any required Air Pollutant Emission Notices (APENs) and air permitting. Most air monitoring will be focused on construction and operations activities.

Final configuration after the stored waste in the RWSF has been removed will be to remove the structure and regrade and revegetate the facility footprint. Closure plans will be submitted during the design review process. The disposal option discussed in RFCA paragraph 80 is deferred at this time. until . . .

1.2.2 Decision Document Objectives

In order to meet the primary objective of documenting the technical justification for the CAMU and RWSF, this document provides information on how the use of a CAMU can meet each of the seven decision criterion identified in the CAMU regulations (6 CCR 1007-3, Part 264, Subpart S).

The objectives which lead to the determination that a CAMU option is necessary include the following:

1. In support of the RFCA and the TYP, the management of low-level. low-level mixed, and hazardous remediation waste must ensure the safety of the public, RFETS workers, and the environment through reliable, effective, protective and cost-effective management of remediation wastes at the RFETS.

2. A means of consolidating remediation waste in one location is needed to support near-term risk reduction goals while addressing long-term liability and safety issues.

3. The management of low-level, low-level mixed, and hazardous remediation waste must result in a cost-effective solution that can be implemented under existing budgetary constraints.

4. The solution must be compatible with future land uses for the Site and the Site Vision.

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1.2.3 Drivers

Several drivers establish the need for a CAMU designation as a contingency to meet the TYP as well as to serve as the basis for both the scope and the objectives of the Decision Document. These drivers include:

- The Site Vision is to have the Site cleaned to a level that is consistent with planned future land uses within a ten-year time frame, as identified in the TYP, which is a much shorter time frame than was previously considered.

  what is this? first time mentioned

- The need to consolidate waste management (both remediation and "as generated" waste) activities through a unified approach.

- The need to limit placement of remediation waste in existing permitted units because of a lack of storage capacity.

- The need to be cost-effective because of a diminished budget. Limited available resources will be focused on reducing the overall risk at the Site.

The unresolved issue of radionuclide cleanup levels as well as other uncertainties associated with the waste volume estimates for D&D and environmental restoration create a wide range of timely risk reduction and site closure can be diminished through development of a CAMU designated RWSF contingency.

Activities that are planned in future years are in areas that have a high priority from a risk reduction standpoint. Waste materials generated from planned risk reduction activities will include the residuals from trenches T-1 the Mound Site, the 903 Pad and Lip area. The typical media from these areas will be soils, sanitary sludges and drum carcasses. Soils will be excavated from OUs 9 and 10 during the cleanup of tanks T-2, T-3, T-9, T-10, T-14, T-16, and IHSS 129. A small portion of waste will come from specific hot-spot removals. Contaminated Investigation-Derived Materials (IDM) from environmental investigations will also be generated, and may include some IDM already removed from contaminated areas. A map of the OUs at the Site is shown in Figure 1-2. D&D activities associated with buildings in the 400, 700, and 800 areas may contribute substantial volumes of remediation wastes.

Finally, the last driver is the budget. The reality of a diminished budget for cleanup also dictates the need for cost-effectiveness in the direction and scope of the decision-making process. Overall risk reduction at the Site is influenced by the availability of funds and, therefore, the scope of the Decision Document was influenced by the overall Site strategy of reducing risk with limited funding. At the core of this strategy is the concept that it is best to focus available limited resources on reducing the overall risk at the Site. In essence, the Decision Document must determine, given the budget, what remediation waste management strategy can best reduce risk to the environment and the community.

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1.3 SITE DESCRIPTION

The Rocky Flats Environmental Technology Site (Site) is located in northern Jefferson County, Colorado, approximately 16 miles northwest of Denver (see Figure 1-1). Other surrounding cities include Boulder, Broomfield, Westminster, and Arvada, all of which are located less than 10 miles to the northwest, northeast, east, and southeast of the Site, respectively. The Site consists of approximately 6,550 acres of federal land in Sections 1 through 4, and 9 through 15 of T2S, R70W, 6th Principal Meridian. Most of the structures at the Site are located within a protected central area of approximately 400 acres, and are surrounded by a buffer zone of approximately 6,150 acres.

The Site is bounded on the north by State Highway 128, on the east by Jefferson County Highway 17 (also known as Indiana Street), on the south by agricultural and industrial properties and Highway 72, and on the west by State Highway 93.

The majority of residential use within five miles of the Site is located immediately northeast, east, and southeast of the Site. Commercial development is concentrated near residential developments north and southwest of Standley Lake as well as around Jefferson County Airport, approximately three miles northeast of the Site. Industrial land use within five miles of the Site is limited to quarrying and mining operations. Open space lands are located northeast of the Site near the City of Broomfield and in small parcels adjoining major drainages and small neighborhood parks in the cities of Westminster and Arvada. The west, north, and east sides of Standley Lake are encompassed by Standley Lake Park open space. Irrigated and non-irrigated croplands, producing primarily wheat and barley, are located north and northeast of the Site near the cities of Broomfield, Lafayette, Louisville, and Boulder, and in scattered parcels adjacent to the eastern boundary of the Site. Several horse operations and small hay fields are located south of the Site. Future land use in the vicinity of the Site may involve continued urban expansion, increasing the density of residential, commercial, and industrial land use in the areas.

The Site is a government-owned, contractor-operated facility, that is part of the nationwide Nuclear Weapons Complex. The Rocky Flats Environmental Technology Site was operated for the United States Atomic Energy Commission (AEC) from its inception in 1951 until the AEC was dissolved in January 1975. At that time, responsibility for the Site was assigned to the Energy Research and Development Administration (ERDA), which was succeeded by the United States Department of Energy (DOE) in 1977.

From 1953 through 1989, the RFETS was used to produce components for nuclear weapons from materials such as plutonium, uranium, beryllium, and various alloys of stainless steel. Additional plant missions included plutonium recovery and reprocessing, and waste management. Production activities included metal fabrication and assembly, chemical recovery and purification of process-produced transuranic radionuclides. The consequence of these various activities over nearly 40 years was the contamination of some of the RFETS soils, groundwater, buildings, process pipelines and associated waste management equipment.

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While environmental cleanup and waste management were a part of routine day-to-day operations at the RFETS, national heightened environmental awareness and new environmental regulations have expanded and accelerated both activities. The DOE, in response to these changing conditions and the radical change in global politics, set a new mission for the RFETS focusing on waste management, environmental restoration, and decontamination and decommissioning of facilities. Consistent with this new mission and with a view toward rapid and safe cleanup, the RFCA sets a framework and approach for this final phase of the waste management and cleanup program. The United States Environmental Protection Agency (EPA), the CDPHE, and the DOE have agreed within the RFCA to a wide range of objectives leading to the final disposition of the entire RFETS complex. Among these objectives are important areas necessary to responsibly address the environmental consequences of the past 40 years of operation and production.

Current waste handling practices involve onsite and offsite recycling of hazardous materials, onsite storage of hazardous and radioactive mixed wastes, and offsite disposal of solid radioactive materials at the Nevada Test Site (NTS). Rocky Flats Plant operating procedures historically included both onsite storage and offsite management of hazardous, radioactive, and radioactive mixed wastes.

Historically, the management of RFETS remediation waste has been cumbersome and has frequently required some form of storage. Investigation-derived materials (IDM), which are primarily drill cuttings from environmental investigations, have been placed in 30- and 55-gallon drums and managed as hazardous waste. This process has been labor intensive due to characterization requirements and can, at best, provide only a short-term solution for these materials. A majority of the IDM drums have been released from CERCLA/RCRA management through a risk characterization process.

Regina's Comments

2.0 VERIFICATION OF CAMU DESIGNATION CRITERIA

The ability to designate the RWSF as a CAMU is dependent on compliance with the criteria found in 6 CCR 1007-3 264.552 (c), Corrective Active Management Units (CAMU). In order to demonstrate a need for a CAMU at RFETS, these seven criteria were made an integral part of the decision-making process. Each of the seven CAMU criteria listed below is followed by a description of how the selected RWSF remedy demonstrates compliance with the criterion.

1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies.

The CAMU designation of the RWSF would be the cornerstone in successfully completing environmental restoration activities within the accelerated schedule for Site closure proposed in RFCA. The ability of the RWSF to provide readily accessible storage capabilities for large volumes of remediation waste, with generally low levels of contamination, facilitates reliable, effective, protective, and cost effective remedies by:

- Accelerating IHSS closures by providing a facility for interim storage and/or treatment of contaminated material while simultaneously developing cost effective offsite disposal capabilities. Currently, the logistics of offsite disposal limit schedules for closing IHSS. Designation of a CAMU will allow limited resources to be focused on supporting near-term risk reduction.

- Allowing RFETS to maximize economies of scale for treatment, storage, and disposal so that action levels for Site closure can be achieved.

The effectiveness of specific cleanup actions will be enhanced by the availability of the RWSF. This will allow for a more aggressive remediation strategy. Source materials, including contaminated soils that might have been left in place for a number of years as a continuing source of contamination will be removed from the environment and placed in the RWSF.

Stated redundantly

From a logistical standpoint, the RWSF will offer individual site clean up actions a reliable, readily available facility that can accept large quantities and wide varieties of remediation waste. The waste will not have to be transported offsite, ~~so little in the way of~~ staging and packaging for transportation will be necessary. There will not be the questions of whether a shipment can be transported, whether the shipment will be returned, or whether the facility will be in operation when needed. The RWSF will accept only remediation waste (including D&D waste). The flow of waste into the facility, therefore, will not be impacted by waste from other generators.

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~~Because of the modular, compartmentalized design of the RWSF, it will be able to accept a wide variety of remediation waste including D&D waste~~. The waste will not have to be homogeneous. Changes in waste form can be accommodated so that operations will not be held up due to unanticipated conditions in the field. For example, if during remedial excavation of soils, a drum or block of concrete is uncovered, this material can be put into the RWSF without shutting down remedial or RWSF operations or requiring extensive paperwork. Also, a wide variety of waste forms can be accepted so that even if the contaminants change, the RWSF can accommodate that change and the environmental remediation project can proceed without much delay. This availability of immediate storage will facilitate the effectiveness of cleanup actions by allowing all of the contaminants and source materials to be removed at once and with minimal delay.

already stated

D&D context i.e. wide variety of waste types

The RWSF CAMU offers more protectiveness than no action, cap-in-place, or several small storage facilities because it consolidates the remediation waste into an engineered barrier protective of human health and the environment. The remediation waste can be physically removed from an IHSS or building and placed into the RWSF. Additional engineered protection can be provided for the same cost because it is a single large facility as opposed to numerous smaller facilities. Remediation waste that might have been left capped in place or placed in several smaller storage facilities will have the benefit of being centrally located and completely surrounded by multi-layered impermeable protection. In addition, the remediation waste will be monitored at a single location. The leachate generated by all the remediation waste will be isolated and recovered at this single location.

The design proposed was selected based on the ability of the RWSF to provide a low-cost storage alternative while achieving compliance with applicable design standards as well as ensuring protectiveness of human health and the environment. Even with multiple protective design features, the concrete lined cell was still the most cost effective of any design considered. The cost was kept low by utilizing bulk storage in modular compartments as opposed to containers, by keeping the waste onsite for the immediate future, and by using a design that minimizes the footprint and material costs. Another factor that lowered cost was the ability of the RWSF to accept a wide variety of waste forms. The ability to accept the waste from D&D activities represents significant cost savings that can be directly translated into money available for additional Site closure activities.

when ship offsite what does it do to $$?

revised

how

~~Contaminated areas require more active management and, therefore, cost more to manage~~. Sources that may impact other site activities and workers as well as potential exposures to offsite receptors can be removed from the environment sooner if the RWSF is available. This supports the concept of accelerated site closure by allowing previously contaminated areas to be cleaned up to interim cleanup levels agreed to in RFCA rather than closed with contamination above action levels in place. Once contaminant sources

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not included as remediation waste

are removed from the environment through deactivation, D&D, and environmental restoration activities, cost savings can be realized since these areas no longer require active landlord management. This early closure can result in what is termed "mortgage reduction". Savings achieved from reducing the mortgage through these cleanup activities can be applied to accelerate additional activities supporting Site closure.

Treatment requirements which are not necessary to protect human health and the environment can be deferred under the flexibility of the CAMU regulations. This further allows finite resources to be focused on actual cleanup sooner rather than in the future.

2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents.

This criteria is meant to address ~~actual~~ risks that occur during active operation of the CAMU. Long term risk reduction is addressed under criteria 1 and 4.

Not only does the RWSF CAMU not create unacceptable risks but it eliminates risks that might be associated with alternative remedies. The RWSF CAMU minimizes risks to human health and the environment in the following ways:

- Remediation waste ~~is~~ will be removed from the environment and put into an effective and protective facility. No longer will it be exposed to natural transport phenomena that could spread the contamination.

- Safety precautions will be taken during construction of the facility. All activities will be performed within the safety and radiological protection standards that exist at the Site. Individuals with expertise specific to safety construction will ensure that all construction activities are carried out in a safe manner. Construction quality assurance efforts will ensure that the RWSF will meet all design criteria and performance standards for protectiveness.

- Initial transportation of the wastes will be performed in a controlled environment over short distances on non-public roads with minimal or controlled traffic. Operations will be closely monitored and safely controlled. Public exposure will be limited because the waste will not leave the plant site until final closure of the Site rather than throughout the life of site closure operations. Because the distances will be so short and the process will be tightly controlled, the risk of transportation accidents will also be minimized. Administrative and engineered controls will be used to ensure that high winds do not mobilize the contamination during transport. These measures may include precautions such as covered loads, spraying water or other dust suppressants on the loads, high wind shut downs, and other appropriate precautions. Final disposition of the wastes will be conducted once cleanup is complete, allowing resources to be more efficiently focused, economies of scale to be achieved, and support operations to be appropriately scaled.

- Safety during filling of the facility will also be closely monitored and controlled. Precautions being considered include spraying the waste for dust suppression, keeping the waste covered, high wind shut downs, and appropriate personal protective equipment. All filling activities will be conducted under appropriate health and safety plans.

* a cover that is protective of human health + environment

Indirect effects and cumulative impacts of the Environmental Restoration program at the Site will be reduced by utilizing the centralized RWSF. Impacts to the environment will be minimized because the footprint of contaminated areas will be reduced to one facility compared to multiple IHSSs that now exist, and the RWSF will be constructed and thus will not impact previously undisturbed areas of the Site.

~~contaminated~~ maybe mention precedent? - NO - we meet the criteria by locating on a contaminated area

3) The CAMU shall include uncontaminated areas of the facility, only if including such areas for the purposes of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.

- need to mention something on being "more protective"

This CAMU criteria was a major influence upon the selection of the RWSF location east of the Solar Ponds. This location is in a contaminated area of the Site. The proposed RWSF location east of the Solar Ponds overlaps with the following areas of contamination:

why?

- **IHSS 165 - The Triangle Area** This IHSS was part of the former OU 6. Drums containing plutonium-bearing wastes were stored in this area. The drums leaked and contaminated the soil. In 1973, 200 cubic yards of soil were removed from this site.

- **IHSS 176 - Swinerton and Walberg Contractor Storage Yard** This IHSS was part of the former OU 10. Water spray from the Solar Ponds blew into this area. Also, leaking drums containing waste oils and volatile organic compounds were stored here. Volatile organic compounds were detected during the soil gas survey characterization of this site.

- **HSS 101 - Solar Ponds Area** These are former OU 4 solar evaporation ponds which were used for storage and evaporation of liquid low-level radioactive waste. All of the sludge has been removed from the Solar Ponds but the liners are still in place. The proposed CAMU location overlaps the eastern edge of the ponds. Additional facilities may be placed on the ponds themselves if expansion of the RWSF is needed and designated in the future. Placement of the facility at this location is expected to facilitate cleanup operations at the Solar Ponds.

See fed reg Feb 16, 93 Preamble to CAMU Rule

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- **Building 964** - This building housed low-level waste storage. It was also exposed to the water spray coming from the solar ponds.

Although this area is contaminated, it is not expected that placement of the RWSF in this area will hamper any cleanup operations. Likewise, the levels of contaminants that would be found at the RWSF construction site are not expected to hamper its construction or operation.

4) Areas within that CAMU, where remediation wastes remain in place after closure of the CAMU, shall be managed and contained so as to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment.

This criterion is not applicable. At this time, the intended use of this facility is for monitored, retrievable waste storage.

5) The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). The Department shall designate a CAMU in accordance with the following:

(1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

(2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to hazardous wastes or hazardous constituents. Verbiage not necessary

Reference criteria #1 + #2

Once constructed, the facility will expedite remedial activities. Waste will be transported directly from excavation or treatment into the RWSF. Planning documents for cleanups will be simplified since the waste management methodology will be established. It will be possible to establish work crews that could clean up IHSSs in an almost assembly-line fashion, moving from IHSS to IHSS with the necessary equipment while trucks transport the remediation waste to the RWSF. Concurrent to these activities, new modules to the RWSF could be constructed so that there would be sufficient capacity available to accept the waste. Crews could be simultaneously performing deactivation followed by D&D and environmental restoration, moving from building to building, and transporting these waste materials to the RWSF. not these wastes

6) The CAMU shall enable the use, when appropriate, of treatment technologies (including innovative technologies) to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste that will remain in place after closure.

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Mention this is not ZDR treatment. What will the WAC of this fac. be? So refined WAC

The selected remedy supports the ability to treat waste before or after placement. Wastes could be treated in-place prior to excavation, after excavation, or because the RWSF design supports retrievability, the waste could be retrieved and treated. It could even be possible to apply some types of innovative technologies in the facility itself since the waste will be completely contained.

what are we referring to?

The CAMU will also support treatment technologies by acting as a centralized location for remediation waste treatment. This will also allow economies of scale to be achieved so that technologies not cost-effective for small quantities of wastes might be more applied to large volumes.

Will we be required to mod our RCRA permit to treat these waste? yes

Temporary or permanent staging areas near the facility could be set up, and mobile or permanent treatment equipment could be bought in. These treatment technologies could include soil washing, solidification, thermal desorption or more innovative technologies identified in the future.

7) The CAMU shall minimize the land area of the facility upon which remediation wastes will remain in place after closure of the CAMU unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2). The Department shall designate a CAMU in accordance with the following:

(1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

(2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to hazardous wastes or hazardous constituents.

This criterion is supported by the fact that multiple source areas at RFETS that might have previously been closed in place now have the option of closure to the action levels agreed to in the RFCA. The CAMU will support a bias towards removal rather than isolating sources in place. This will facilitate release of areas at RFETS for future land use, as described in the RFETS Vision.

If waste are going to be treated to a defined WAC. We need to state that in the scope or somewhere upfront

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3.0 WASTE CHARACTERISTICS

3.1 REMEDIATION WASTE CHARACTERIZATION

General waste types characteristics and volumes which may be placed into the RWSF are described in this section. Identification of waste characteristics, sources and projected volumes for the RWSF clarify and substantiate the need for a contingency to existing waste storage. Only remediation waste will be considered for management in this facility. No process

Remediation waste is defined as follows by RFCA, part 5, paragraph 25 bf.:

Remediation waste means all: "(1) solid, hazardous, and mixed wastes; (2) all media and debris that contain hazardous substances, listed hazardous or mixed wastes or that exhibit a hazardous characteristic; and (3) all hazardous substances generated from activities regulated under this Agreement as RCRA corrective actions or CERCLA response actions, including decommissioning. Remediation waste does not include wastes generated from other activities. Nothing in this definition confers RCRA or CHWA authority over source, special nuclear, or byproduct material as those terms are defined in the Atomic Energy Act."

The potential contaminants of concern in remediation waste include:

- Radionuclides (such as plutonium, americium, and uranium)
- Metals (such as cadmium and chromium)
- Volatile organic compounds (such as carbon tetrachloride, trichloroethene [TCE], tetrachloroethene [PCE])
- Semivolatile organic compounds
- Asbestos
- Polychlorinated biphenyls (PCBs) (such as Aroclor-1254)

less than 100 nCi/gram

Low-level waste, as defined by RFCA, is radioactive waste that is not high-level waste, spent nuclear fuel, by-product material, or transuranic waste (although it may contain small amounts of transuranic elements). The majority of the low-level waste managed at the RWSF will have a radionuclide activity much less than 10 nanocuries per gram (nCi/g] based on the Hazard Categorization Analysis (see Section 9.0 References, Kaiser-Hill, 1996a). Residuals from the Solar Evaporation Ponds, such as portions of the liners and sludge, will be considered remediation waste and suitable for placement in the RWSF. No process waste will be accepted. Waste media and forms (e.g., under 6 CCR 1007-3 Part 264.312-264.317, subpart N) for placement in the RWSF were modeled after Landfill restrictions, which include the following:

more to remediation waste section

more upfront

- No free liquids
- No compressed gases
- No transuranic (TRU) waste
- No incompatible wastes (such as pyrophoric uranium) ?
- No ignitable or reactive wastes — Not deactivation

Remediation waste types include:

- Contaminated soil collected from remedial actions
- Treated and untreated sludge and sediments from S Ponds
- Toxic Substance Control Act (TSCA) waste (such as asbestos and PCBs)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions
- IDM from past and future characterization activities, such as wells, and borings, if the IDM is characterized as hazardous, low-level, or mixed remediation waste
- D&D waste which has been characterized as hazardous, low-level, or mixed waste. D&D waste includes building rubble, equipment, and utilities removed from the building prior to demolition. — does not include deactivation

The LLMW and HW placed in the RWSF will consist of remediation waste which is currently stored at the Site and the remediation waste which will be generated in the future.

spell out

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3.2 REMEDIATION WASTE VOLUME

Waste volume estimates were based on planned risk reduction activities. A preliminary estimate of remediation waste types, and volumes is presented in the Table 3-1. The total volume of remediation waste is estimated to be 123,000 cu yd of which 114,000 cu yd could be placed in a RWSF after treatment. These estimates were based on current information and coincide with the Ten Year Plan waste volumes. These volume estimates are not intended to limit the size of the facility, but serve as a tool to create alternatives for the decision making process.

The actual volume of soil defined by Tier 1 and Tier 2 cleanup levels in RFCA could be larger or smaller because volume estimates were made with preliminary data. Final volumes will be determined in the field based on RFCA action levels and any other negotiated cleanup levels.

Table 3-1 Waste Identification and Volumes for a Remediation Waste Storage Facility

Waste Source (OU/IHSS's)	Description of Media	Waste Type	Estimated Total Volume (cubic yds)	Volume after T. D. Treatment (cubic yds)[1]
OU 4 Solar Ponds				
Liners	Asphaltic Material & Soils	LLMW (rads/metals)	120	120
Sludge [2]	Sludge	LLMW (rads/metals)	6,000	10,000
Accelerated Actions (Top IHSSs)				
OU 2 Trench T-1	Soil, Drums; Pyrophoric U	LLMW (rads/VOC)	1,100	1,100
OU 2 Trench T-3	Soil, Drums, San. Sludge	LLMW (rads/VOC)	1,700	60
OU 2 Trench T-4	Soil, Drums, San. Sludge	LLMW (rads/VOC)	2,100	60
OU 2 Mound Area	Soil & Drums	LLMW (rads/VOC)	600	20
OU 2 903 Pad	Soil & Asphaltic Mat.	LLMW (rads/VOC)	9,800	8,600
OU 2 Lip Area	Soil	LLW (rads)	13,500	13,500
OU 9 Tanks 9 & 10 (includes IHSS 118.1)	Soil, tanks, piping	LLMW (rads/VOC)	2,000	50
OU 9 Tanks 2 & 3	Soil, tanks, piping	LLMW (rads/VOC)	25	25
OU 1 IHSS 119.1	Soil	LLMW (rads/VOC)	1,500	20
OU 9 Tanks 14 & 16	Soil, tanks, piping	LLMW	120	120
OU 10 IHSS 129	Soil	HW (VOC)	2,200	0
Subtotal for Accelerated Actions			34,645	23,555
Investigative Derived Material (IDM)[3]	Drill Cuttings/Soil	LLMW, HW, LLW	1,300	130
D & D Waste[4]	Soil, Debris, rubble, etc.	LLMW, LLW, HW	64,880	64,880
Subtotal			106,945	98,685
Expansion Factor; 15%			16,042	14,803
GRAND TOTAL			122,987	113,488
Revision Date 10/10/96				

1. T.D. Treatment signifies Thermal Desorption Treatment.
2. The volume after treatment accounts for expansion due to the solidification process
3. The 1,300 yd^3 represents an inventory of 4,800 drums of which 1,600 drums or 430 yd^3 meet Tier 1 put back levels and will go to the Sanitary Lakdfill.
4. D&D waste volumes are estimated within a range of 44,880 to 164,880 cu yd.

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√ Reg in a's Comments

4.0 IDENTIFICATION OF SUBSTANTIVE CRITERIA

Paragraph 80 of RFCA provides: "(I)f the application meets the appropriate substantive criteria CDPHE will issue a CAMU designation." Likewise, the CAMU rule, promulgated pursuant to the CHWA, states that "(t)he Department shall specify, in the permit or order, requirements for CAMUs..." (See 6 CCR 1007-3, Part 264.552 [e).

4.1 CAMU Objectives

The designation of a Corrective Action Management Unit must be performed in accordance with the seven criteria enumerated in 6 CCR 1007-3, Part 264.552(c). The seven criteria are, by nature, high level objectives. For that reason, the seven criteria were adapted and used in Section 6.0 as the decision criteria for comparison and selection of an alternative. The seven CAMU objectives include:

1. The CAMU must facilitate the implementation of reliable, effective, protective, and cost-effective remedies;

2. The waste management activities associated with the CAMU must not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents;

3. The CAMU may only include uncontaminated areas of the facility if including such areas is more protective;

4. Where remediation wastes will remain in place after closure the CAMU must be managed and contained so as to control, minimize or eliminate future releases to the extent necessary to protect human health and the environment;

5. The CAMU must expedite the timing of remedial actions;

6. The CAMU must enable the use, when appropriate, of treatment technologies to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remediation waste.

7. The CAMU must be placed on the minimal area necessary to provide a reliable, effective, protective, and cost effective remedy.

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4.2 RFCA Requirements

Paragraph 80 of RFCA provides:

> ...that the design criteria for the facility described in this paragraph shall be the same whether the facility is for the retrievable, monitored storage of remediation wastes or for the disposal of remediation wastes. Specifically, the facility described in this paragraph must ensure retrievability of wastes and protection of human health and the environment through a combination of requirements that include, but are not limited to: detection and monitoring/inspection requirements; operating and design requirements, including cap/liner system that meets the requirements as set forth in 6 CCR 1007-3, Part 264, Subpart N; a groundwater monitoring system; and requirements for responding to releases of wastes or constituents from the units. In addition, where necessary for protection of human health and the environment, waste treatment will be required."

In response to RFCA paragraph 80, the following design and operating requirements will be addressed and implemented:

- leak detection;
- inspections;
- a cap that meets RCRA Subpart N requirements;
- a groundwater monitoring system;
- corrective action for releases; and
- a waste acceptance criteria, consistent with design and operation, that provides treatment of wastes where necessary.

The above requirements are discussed in Section 7 for the specific selected alternative, the Concrete Lined Cell. As part of the IM/IRA process, paragraph 109 of RFCA also directs consideration of seven topics, including:

- worker safety;
- protection of human health and the environment;
- transportation;
- facility design, containment, and monitoring;
- institutional controls;
- cost; and
- community acceptance.

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4.3 CAMU Requirements

Additional requirements for designation are enumerated in Part 264.552(e) of the CAMU rule. The following are the additional requirements:

- specification of the area configuration, Part 264.552 (e) (1));
- specification of the design requirements (Part 264.532 (e) (2);
- specification of operation requirements (Part 264.552 (e) (2);
- specification of groundwater monitoring requirements (Part 264.552 (e) (3);
- specification of closure and post closure requirements (Part 264.552 (e) (2) that:
  - minimize the need for further maintenance and (Part 264.552 (e) (4) (iii) (A);
  - consider the CAMU design (Part 264.552 (e) (4) (iii) (A);
  - consider the potential for releases (Part 264.552 (e) (4) (iii) (C);
  - consider the physical and chemical characteristics of the waste (Part 2 64.552 (e) (4) (iii) (D);
  - consider hydrological and other environmental conditions at the facility that may influence the migration of any releases (Part 264.552 (e) (4) (iii) (E);
  - consider potential human or environmental exposures to releases (Part 264.552 (e) (4) (iii) (F)
  - requirements for excavation, removal, treatment, or containment of remediation wastes (Part 264.552 (e) (4) (ii) (A);
  - requirements for removal and decontamination of equipment, devices and structures used in remediation waste management activities within the CAMU (Part 264.55 (e) (4) (ii) (C);

Paragraph 80 of RFCA provides: "(I)f the application meets the appropriate substantive criteria CDPHE will issue a CAMU designation." Likewise, the CAMU rule, promulgated pursuant to the CHWA, states that: "(t)he Department shall specify, in the permit or order, requirements for CAMUs..." (See 6 CCR 1007-3 Part 264.552 (e).

stated in 4.0

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Regina Sarter
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5.0 SCREENING OF ALTERNATIVES

A two-phase decision-making process was developed for screening and selecting remediation waste management storage alternatives that support the best remediation waste management strategy for the Site. The first phase evaluated different onsite locations and the second phase evaluated conceptual storage design alternatives. The onsite location selected was then coupled with the conceptual storage design alternative for inclusion in the Final Comparison of Alternatives. (See Figure 501, Decision Process for Remediation Waste Management).

5.1 PHASE 1 - ONSITE REMEDIATION WASTE STORAGE FACILITY SITING STUDY

The selection of a location for a RWSF at the Site is detailed in Appendix C, Onsite Remediation Waste Storage Facility Siting Study. The objective of Phase I was to evaluate and select an onsite location for a RWSF. The method used was as follows:

- Identify and rank criteria to be used for siting of an onsite RWSF location;
- Develop a methodology for a comparative analysis of different sites;
- Evaluate the criteria subjectively and assign a relative weighting factor to each criteria; and
- Recommend an onsite location based on the above criteria and methodology.

This process is described below.

1. Identify and rank criteria to be used for siting an onsite RWSF location. This criteria required, at a minimum, substantive requirements as discussed in Section 4, as well as general guidelines that had been discussed at various stakeholders meetings regarding a RWSF at the Site. The criteria were then organized into the six major categories summarized below, and further divided into specific issues within each of these major categories. Further details of the criteria are in Appendix D.

   - The ability to designate the RWSF as a ~~Corrective Action Management~~ Unit (CAMU): All CAMU criteria were evaluated, but the deciding criteria was the ability to facilitate the implementability of reliable, effective, protective, and cost-effective remedies, and to not include uncontaminated areas of the Site in the footprint of the RWSF. [illegible] Looby letter

   - The ability to ensure the protection of the public, per 6 CCR 1007-2 Part 2, Requirements for Siting of a Hazardous Waste Disposal Site: Although the RWSF is a storage facility, these criteria which relate to long-term disposal were used to

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evaluate locations for storage as an additional degree of protectiveness. There are 12 separate associated criteria under this requirement; a summary of these criteria is as follows:

- Geological and hydrogeological conditions of a site in which hazardous waste is to be disposed shall be such that reasonable assurance is provided that the wastes are isolated within the disposal area and away from natural environmental pathways that could expose the public for 1,000 years;

- Structural-related issues including slope and geotechnical stability will be addressed;

- The immediate area of the site should be in a strata of minimal groundwater flow;

- Relative depth to bedrock and groundwater; and

- The evaluation of the relative distance to the nearest discharge area will include consideration of groundwater flow direction and travel time.

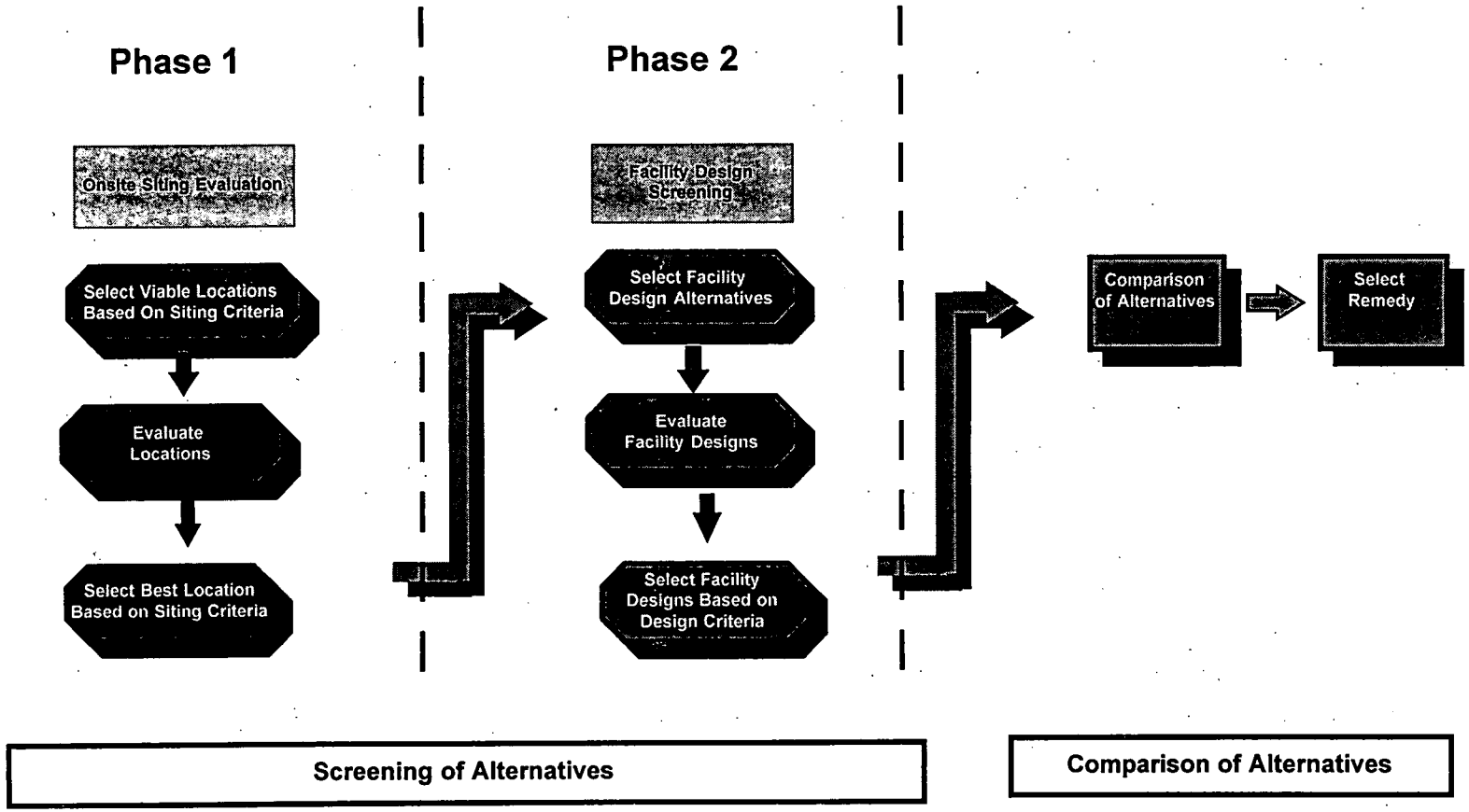
- The ability to support the RFCA. The Preamble to RFCA Section B.2 states: "Waste management activities for low-level, low-level mixed, hazardous, and solid wastes will include a combination of onsite treatment, storage in a retrievable and monitored manner, disposal, and offsite removal. Low-level and low-level mixed wastes generated during cleanup will be stored in a safe, monitored and retrievable manner for near-term shipment offsite, long-term storage with subsequent shipment offsite and/or long-term storage with subsequent disposal onsite of the remaining wastes."

- Cost criteria, including the cost of preconstruction activities, and the following:

  - Building demolition;
  - Subsurface utility line removal and rerouting;
  - Access requirements and power/facility requirements; and
  - The cost of engineering and construction of protective measures.

- Regulatory Support focused on using CDPHE guidelines (Looby, 1995) for onsite waste management of contaminated materials. Key points evaluated include the minimization of the number of disposal sites, consolidation of contaminated materials, and having a centralized site in an area with optimum geologic parameters preferably close to or within the Industrial Area with limited future land use.

Figure 5-1 Decision Process For Remediation Waste Management



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- Other Stakeholder concerns include the general acceptance of the RWSF by the general public and the Municipal or County governments.

2. Develop a methodology for comparative analysis of the different sites: A basic assumption was that the entire Site, both within the buffer zone and the Industrial Area, would be included in the evaluation. A series of GIS (Geographical Information System) maps were produced to assist in this evaluation. These maps, which included key elements cited in the criteria, were evaluated for being beneficial or adverse to the siting of a RWSF.

   The initial evaluation of the sites reduced the number of potentially useable locations to seven, with four in the buffer zone and three in the Industrial Area.

   Potential Industrial Area sites identified were:

   - Industrial Area-West (IA-West), an area on the west side of the Industrial Area;
   - Industrial Area-East (IA-East), an area on the east side of the Industrial Area; and
   - Solar Ponds, an area adjacent and east of the Solar Pond in the northeast section of the Industrial Area.

   The potential buffer zone sites identified were:

   - The New Sanitary Landfill (NSL);
   - An area encompassing the East Spray Fields (ESF);
   - An area in the southeast quadrant (SE Quad) of the buffer zone; and
   - An area in the southwest quadrant (SW Quad) of the buffer zone.

3. Evaluate the criteria subjectively and assign a relative weighting factor to each of the criteria: For a more detailed description of the methodology see Appendix C, Section C.2.2, Methodology.

   The methodology that was applied began by developing a relative weighting factor (%) based subjectively on the importance of each of the six categories of criteria as shown under Table 5.2 below.

Next, the categories were divided into 38 specific issues. Each of the issues was subjectively assigned a value between 0 and 3, with a 3 being a more important issue, 1 being less important, and a 0 being a potential fatal flaw.

The next step was to develop a matrix using the 7 locations versus the 38 issues (see Appendix C, Table C-2). A score was assigned relative to the other sites and the criteria being evaluated. A score of 0 for any of the 38 issues would signify a fatal flaw and the site would be withdrawn from further consideration in the evaluation. wording

Table 5-2 Methodology Weighting Factors

Category	Criteria	Weighting Factor (%)	Number of Specific Issues	Total Number of Points Assigned
1	Corrective Action Management Unit (CAMU)	15	7	19
2	Public Protection (Geotechnical and Hydrological Criteria)	20	12	28
3	Site Special Issues	20	8	15
4	Cost Criteria	15	2	6
5	Regulatory Support	15	5	13
6	Other Stakeholder Concerns	15	4	9
	*** Total**	**100**	**38**	**90**

* A weighted average was arrived at for each of the categories and the values were summed.

4. Recommend an onsite location based on the above criteria and methodology: The location receiving the highest score was the recommended onsite location for a RWSF (see Appendix C, Section C.2.3, Table C-5). The location recommended for a RWSF is the area in the northeast corner of the Industrial Area adjacent and east of the Solar Ponds (see Figure 5-2).

5.2 PHASE 2 - SCREENING OF ONSITE DESIGN OPTIONS

The objective of Phase 2 was to select and evaluate different design options for an onsite RWSF. A list of innovative RWSF designs was developed. This list was compiled from literature and input from the Citizen's Advisory Board (CAB), current Site practices, and designs in use at other facilities in the United States and Europe. These design options are either actual facilities in use or under consideration elsewhere (see Appendix E, Remediation Waste Storage Facility Design Alternatives).

The following design options were proposed for the screening process:

- Pyramid Design - Bulk waste is enclosed in a rectangular pyramid constructed out of granite blocks; design proposed at a meeting of the CAB by a member of the public;

- Metal Buildings - Waste is enclosed in cargo containers placed inside engineered metal buildings on concrete slabs; this is RFETS' current practice to store LLW;

- Slab on Grade - Waste is stored in cargo containers placed on an abovegrade concrete slab; This is current practice at some DOE/DOD sites;

- Hardened Concrete Vault - Waste in cargo containers is placed in an abovegrade freestanding concrete structure with liners and a leachate collection system; this is a current practice at the DOE Savannah River Site for LLW & LLMW;

- Abovegrade Concrete Lined Cell with bulk placement - Bulk waste is placed in modules in concrete lined cell. Under the cell is a liner and a leachate collection system;

- Abovegrade Concrete Lined Cell in Cargo Containers - Waste in cargo containers is placed in modules in concrete lined cell. Under the cell is a liner and a leachate collection system;

- Abovegrade Storage Cell - Earthen structure similar to a RCRA cell except facility would be constructed Abovegrade with berms and a liner/leachate collection system; design as proposed is similar to current practice around the nation to meet RCRA-Subtitle C, requirements;

- Silo Design - Bulk waste would be place in concrete cylinders which sit on top of a concrete pad. Under the pad is a liner/leachate collection system; this design was proposed in an interim report by the Idaho National Engineering Laboratory (INEL) (EG&G, 1994);

- Entombment - Waste would be placed in 55 gallon drums and then sealed with grout in concrete boxes which would be stored in a hardened concrete vault. This design was proposed in an interim report by the INEL (EG&G, 1994);

- Waste Pile - Bulk waste is compacted into a rectangular pile with all sides covered with a geomembrane. A liner system would be place under the pile. This design is based on the Interim Remedial Action for Basin F, Rocky Mountain Arsenal

- No Action (i.e., no CAMU designated Remediation Waste Storage Facility) - Remediation waste would have to be treated and shipped to an offsite disposal facility as soon as it is recovered. This alternative was included as required by CERCLA and NEPA.

The initial conceptual design screen, summarized in Table 5-3, which used the same criteria as the Siting Study, narrows the 11 design alternatives to four final design alternatives. Table 5-4 is a comparison of the 11 design alternatives with respect to cost.

As a summary by design alternative, the following results explain the rationale of screening each alternative for the selection of the final four design alternatives.

The Abovegrade Concrete Lined Cell is similar to RCRA Subtitle "C" landfills except that the facility would be built at grade. This facility also incorporates the concept of long-term waste management with protection to the public and the environment by constructing a double liner system with a leachate collection system. The total footprint of this facility is larger than the other options because of the side berms required for construction of the cell. This feature makes the cost higher than the Concrete Lined Cell bulk storage option. Retrievability is more difficult than a concrete lined cell or options utilizing containers. This design was selected because it is a known, proven design that meets RFCA requirements, provides the necessary protection, and is one of the less costly designs evaluated.

?

are we talking about dollars here?

The Abovegrade Concrete Lined Cell with bulk placement combines features of several alternatives. As a long-term RWSF it provides protection to the public and the environment because of the RCRA double liner system and a leachate collection system that allows for early detection of leaks. This facility would consist of a concrete lined cell with integral walls to separate the remedial waste, which would segregate the waste and provide for retrievability. The waste could be managed in both bulk and containerized forms. The cost for this option was the most reasonable compared to all other options because it offered flexibility

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in waste handling, had a smaller facility footprint, and still offered the necessary protectiveness. The modular design further enhances flexibility as well as enhances waste segregation and retrieval abilities. This design was selected because it meets the substantive criteria, provides the necessary protection and is cost effective.

Table 5-3 Summary of Facility Design Screen

Facility Design	CAMU Criteria	Public Protection (Geotechnical and Hydrological Criteria)
Pyramid Design	Not effective because of schedule concerns for expediting cleanup and higher costs. Hard to monitor. Reliability is not proven.	Structure could experience differential settlement and breach the barrier. Rigid structure not as elastic as other alternatives.
Silo Design	Minimizes land area by consolidation of waste to one location.	Design provides barriers and leachate collection to protect groundwater and surface water.
Metal Buildings	Intended as a short-term storage option with periodic maintenance. Costs are high due to bulk containers. Large area footprint because of number of buildings required.	Short-term storage. For up to 30 years it would provide adequate protection to environment. Protective barrier is the building shell and containers.
Slab on Grade	This alternative is a short-term storage option. Waste would be more exposed. Land area would be minimized. Retrieval would be more difficult.	Exposes containers to the weather elements, has a greater risk of releases to surface water or groundwater. No barriers.
Hardened Concrete Vault	Not cost-effective because of storage containers and rigid structure. Good retrievability with a larger footprint because of accessible aisles.	Provides multiple barriers to limit release of contaminants with a leachate collection system. Enclosed concrete structure and containers provide additional protection.
Abovegrade Concrete Lined Cell with Bulk Placement	A good mix of cost-effectiveness and protectiveness. Supports expediting cleanup activities because of modular design with integral separation walls for retrievability.	Provides numerous barriers to limit release of contaminants with a leachate collection system.
Abovegrade Concrete Lined Cell In Cargo Containers	Good retrievability but higher costs than Concrete Lined Cell because of waste containers.	Provides numerous barriers to limit release of contaminants with a leachate collection system. Containers provide additional protection.
Abovegrade Storage Cell	Provides good support for remedial activities, minimizes risk of future releases.	Liners and leachate collection system provides reliability, and protection to groundwater.
Waste Pile	Retrieval is difficult, similar to Abovegrade Storage Cell.	Short term Storage. No protective barriers or leachate collection.
Entombment	Good protection to environment and public. Larger footprint because of smaller containers for storage of wastes.	Provides additional barriers other than the multiple liners and leachate detection (i.e., concrete canisters and drums).
No Action	Individual remedial actions will require handling the waste separately by storing with ultimate offsite disposal.	Individual remedial actions will require handling the waste separately by storing with ultimate offsite disposal.

Table 5-3 (continued)

Facility Design	Site Special Issues	Cost Criteria
Pyramid Design	Does not provide an expeditious construction schedule because of logistics in acquiring the granite blocks. Does not support Site Vision.	This design fell in the middle of the range for total life-cycle costs.
Silo Design	Supports Site Vision and RFCA, relatively small footprint.	Cost-effective, third lowest total life-cycle cost due to small footprint .
Metal Buildings	Large footprint because of multiple facilities. Simple design allows quick construction.	Total cost is high due to cost of containers and multiple buildings.
Slab on Grade	Simple design allows quick construction. A short-term storage solution.	Total cost is high due to cost of containers.
Hardened Concrete Vault	Meets this criteria better than most designs, smaller footprint reduces impacts.	This option fell in the upper end of the cost range because of containers and free- standing rigid structure.
Abovegrade Concrete Lined Cell with Bulk Placement	Supports Site Vision and RFCA, small footprint, less impact to other Site programs. Flexible, modular type facility.	Low construction, site preparation, and closure costs yielded the second lowest total life-cycle cost of any of the designs.
Concrete Lined Cell In Cargo Containers	Supports Site Vision and RFCA, less impact to other projects.	This option fell in the middle of the cost range because of the cost of containers.
Abovegrade Storage Cell	Large footprint could cause additional impacts, supports Site Vision and RFCA.	Low total life-cycle cost in spite of high construction costs.
Waste Pile	Short term solution, consolidates wastes to one location, small footprint. Does not support RFCA or necessary requirements	The lowest life cycle costs due to a lack of protective features.
Entombment	The largest footprint of all alternatives. Construction would be very time- consuming and costly.	The most expensive design, highest life-cycle costs because of the double containment (drums and concrete bins).
No Action	Requires offsite disposal which could delay shipments and increase interim storage.	Total life-cycle costs were in the high end of the range because the offsite disposal cost.

Table 5-3 (continued)

Facility Design	Regulatory Support	Other Stakeholder Concerns
Pyramid Design	Design is not state of the art. No barrier systems or leachate detection other than the solid granite walls.	Questionable design/technology. Availability of materials in a timely fashion is uncertain.
Silo Design	Limited flexibility for future uses. Consolidation of waste in one footprint.	Design is not widely used. Protects environment and public. Retrieval would be more difficult.
Metal Buildings	Large footprint, , Poor consolidation of wastes since multiple buildings are required	Excellent retrievability. Proven technology and easy to implement quickly.
Slab on Grade	Small footprint for consolidation of wastes. Not a state of the art facility.	Excellent retrievability. Provides only minimal barriers for protection of environment. Proven technology and easy to implement quickly.
Hardened Concrete Vault	Long-term waste management. Protects environment and public.	Waste is retrievable, but not as retrievable as other designs. Proven technology but it would take more time and effort to construct.
Abovegrade Concrete Lined Cell with Bulk Placement	Long-term waste management that consolidates waste into modular/flexible facility.	Provides good protection to the environment and public health. Good retrievability because of integral dividing walls.
Concrete Lined Cell In Cargo Containers	Long-term waste management that provides good protection to public and environment. Retrievability is a little better because of accessibility to containers.	Provides good protection to the environment and public. Waste is more retrievable because of containerization.
Abovegrade Storage Cell	Provides good protection to the public and environment. Consolidates wastes into one location.	Proven technology because of past performance. Retrievability is achievable but fair because waste is in bulk quantities.
Waste Pile	Short-term solution. Provides good protection to public and environment. Not designed to meet RCRA considerations.	Retrievability is achievable but much more difficult than other designs due to a lack of segregation.
Entombment	Provides enhanced protection to the public and environment by the additional containers. Footprint is enlarged because of unusable/wasted space.	Retrievability is good because waste is segregated in concrete bins and drums. Longer construction schedule because of the complexity and number of drums to handle.
No Action	Increased interim storage until the individual remedial actions can ship waste offsite.	Requires offsite disposal. It would require interim storage and would delay some cleanup activities.

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Is this the cost of CAMU #2 (No) separate Estimate was done

Table 5-4 Comparison of Design Alternative Costs (Cost in thousands of dollars)

Alternative	Abovegrade Waste Cell	Pyramid	Concrete Lined Cell Bulk Placement	Concrete Lined Cell w/Containers	Hardened Concrete Vault
Total Life-Cycle Cost [1]	$118,800	$140,300	$77,320	$165,650	$181,630
Cost of Construction					
Design	$2,200	$2,200	$1,600	$1,600	$2,200
Pre-Construction	$400	$400	$150	$150	$400
Construction	$41,700	$57,900	$18,600	$18,600	$26,000
Total Cost of Construction	$44,300	$60,500	$20,350	$20,350	$28,600
Cost of Site Preparation	$8,800	$14,500	$1,970	$1,970	$6,100
Cost of Closure					
Interim Cap	$5,300	N/A	$5,300	$5,300	$5,300
Interim Closure Care & Monitoring	$13,900	$13,900	$13,000	$10,400	$10,400
Total Cost of Closure	$19,200	$13,900	$18,300	$15,700	$15,700

Table 5-4 (cont.) Comparison of Design Alternative Costs (Cost in thousands of dollars

Alternative	Silo Design	Slab on Grade	Metal Buildings	Entombment	Waste Pile	No Action
Total Life-Cycle Cost [1]	$107,300	$141,600	$161,400	$525,000	$36,669	$215,900
Cost of Construction						
Design	$2,000	$300	$2,300	N/A [2]	N/A [2]	N/A [2]
Pre-Construction	$400	$200	$1,300	N/A [2]	N/A [2]	N/A [2]
Construction	$30,400	$3,800	$17,900	N/A [2]	N/A [2]	N/A [2]
Total Cost of Const.	$32,800	$4,300	$21,500	N/A [2]	N/A [2]	N/A [2]
Cost of Site Preparation	$6,100	$6,100	$2,800	N/A [2]	N/A [2]	N/A [2]
Cost of Closure						
Interim Cap	$5,300	N/A	N/A	N/A [2]	N/A [2]	N/A [2]
Interim Closure Care & Monitoring	$13,900	$8,500	$10,400	N/A [2]	N/A [2]	N/A [2]
Total Cost of Closure	$19,200	$8,500	$10,400	N/A [2]	N/A [2]	N/A [2]

Footnotes:
1. Total life-cycle costs also include costs for containers, permitting, operations, contingency, etc. More detailed estimates are presented in Appendix E.
2. Costs for these alternatives were not broken down because of the following:
   - The Entombment costs were based on a projected total cost that did not address specific costs.
   - The Waste Pile costs were based on actual costs from Rocky Mountain Arsenal Cleanup in Colorado
   - These costs were not applicable for The No Action alternative.

The cost of eventual off site disposal was not included in any of the options except the No Action Alternative

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CAMU #2 ? No the CAMU #2 is ~~[illegible]~~ a building design

The Abovegrade Concrete Lined Cell in cargo containers is similar to the aforementioned Concrete Lined Cell with bulk placement except that all remedial waste would be stored in cargo containers rather than bulk. A slightly higher degree of protection for the public and the environment is met because the containers act as an additional barrier. The retrievability is enhanced because of the containers, however, the cost is significantly higher than bulk placement. The design was screened out because the ability to put the waste in containers could not justify the additional cost. — then what is our just. for CAMU #2 ? Not CAMU #2

The Hardened Concrete Vault alternative is a free standing, totally enclosed concrete structure intended for long-term waste management. Remedial waste would be stored in cargo containers which would be considered a fairly good retrievable option with built in aisles. Protection to the public and the environment is good because of the RCRA double liner system and leachate collection. The cost is high relative to other designs because of the cost of containers and free-standing rigid structure. The ability to monitor the facility is good because of the leachate detection system. This design was not considered as viable as other designs because of its high relative cost and the time and effort it would take to design and construct such a facility would impact remedial activities.

The Silo Design incorporates the concept of long-term waste management by storing remediation wastes in totally enclosed 5,000 cy concrete silos. As in some of the other alternatives, this facility would incorporate a double liner barrier with a leachate detection system. An extra level of protection for the environment and the public is provided because of the concrete silos. The remediation waste is retrievable because of the multiple silos, and the cost is lower than most of the other designs. This design was eliminated because the ability to retrieve waste is not as good as most of the other designs and it offered about the same level of protectiveness as the concrete lined cell but still would cost more.
Slab on Grade is similar to the Metal Buildings alternative from the standpoint of becoming a short-term (i.e., 25-30 yrs.) waste management option. The remedial waste would be placed in stored cargo containers which are stacked on a slab on grade. The slab on grade is open to the environment and would not have any protective liners or barriers underneath. Liners were not deemed necessary because the cargo containers could be inspected and leakage could be detected early on. It is possible to add a liner but the costs would increase. This option would have a high degree of retrievability because of the accessibility to cargo containers. Again, the maximum life cycle of this alternative is approximately 25 to 30 years before the remedial waste was redispositioned. The cost for this option was high because of the additional cost for containers. The alternative was screened out because it could not offer the protectiveness of other designs and yet was more expensive.

Metal Buildings were more expensive than other alternatives because of the cargo containers and the number of buildings. This alternative has no liner system for protection of the environment other than the containers and the building structure which provides adequate

protection for the life of the facility (25 to 30 years). A liner system was not needed because the containers could be inspected for leaks. A liner system could be added but would increase the total cost of the facility. Although this design supports the intended cycle of the 10 Year Plan, the protectiveness of this design is less than the concrete-lined cell designs and the economies of scale achieved through bulk storage are absent. The facility footprint would be larger than other options because of the required large central corridor for routine access and monitoring. The retrievability of this option is good because of the accessibility to cargo containers. This alternative was not screened out because it is an established design and offers good retrieval and inspection capabilities.

The Entombment alternative protects the public and the environment because of the multiple barrier systems. Again, this facility would incorporate a double liner system with a leachate detection system. This design option stores remediation waste into 55-gal drums which are then stacked as a cluster of eight in concrete bins. The enclosed concrete bins are then stacked within the cell liner. Because of the multiple container/barrier system, the cost for this alternative is the most expensive. The footprint for this facility is larger because of the wasted space within each concrete bin. The retrievability is good for this alternative as well. This alternative was screened out because its cost, large footprint, and the additional time and effort to construct the facility could not be justified by its level of protectiveness.

The Pyramid Design was not as favorable as the other design alternatives because of several concerns. Schedule concerns for expediting the remedial actions would be dependent on acquiring the large volume of granite stone and construction. Monitoring and retrieving the remedial waste would be difficult in this structure due to accessibility. The downgradient wells would be the only indication of a contaminated plume. A liner system could be added to this design but would increase the total cost and the cost is already one of the highest of any of the alternatives examined.. The remedial waste is not segregated but is stored in a bulk capacity. The facility is a totally enclosed rigid structure and would require stringent design standards to prevent differential settlement which could crack mortar joints and ultimately breach the barrier. From this standpoint, long-term maintenance would be required. This alternative was screened out because of cost, concerns about settling, the availability of materials, and concerns about the facilities ability to contain and monitor the waste.

The Waste Pile alternative is a short-term waste management solution. The remediation waste is enclosed with a surrounding geomembrane . The facility footprint would generally be smaller than the other alternatives because the waste is stored as bulk. The retrievability is achievable but at a lesser degree and is measured similar to the Abovegrade Waste Cell. Logistics of daily operations would be difficult because the waste pile would be open to the environment. The protectiveness of this design is poor. The design does not support the active management of waste as envisioned in the 10 Year Plan nor does it meet the basic requirements for a CAMU described in RFCA. This alternative was screened out because of poor protectiveness, an inability to support cleanup operations and an inability to meet 6 CCR 1007-3 Part 264, Subpart N as required by RFCA.

The No Action Alternative is carried throughout the screening process because of the requirements of NEPA and CERCLA as a baseline. The No Action Alternative essentially means the remediation waste is prepared for offsite disposal and no CAMU designation is obtained . If the No Action Alternative was followed through, and no long-term onsite RWSF was planned for, then the individual remedial actions would have to handle their wastes at the time of generation. This would result in an early expenditure of funds to meet treatment, transportation, and disposal costs which would limit the funds available for actual cleanup activities in support of site closure.

The four selected alternatives that reached the final screening were as follows:

- Abovegrade Storage Cell;
- Abovegrade Concrete Lined Cell with bulk placement;
- Metal Buildings; and
- No Action Alternative.

Several factors affected the selection of these alternatives for the final comparison which are explained below.

The Abovegrade Storage Cell is similar to the standard hazardous waste landfill built to RCRA Subtitle "C" standards. This facility would be built above the existing grade to prevent groundwater infiltration. This design, as well as the Concrete Lined Cell are proven technology. As with the Concrete Lined Cell, the liners and leachate collection system provide the ability to detect leaks and recover contaminants prior to entering the environment. This facility offers flexibility, retrievability and still remains one of the least expensive over the long term. In addition, this design supports the RFCA in terms of design requirements, and supports the 10 Year Plan by providing the necessary flexibility.

does this not meet RFCA Yes

The abovegrade Concrete Lined Cell with bulk placement (Concrete Lined Cell) was selected for the final comparison for several reasons. The concrete cell adds another layer of protectiveness to groundwater from the leachate generated during placement and storage operations. This design is flexible and allows for modular installation that will optimize the sizing of the cells and timing of the installation as waste is generated. This design will also expedite risk reduction activities under the Site Vision because of the flexibility. The first module will be sized for 25,000 to 33,000 cu yd of waste, and therefore, can be installed more quickly. Subsequent cells would be added as needed up to a total capacity of approximately 100,000 cu yd. A fair degree of retrievability is maintained because a combination of containers and bulk storage is utilized. This allows the flexibility to utilize the facility for either short-term or long-term storage.

400 cu yd

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The Metal Buildings alternative was selected for the final screening because it would allow for interim storage of the waste until the final disposition is determined. Storage of waste will allow remediation to proceed in a timely fashion. The waste would be stored in cargo containers and would be fully monitorable and recoverable. It was, therefore, believed that public perception and acceptance of this alternative would be high despite the higher cost and shorter useful life.

The No Action Alternative was selected for the final screening because it must be assessed to meet NEPA values and 10 CFR 1021.321(c) requirements.

The final design alternative comparison used the RFCA criteria, as discussed in Section 6, to select the best alternative.

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6.0 COMPARISON OF ALTERNATIVES

Based on the analysis presented in this decision document, bulk placement of the remediation waste in the Concrete Lined Cell at the Site east of the Solar Pond is the remedy selected for management of remediation waste. The abovegrade Concrete Lined Cell with Bulk Placement was selected from the four final alternatives screened in Section 5.0:

- Abovegrade Storage Cell;
- Abovegrade Concrete Lined Cell with bulk placement;
- Metal Buildings; and
- No Action Alternative.

These four design alternatives were compared using the seven RFCA criteria from Paragraph 109a (DOE, 1996a) to select the best Alternative for remediation waste management at the Site. The seven RFCA criteria are as follows:

1) Worker Safety;
2) Protection of Public Health and the Environment;
3) Transportation;
4) Facility Design, Containment and Monitoring;
5) Institutional Controls;
6) Cost; and
7) Community Acceptance.

Two other criteria have been included that address NEPA values:

- Short-Term Effectiveness; and
- Long-Term Effectiveness and Permanence.

A summary of the final comparison of Alternatives is given in Table 6-1. Statements concerning public acceptance serve as placeholders and will be modified based on public input as the review cycle progresses.

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Table 6-1 Summary of the Final Alternative Comparison for Remediation a Waste Storage Facility

Final Design Alternative	RFCA Criteria Worker Safety	Protection of Public Health and the Environment	Transportation	Facility Design, Containment and Monitoring	Institutional Controls
Abovegrade Storage Cell	Risks to workers are similar for all Alternatives considered. Spraying of water during construction will reduce exposure to dust. Location is in a low traffic area.	RCRA double liner system provides groundwater protection. Leakage would be detected in the liner system	Centralized location minimizes transportation requirements onsite. Design and location should have minimal impact on existing traffic patterns.	Liner system provides additional containment plus the ability to detect leaching. Air monitoring could be performed in conjunction with existing RFETS monitoring.	The RFCA acts as an Institutional control requiring continued maintenance of the facility. Since the use of the facility is for short-term storage, controls beyond those inherent in RFCA are not necessary.
Concrete Lined Cell with Bulk Placement	Risks to workers is similar for all Alternatives considered. Spraying of water during construction will reduce exposure to dust. Location is in a low traffic area.	RCRA double liner system provides groundwater protection. Concrete walls and floor provide additional protection. Leakage can be detected and collected prior to reaching liner system.	Centralized location minimizes transportation requirements onsite. Design and location should have minimal impact on existing traffic patterns.	Leachate would be detected and collected in a cell collection system prior to reaching the subsurface liner. Air monitoring would be performed in conjunction with existing RFETS monitoring.	The RFCA acts as an Institutional control requiring continued maintenance of the facility. Since the use of the facility is for short-term storage, then controls beyond those inherent in RFCA are not necessary.
Metal Buildings	Risks to workers is similar for all Alternatives considered. Spraying of water during construction will reduce exposure to dust. Location is in a low traffic area.	Containerized waste and building reduces exposure to the worker and the public. Visual inspections allow leaks to be detected before release to the environment.	Centralized location minimizes transportation requirements onsite. Design and location should have minimal impact on existing traffic patterns.	No liner system would be present; however, waste would be in containers which would be more easily monitored visually. Air monitoring would be performed in conjunction with existing RFETS monitoring.	The RFCA acts as an Institutional control requiring continued maintenance of the facility. Since the use of the facility is for short-term storage, then controls beyond those inherent in RFCA are not necessary.
No Action Alternative	Some increased exposure could occur due to increased transportation requirements. Worker risk is similar to risk for storage Alternatives.	It is assumed that permitted offsite facilities are protective. Increased transportation risks will occur.	Upgrades to existing facilities could be needed to accommodate offsite shipments. Shipments would be transported through several major population centers. by rail or truck .	Off-site facility would offer less containment in terms of design but more containment in terms of geologic setting. The off-site facility would have air and water monitoring capabilities.	Institutional controls would exist for offsite facilities.

Table 6-1 (continued)

Final Design Alternatives	Cost[1]	Community Acceptance	Short-Term Effectiveness	Long-Term Effectiveness and Permanence
Abovegrade Storage Cell	This Alternative has a high total cost of **$119M** and requires a large footprint for the total facility.	Monitoring and retrieving the waste is more difficult with this option.	Reduces waste handling requirements for accelerated actions and D&D projects. Focuses resources on risk reduction.	Provides sufficient permanence for an interim solution. Utilizes natural nondegradable materials in cap and liner design to support long-term use.
Concrete Lined Cell With Bulk Placement	This Alternative has a total life-cycle cost of **$77M**. The cost benefit outweighs other Alternatives and allows more resources to be applied to risk reduction rather than waste management. Option offers an ability to monitor and retrieve waste at a relatively low cost.	This Alternative offers monitoring and retrievability of the remediation waste but physical inspection is not to the degree that metal buildings would offer.	Reduces waste handling requirements for accelerated actions and D&D projects. Modular design allows for rapid construction. Focuses resources on risk reduction.	Provides sufficient permanence for an interim solution. Utilizes natural nondegradable materials in cap and liner design to support long-term use.
Metal Buildings	This Alternative has a life-cycle cost of **$161M**. The high cost is the result of the container costs.	This Alternative combines easy monitoring and retrievability with offsite disposal. Visual leak inspection is possible. Protectiveness is less than other onsite options.	Additional packaging requirements needed to containerized waste. Rapid construction will speed up availability of facility. Focuses resources on risk reduction.	Provides sufficient permanence for an interim solution The buildings themselves are not effective for the long-term due to high maintenance.
No Action Alternative	This Alternative has a life-cycle cost of **$216M**. This cost is driven by the cost for containers, waste treatment, and offsite disposal costs.	Waste would be sent offsite. Waste would be transported near population centers.	Readily available to support on going projects. Additional effort needed for packaging, transportation, and documentation requirements.	All offsite disposal facilities under consideration have been designed for long-term use.

1. Cost estimates, except the No Action Alternative, do not include offsite shipment and disposal which is deferred until closure of the RWSF.

Worker Safety - Each of the Alternatives poses risks to workers. All of the Alternatives will be labor intensive to implement but will not pose any unusual risks. Air monitoring, spraying to minimize dust, and the use of a daily cover will protect plant workers from airborne contaminants during construction and operations. Once constructed, the onsite Alternatives will pose minimal risk to RFETS' workers because engineered barriers will contain the remediation waste. In addition, the selected site is in an area of minimal traffic. Worker safety for the no-action Alternative at offsite location was not evaluated but was assumed to be comparable to the onsite Alternatives.

Protection of Human Health and the Environment - In terms of design, the Concrete Lined Cell with bulk placement has the most protective design elements. A significant advantage is the leachate collection system in the concrete floor of the cell. Unlike the above-grade storage cell, contaminants could be detected and captured within the cell. In the above-grade storage cell design, the contaminants would be captured in the first or second layer of liners. The metal building Alternative could also contain the leakage in the structure of the facility, itself; however, once the leakage is out of the buildings, contaminants would escape into the environment since there is not a liner system. In contrast, the Concrete Lined Cell has a double liner system.

The no-action Alternative would immediately have to rely on an offsite facility to provide protection. A permitted offsite disposal facility is assumed to afford adequate protectiveness once the waste is placed. Additional risk to human health and the environment would occur as a result of increased handling requirements and transportation. In addition, substantially more treatment, handling, transportation, and disposal costs would be incurred for each IHSS or cleanup action. These additional costs would limit the amount of risk reduction per dollar that could be accomplished. This, in turn, would result in more contaminant sources remaining exposed in the environment and could actually increase the risk to human health and the environment.

All of the Alternatives offer protection from erosion. Likewise, there is little difference among the Alternatives in terms of biological impacts since these impacts are expected to be minimal.

Transportation - The central location of the RWSF will minimize onsite transportation of remediation waste. In addition, the location is in a low traffic area. However, eventual shipment offsite will require additional transportation either by truck or by rail. Offsite shipments would pass through at least two major population centers; there is only one facility currently available to accept low-level and mixed low-level wastes and that would probably be utilized and the routes to this facility are limited. It is possible that under the three onsite storage alternatives that remediation waste could be shipped to Alternative offsite facilities thereby reducing transportation risks. For all of the alternatives, upgrades to RFETS shipping and transportation facilities would be necessary.

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Facility Design, Containment and Monitoring - All of the onsite Alternatives have engineered features to provide additional containment and monitoring. The Concrete Lined Cell with bulk placement has the best physical containment because both the cells and the liners have a leachate collection system. The metal building Alternative offers the ability to visually monitor the waste, plus the waste would be in containers and easily retrieved for shipment. The Abovegrade Storage Cell does not offer the same degree of monitoring or containment as the two other onsite options.

Institutional Controls - The selected location in the Solar Ponds Area combined with the RFCA acts as an institutional control since the DOE must comply with paragraph 278 of the RFCA which would require continued maintenance of a containment system in the event that the property is leased or the title is conveyed to another party. Because the RWSF will only be operational as long as operations are continued in the Industrial area, additional institutional controls beyond the existing controls are deemed not necessary. For the no-action Alternative, institutional controls of some form would likely exist; however, DOE and CDPHE involvement in those controls could be minimal.

Cost - Based on near-term costs, the concrete-lined cell was the least expensive ($77,300,000). The no-action Alternative was more expensive ($215,900,000) than the other Alternatives specifically because of the cost of treatment and disposal. This cost is likely to be deferred for the other Alternatives until the waste material is removed from storage. The Abovegrade Storage Cell was more expensive ($118,800,000) than the concrete-lined cell because its footprint was bigger which would require more site preparation and fill material. The cost of the metal buildings ($161,400,000) is also greater than the cost of the concrete-lined cell because of the cost to purchase containers and, again, because of the additional costs incurred by having a larger footprint.

The costs for each Alternative are listed in Table 6-1. A more complete breakdown of costs are in the Alternative descriptions in Appendix E and in the backup for the facility design screen in Appendix F. None of the cost estimates included offsite disposal which was assumed to be deferred until the waste would be removed from storage.

Community Acceptance - The no-action Alternative would best meet the desires of some segments of the local community since this Alternative would remove the waste from the area the earliest; however, other segments of the community might desire storage to allow more time to develop offsite options for transportation, treatment or disposal. The local communities desire to remove the waste must be balanced with the desires of more distant communities that are near waste disposal sites or are on the highways or railways over which the waste must be transported. Because only temporary storage of the waste is being proposed, ultimately there must be some community impact with any of the options. Of the three onsite options, the metal buildings would likely be the most acceptable option to the public since this Alternative offers the ability to inspect the waste in containers and to easily retrieve the containers for offsite shipment. Furthermore, since metal buildings have a limited useful life,

the community might find this a more acceptable Alternative since it would have a limited ability to provide long-term storage. All of the alternatives have the ability to monitor and retrieve the stored waste.

Short-Term Effectiveness - Because only temporary storage is being considered, the relative importance of the criterion is elevated. Particular emphasis needs to be placed on supporting an accelerated cleanup of RFETS as described by the TYP and the RFCA. One of the main advantages of the onsite alternatives is the ability to defer the cost of offsite disposal. Use of the RWSF would allow the immediate cleanup of high risk IHSSs as well as the D&D of more buildings in a shorter time frame. The RWSF could also impact the plant mortgage by allowing more mortgage reduction activities to occur and thereby reducing the mortgage sooner.

The other issue of short-term effectiveness is logistics. Until a facility is available to handle large volumes of remediation waste, short-term effectiveness at RFETS is limited. Once the RWSF is built, dealing with the remediation waste would be easier than shipment to an offsite facility because packaging, sampling, documentation, and transportation issues would be much easier to address. An Abovegrade Storage Cell and the Concrete Lined Cell would allow bulk waste to be placed in the facility without additional containerization, and onsite transportation requirements would be minimal.

Because of convenience and initial cost, the Abovegrade Storage Cell and the Concrete-Lined Cell would best support the implementation of D&D and Environmental Restoration actions. The metal building Alternative would require some additional packaging effort and the no-action Alternative would require additional preliminary efforts to both package and transport the waste; however; all of the alternatives would require these actions for eventual offsite shipment.

Long-Term Effectiveness and Permanence - Since at the closure of the RWSF, all of the waste is going offsite for disposal, ultimately, the long-term ability of any Alternative is dependent on the offsite disposal facility selected. However, the relative permanence and long-term effectiveness of the selected Alternative is important because they are generally indicative of the facilities protectiveness. Also, permanence allows the flexibility for long-term storage should there be a need.

Of the four alternatives, the Concrete-Lined Cell with bulk waste placement would have the greatest degree of long-term effectiveness and permanence based on the extra protection offered by the 12-inch thick concrete walls and 18-inch thick floor. The internal concrete structure adds both an additional barrier to leakage as well as internal structural support for the facility.

The no-action Alternative and the Abovegrade Storage Cell also offer good long-term effectiveness and permanence. The Abovegrade Storage Cell offers about the same degree

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of permanence as the concrete-lined cell because it would utilize a similar liner system and a contoured, impervious interim cap. However, the Abovegrade Storage Cell would not have the additional protection of the concrete infrastructure of the concrete-lined cell. The metal building Alternative offers the least amount of long-term effectiveness and permanence. Since the facility is only intended for temporary storage this translates into only limited flexibility.

The Concrete-Lined Cell was selected because of the following criteria:

- It is protective of the environment and human health. The engineered features provide additional protection that the other alternatives do not have such as a multiple layer interim cap and an 18-inch concrete floor with its own leachate collection system.

  It provides more flexibility in storage options since it can accommodate either bulk storage or containers. It offers the retrievability needed for short-term storage combined with the protectiveness of a more permanent facility.

- It best supports environmental restoration and D&D activities since bulk waste could go from treatment or excavation right into the facility. The circumvention of the transportation requirements and packaging requirements would allow these activities to become more efficient and cost-effective. In the near-term, it costs less than the no-action Alternative and, therefore, which frees up funding for additional mortgage reduction activities and accelerated environmental actions. It is the least costly of the onsite alternatives.

- This facility would be installed in a modular fashion so that additional cells could be built adjacent to the original cell if needed. The use of modules would allow for some modules to be filled while others are constructed. This creates flexibility for future waste management decisions while not committing funds until necessary. This modular design conforms well to the 10 Year Plan and the RFCA as well as plans for the future use of the Site.

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Regina Sarter
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7.0 SELECTED REMEDY

7.1 REMEDY DESCRIPTION

This section describes the conceptual design of the selected alternative and gives more detail of how the alternative meets the objectives of the IM/IRA, the RFCA, and CAMU criteria. The basis for the decision to select the specific alternative is described in Section 7.2, with a discussion of how the selected alternative meets the objectives of this IM/IRA that were outlined in Section 1. A Risk Evaluation is provided in Section 7.3 which discusses studies that were performed to provide assurance that the RWSF will meet the siting criteria, design requirements, and monitoring requirements included in RFCA and in the CAMU rule. Section 7.4 discusses technical and administrative controls for the CAMU that will meet the requirements identified in RFCA paragraph 80. Discussion of how NEPA values were addressed throughout the document is included in Section 7.5. Conceptual waste acceptance criteria (WAC) are described in Section 7.6. Section 7.7 discusses operational controls and plans that will control the activities and waste operations of the RWSF.

The selected alternative, the Concrete Lined Cell, will consist of a series of modular cells, each sized for approximately 33,000 cu yd of waste and having a total capacity of up to 100,000 cu yd, as appropriate, to meet storage needs. The concrete-lined cell will be located immediately east of the Solar Ponds in the northeast quadrant of the Protected Area. (See Figure 7-1). This facility would be placed abovegrade with the lowest point of the leak detection system also being abovegrade. The RWSF will be designed with a double composite liner system with modular concrete cells. (See Figures 7-2 and 7-3.) An impervious interim cover will isolate wastes from infiltration and erosion. An example of a type of impervious interim cover is included in Figure 7-3. The liner will comply with RCRA Subtitle "C" requirements as defined in 6 CCR 1007-3, Part 264. For the purpose of costing, the conceptual design currently incorporates the following features:

- self-supporting reinforced concrete structure;
- facility size will be 500 ft long by 360 ft wide and 14 ft deep (approximately 4.13 acres);
- the facility will consist of up to three modules, each 500 ft long by 120 ft wide further sectioned/divided into compartments for waste segregation by bulk or cargo containers;
- a reinforced concrete slab with cast-in-place drain channels and sumps to collect leachate;
- external and internal reinforced concrete walls with integral waterstops;
- a composite double liner and leachate detection/collection system;
- an operational cover to enclose the cell/module during operations for fugitive dust controls and to reduce the generation of leachate;
- an impermeable interim cover system which would slope at a 3% grade; and
- five monitoring wells for groundwater monitoring.

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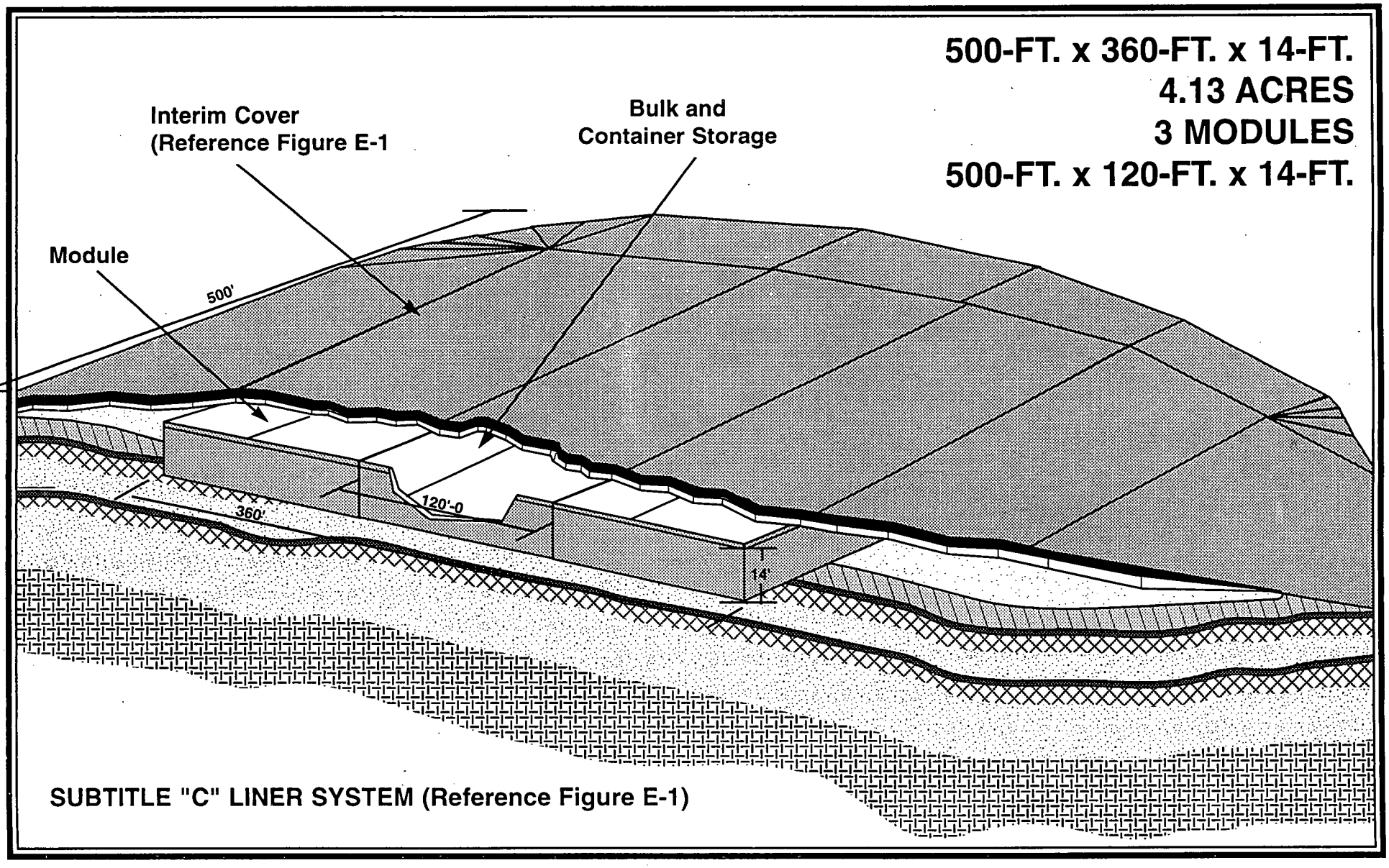

Figure 7-2

CONCRETE-LINED CELL WITH BULK WASTE PLACEMENT

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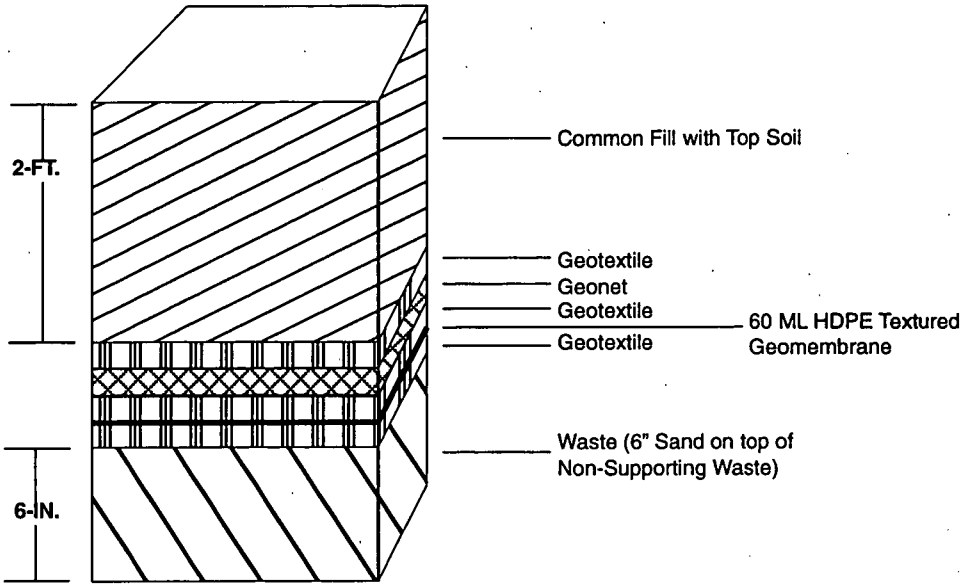
INTERIM CELL COVER



CELL LINER

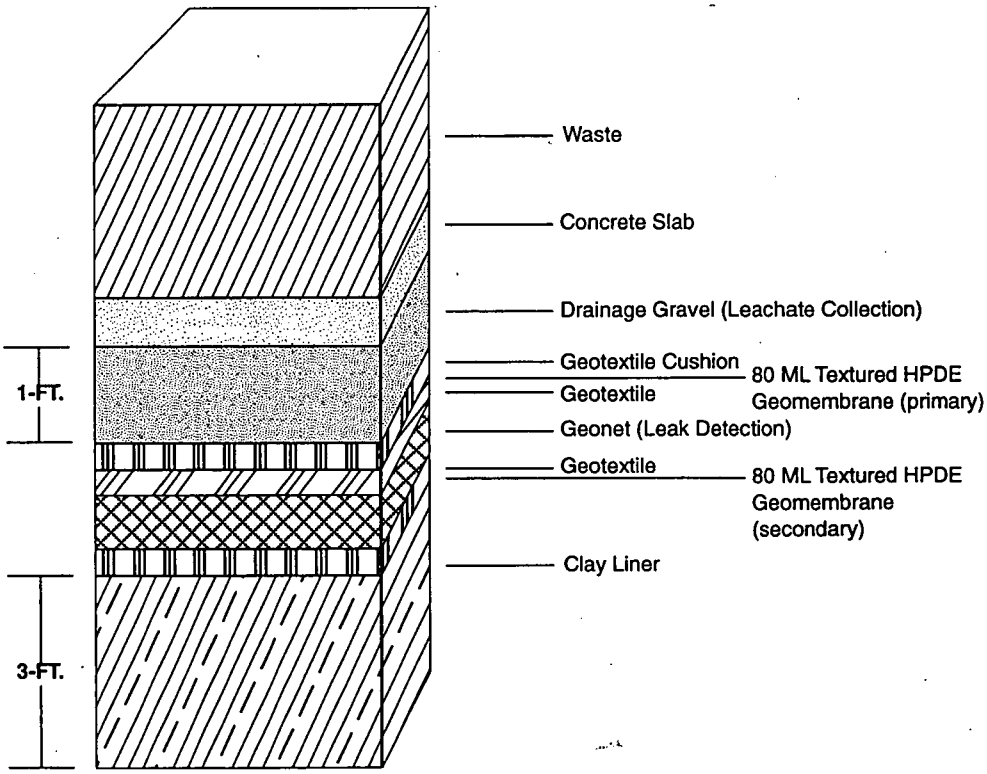


Figure 7-3

ON-SITE FACILITY CROSS SECTION

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The leachate transfer and storage system would be provided to manage leachate that is collected in the RWSF. Leachate will be transferred from the RWSF to a treatment system, as necessary.

Groundwater monitoring will be done in accordance with all applicable rules and regulations, including, but not limited to, CAMU requirements in 6 CCR 1007-3, Section 264, Subpart S and applicable requirements in 6 CCR 1007-3, Subpart F. A groundwater monitoring plan will be prepared in accordance with 6 CCR 1007-3, Subpart F.

During operations, an operational enclosure sprung structure will cover the cell/module to minimize fugitive dust and reduce the infiltration and generation of leachate until the interim cover has been established. Waste will be placed in the facility in bulk or in containers. Additionally, this facility will allow for the options of placing waste in cargo containers or segregating wastes.

Once a module/cell has reached capacity with remediation wastes, an interim cover will be constructed and the temporary sprung structure will be removed. The interim cover will be approximately two feet thick and consist of vegetative cover, drainage layer, and an impervious geosynthetic membrane (e.g., HDPE). The cover will be sloped 3% - 5% to promote drainage.

7.2 DECISION BASIS

A concrete-lined cell in the Solar Ponds Area was selected and justified based on the screening criteria and the final comparison criteria presented in Sections 5 and 6 of this Decision Document. To further support that selection, Section 7.2.1 is an evaluation of the selected remedy in terms of the original objectives of this document as presented in Section 1.0. In order to demonstrate compliance to RFCA, Section 7.2.2 demonstrates how the criteria in paragraphs 80 and 109a of RFCA were considered in the analysis of alternatives and, specifically, how the selected remedy addresses these criteria. Finally, in Section 7.2.3, the basic benefits of the selected remedy are stated to summarize the decision basis.

7.2.1 Objectives

As stated in Section 1.1.1, there are four main objectives of this IM/IRA. The selected remedy meets those objectives in the following manner:

1) In support of the RFCA and the TYP, the management of low-level, low-level mixed and hazardous remediation waste must ensure the safety of the public, RFETS workers, and the environment through reliable, effective, protective, and cost-effective management of remediation wastes at the RFETS.

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The selected remedy addresses this objective through the following safety features:

- all work including construction, filling operations, handling, and transportation will be done under an approved health and safety plan (HASP);
- the remediation waste that would be placed in this facility will generally have very low levels of radionuclides;
- work will be performed under the oversight of industrial hygienists, occupational safety professionals, and radiological engineers;
- workers will be required to undergo extensive training based on the specific hazards of their job;
- a wide range of dust suppression measures will be taken during construction, transportation, handling, and filling operations to ensure that fugitive emissions of vapors or particulates are not generated. Dust control activities during handling, transportation, construction, and placement could include an operational cover, dust suppresion sprays, high wind shutdowns, or other precautions.
- various types of monitoring would be performed to ensure not only the safety of the public and Site workers but also protection of the environment. This would potentially include air monitoring for particulates and contaminants, radiological monitoring, ground water monitoring, and surface water monitoring; and
- once a module or cell is filled, an interim protective cover would be placed over it.

The facility, itself, has numerous design features added to ensure protection of human health and the environment. Some of these protective measure are as follows:

- Leakage will be detectable within the facility, therefore, leachate can be collected prior to reaching the first liner;
- An impervious interim cover will reduce infiltration-related leaching and soil erosion;
- An 18-in. thick reinforced concrete slab floor;
- Waste separation could be done through the use of compartments built into the modular design;
- 12-in. thick reinforced concrete walls;
- Two leachate collection systems, one system will be built into the floor of the facility; the second system will be built into the liner system;
- A multiple-layer liner system that utilizes both synthetic and natural materials; and
- A groundwater monitoring system.

2) A means of consolidating remediation waste in one location is needed to support near-term risk reduction goals while addressing long-term liability and safety issues.

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The location and design were selected to allow large quantities of remediation waste to be consolidated at a single location. Not only does the location and design allow the physical consolidation of the waste but it also allows waste management activities such as operations, monitoring activities, and inspection to be consolidated as well. The use of a modular design allows the RWSF to adjust to the influx of waste media as remedial activities proceed. Although the waste will be consolidated at a single location, the modular design has features that multiple facilities could offer such as:

- The ability to segregate and isolate differing waste types;
- Future modules could have specialized containment and monitoring features should the need arise; and
- The ability to accept either bulk or containerized waste.

3) The management of low-level, low-level mixed, and hazardous remediation waste must result in a cost-effective solution that can be implemented under existing budgetary constraints.

If storage is needed, the Concrete Lined Cell is the most cost-effective of the alternatives considered that could meet RFCA criteria. (The waste pile could not meet the 6 CCR 1007-3, Part 264, Subpart N requirements that were required by RFCA because it did not have a liner system.) Table 7-1 gives the total life cycle costs for all of the design alternatives considered.

Table 7-1 Life Cycle Costs for Design Alternatives

Alternative	Total Life Cycle Cost
Abovegrade Landfill	$118,800,000
Pyramid	$140,300,000
Concrete Lined Cell with bulk placement	**$77,320,000**
Concrete Lined Cell with containers	$165,650,000
Hardened Concrete Vault	$181,630,000
Silo Design	$107,300,000
Slab on Grade	$141,600,000
Metal Buildings	$161,400,000
Entombment	$525,000,000
Waste Pile	$36,669,000
No Action	$215,900,000

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Based on professional judgment, the cost differences between location alternatives were not as significant as cost differences between the design alternatives and the final alternatives.

Not sure what this says!

In the near-term, it is also more cost-effective to store the waste onsite rather than ship it offsite for disposal (No Action); however, in the long term, if it is possible to ship the remediation waste offsite immediately then it is more cost-effective to do so. In terms of cost, the CAMU should still be ~~an alternative~~ a contingency to the TYP in case additional storage is needed.

4) The solution must be compatible with future land uses for the Site and the Site Vision.

The selection of a Concrete Lined Cell in the Solar Ponds Area is consistent with future land use, (DOE, 1995a) the Site Vision, (Kaiser-Hill, 1996b) and also the RFCA. The ways that the selected alternative supports the Site Vision and projected land uses are as follows:

- The RWFS is a temporary storage facility which is consistent with the Site Vision goal of dispositioning remedial waste in a safe manner.

- The site selected is in the Industrial Area of the plant and could potentially extend over several IHSSs. Future land use for this area is for limited industrial use. The area near the Solar Ponds is far enough away from any building that might be reused so as not to impact any future Site activities; and

The design and centrally located site facilitates monitoring and maintenance. Monitoring can be performed in conjunction with monitoring activities already required for the industrial area. Existing air monitoring systems can also support monitoring for the RWSF.

7.2.2 Summary of Selection Basis

As part of the effort to define the design concept for the RWSF and in accordance with DOE Order 4010.1a, a Value Engineering Study was performed. In the value engineering analysis method, multiple alternative approaches of accomplishing the project functions are subjected to qualitative and quantitative techniques to determine the value of each. The alternative which represents the highest value is selected for further development.

Four categories of protective elements which were considered essential components of any acceptable design and which also represent the highest costs of implementability and operation of the facility were selected for inclusion in the Value Engineering Study.

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The categories were:

- protective barriers at the bottom of the facility (liners and/or other structures);
- protective barriers at the top of the facility (interim cover and/or other structures);
- waste placement; and
- waste removal (exhumation at end of storage period).

Many combinations of construction and placement were identified that could accomplish the functions associated with the four categories. Application of the value engineering techniques identified a design incorporating a concrete structure, conventional liners, and an interim cover. Waste is placed in bulk (rather than in individual containers) to represent the highest value. The results of the Value Engineering Study independently validated selection of the Concrete Lined Cell with bulk storage attained through the alternatives analysis process.
To support the selection of a Concrete Lined Cell at the Solar Ponds Area, the following advantages are cited:

- The modular design offers the greatest degree of flexibility including the following attributes:

  — a wide variety of waste types can be accepted and kept segregated;

  — debris could be placed in the facility without additional characterization, compaction, or size reduction;

  — the facility can be expanded as needed to meet the needs of cleanup at RFETS as the cleanup progresses;

  — the RWSF can accept both bulk and containerized wastes; and

  — the RWSF can store waste for varying durations.

- The facility would have a high degree of protectiveness because of the concrete containment system, the additional liners in the subsurface liner system, and the interim cover. All of these features offer much greater protection than would be found in a typical storage facility;

- One major advantage is that the concrete containment system allows for the capture of contaminants before they reach the subsurface rather than depending on the liner system. Media below the facility would not be contaminated should leaching occur. The liner system would act only as additional back up barriers or as tertiary containment, rather than as the secondary containment system;

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- The facility is situated in an area where contamination is already present;
- The selected location has strong CDPHE support based on previous input; and
- The facility is centrally located to many of the IHSSs that need remediation.
- The RWSF will minimize indirect effects on the environment by being placed in the Industrial Area where existing infrastructure will support use of the facility.

The RWSF will minimize cumulative effects on the environment by being built on an existing facility in an areas previously contaminated, and thus will not add impacts by disturbing additional areas on the Site.

In selecting a remedy, emphasis was on flexibility and environmental protection. The selected remedy offers a environmental protection, durability, and the ability to safely contain remediation waste for whatever period of time is needed. It is a facility well suited to safely contain the remediation waste for long periods of time which would allow new technologies to be developed to treat or contain the waste or for alternative sites for offsite disposal to be developed. In the decision making process, a key factor to the decision was the potential that if the waste could not be removed in a reasonable time period, flexibility was needed to continue to safely store the waste. This facility can safely store the waste for any duration while still retaining protectiveness.

7.3 RISK EVALUATION

A number of studies have been conducted to provide assurance that the recommended alternative will meet the established criteria for the RWSF. These analyses were conducted to support CAMU criteria for protection of public health and the environment as listed in 6-CCR-1007-3 Part 264.552 (c). The analysis of risk has been divided into the following three main exposure pathways:

- Offsite transport of contaminants through the groundwater to neighboring surface waters;
- Worker exposure to radionuclides during operations; and
- Offsite fugitive dust emissions.

The potential for vertical contaminant migration through underlying geologic strata into the Laramie-Fox Hills aquifer has previously been addressed and is considered to be an unrealistic scenario, (see RMRS, 1996). The most conservative calculations of volatile

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organic contaminant transport indicate that travel times of at least 17,000 yr will be required for contaminants to migrate to the deep aquifer, which greatly exceeds the 1,000 yr time-frame considered in this document. The analyses performed in this report confirm the conclusions reached by the U.S. Geological Survey (Hurr, 1976) that plant operations will not impact this aquifer. More information on potential contaminant migration to the Laramie-Fox Hills aquifer is contained within the "White Paper Analysis of Vertical Contaminant Migration Potential" (RMRS, 1996).

Exposures from inadvertent intrusion into the RWSF after closure were also ruled out primarily because waste will be actively managed by inspections and monitoring throughout the life of the facility as per RFCA paragraph 80. In addition, it is assumed that as long as wastes remain on-site in the protected area (PA) and, the site is on the CERCLA National Priorities List (NPL), administrative controls will be required to limit access onto the site and five-year public health reviews will be required to ensure that the remedies used remain protective as long as waste remains onsite. It is also assumed that a fully integrated sitewide monitoring network will remain in effect to detect any releases from this action or any other as long as waste remains on site.

In addition to the pathways analyses referenced above, an analysis of technical and administrative controls is included. These controls are the administrative, design, operational, and post closure practices put in place to ensure releases are prevented or are prevented from impacting human health and the environment. Institutional controls can include deed restrictions, interagency agreements, and other controls.

7.3.1 Offsite transport of contaminants through the groundwater to neighboring surface waters

As with most waste management systems, potential accidental offsite releases to the public or the environment constitute the majority of risk. Siting criteria, design requirements, and facility monitoring requirements have all been established to mitigate the likelihood of a release event occurring. Several studies relative to the location of the RWSF, as well as the design itself, have been conducted to assess the likelihood of a release and the resulting level of contamination associated with such an event. One of the pathways considered was a release of contamination from the facility to groundwater and the subsequent transport of contamination to surface waters, where exposures to the environment or the public could occur. Three integrated studies were conducted to assess what, if any, risks might result from such a release. These are:

- Remediation Waste Storage Facility (RWSF) Particle Tracking Study;
- Leachate Composition Analysis; and
- Discharge Composition Analysis.

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The first two studies identified the primary parameters for an exposure to occur, travel times, and source concentrations of contaminants. The final study defined the overall estimated concentrations based upon infiltration through interim and long term cover designs. These studies are attached to the decision document as Appendix H and are summarized below.

7.3.1.1 Remediation Waste Storage Facility Particle Tracking Model

The particle tracking study used a site validated mathematical model to track contaminant flow through the groundwater beneath the RWSF and estimated travel times to neighboring surface waters. Travel times were based upon varying retardation factors for a particle in contaminant categories that include metals, organic compounds, and radionuclides Retardation factors were based upon solubility, adsorption coefficients, and other factors that influence a contaminant's ability to flow freely within the groundwater. The retardation factors have either been obtained from literature values or from Site-specific values. Time frames considered for transport were 30 yr, 500 yr, 1,000 yr and 10,000 yr. The times used all exceed the estimated operational life of the storage facility since the intent of the facility is to support site closure within the 10 Year Plan time frames by providing a facility for storage only. Travel times did not assume any engineered barriers at the top or the base of the RWSF. These times are extremely conservative due to the assumption of no engineered barriers and represent a worse case scenario. In addition to the conservative travel times, the study makes no representation as to what levels of contaminants would reach neighboring surface waters within these time frames but is strictly limited to the travel time for a particle of material.

Metals and radionuclides have extremely high coefficients of adsorption, meaning that metals and radionuclides tend to adhere to clays within the surrounding soils and, therefore, exhibit limited movement. In addition, clay liner systems within the RWSF would further limit migration. The particle tracking models showed that migration would be limited for periods of nearly 1,000 years. Given the engineered barriers designed for the RWSF and the limited operational life cycle, discharges to surface waters are not expected. In addition, given the levels of metals and radionuclides associated with the estimated leachate composition and the estimated infiltration rates into the RWSF, no contaminant levels above stream standards are anticipated within the unit boundary.

Organic compounds present the predominant risk for completing the pathway to neighboring surface waters. The particle tracking model predicts that organics could conceivably reach surface waters within 100 yr without the engineered caps and liner systems designed for the RWSF. Organics levels however, are expected to be very low since thermal desorption technology is currently being used to treat soils and debris prior to disposition into a storage facility. Given the anticipated levels of organics within the leachate, the levels of organics

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discharged to surface waters if a potential release occurred, would be significantly less than what is allowable to protect human health or the environment and would meet all State standards for water. The leak detection system of the liners would signal an alarm before a potential release to the groundwater or surface waters occurred. These results are detailed in the leachate composition analysis and waste composition analysis.

7.3.1.2 Leachate Composition Analysis

This analysis identified an estimated leachate composition that was statistically based upon actual analytical results for areas at RFETS which are considered possible candidate sites for which materials may be placed into the RWSF. Multiple waste streams were used to ensure that the analysis was based upon a representative sample of likely contaminants for RFETS. This analysis considered organics, metals, and radionuclide concentrations (see Table 1, Appendix H).

7.3.1.3 Discharge Composition Analysis

The maximum contaminant concentrations that may occur in groundwater from a potential release from the RWSF were calculated. These calculations were performed on the basis of estimated concentrations of contaminants from the leachate composition analysis and the estimated volumes of leachate anticipated to be generated as a result of moisture infiltration into the RWSF through the interim cover. Two cover scenarios were evaluated, a final closure cover, and a less extensive interim cover. The intent of this analysis was to provide a benchmark for estimating maximum potential values of contaminant discharge via groundwater into neighboring surface waters from the RWSF. This study assumed that no leachate collection was included in the RWSF design. However, both a leachate collection system and liner are designed to capture any discharges from the RWSF eliminating contaminant transport to the groundwater. The discharge composition analysis study would represent a worst case scenario where the leachate collection system would be inoperable. This does not assume a catastrophic breach however, only a failed collection system where leachate would be allowed to accumulate within the liner system and eventually discharge through the liners into the groundwater. Since active management of the system will occur, it is highly unlikely this scenario would exist for a time frame long enough to allow leachate to migrate through the liners. These flow rates were based upon infiltration rates calculated with the HELP model, an EPA approved model for evaluation of engineered barriers (EPA, 1985).

Based upon an estimated waste stream leachate analysis, no discharges to surface waters above action levels is anticipated for either cover scenario. A detailed table listing estimated discharge levels for specific contaminants is included in the study (see Table 3, Appendix H).

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7.3.2 Worker Exposure to Radionuclides During Operations

A radiological dose assessment was conducted to assess the maximum radionuclide activities allowable in soils at the RWSF, based on annual exposure limits. The dose assessment used an upper annual exposure limit for a worker of 5,000 mrem/yr (10 CFR 834), and a lower limit of 100 mrem/yr (DOE Order 5400.5). The exposure scenario was for a RWSF operational worker and used site-specific exposure factors. (See Programmatic Risk-Based Preliminary Remediation Goals, Rev 2, DOE 1995).

The soil activity for each individual radionuclide necessary to give a 5,000 mrem annual does to a worker at the RWSF is 64,100 pci/g of americium-241, 74,900 pci/g of plutonium-349, and 1,020,000 pci/g of uranium-238. The activity of each radionuclide to deliver a 100 mrem annual dose is 1,280 pci/g for americium-239, 1,500 pci/g for plutonium-239, and 20,400 pci/g for uranium 238. These activities were calculated separately for each radionuclide. If all were present, the maximum concentration of each to deliver a given dose would be reduced. Actual activities of radionuclides in the RWSF will be much lower than those calculated for even the 100 mrem dose.

Soils and other materials from across the Site will be deposited in the RWSF. Average activities will be well below those calculated above for the 100 mrem annual dose, and are estimated to be below the Tier I Action Levels for radionuclides in surface soils (AM-239 = 215 pci/g, Pu-239 = 1,429 pCi/g, and U-238 = 506 pCi/g, DOE, 1996a). The average activities for soils from the 903 Pad area, which would be deposited in the RWSF, are 10 pCi/g for Am-241, 347 pCi/g for Pu-239/240, and 3 pCi/g for U-238. This indicates that wastes that will be deposited in the RWSF will not pose a radiological health threat to operations personnel. Waste acceptance criteria (WAC) for the facility will establish conservative limits on contaminant levels in deposited wastes, and significant health and safety monitoring will also be conducted.

7.3.3 Fugitive Dust Emissions

The fugitive dust emissions study estimated maximum-allowable activities in wastes deposited in the RWSF to deliver a known dose from airborne radionuclide contaminants, transported with dust particulates, to an offsite human receptor at the RFETS boundary, at 96th and Indiana Street. The study conservatively assumed a five-acre area, continuously exposed to wind erosion, with no effects from operational barriers such as cover on wastes or containers, and 1995 Site meteorological wind data. A fugitive dust emissions factor of 66.84 grams/m^2 was calculated using EPA procedures. A regulatory limit for exposure dose was assumed to be 10 mrem per year.

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As in the worker dose calculations reported above, the upper limit activities to deliver the maximum allowable dose (10 mrem/yr) was calculated for each radionuclide. The results estimate that if 100 percent of the dust load at 96th and Indiana was from the RWSF the activities of Am-241 or Pu-239/241 could be up to 220,000 pci/g. The actual contribution of dust from the RWSF would be much less than 100 percent and contributions from the Site would lower the allowable activity, based on air emissions at the RWSF. However, the RWSF WAC will establish administrative controls on maximum contaminant levels at the RWSF that will be well below the level of concern for air emissions.

The average levels of radionuclides in Site soils are much lower than activities necessary to pose a threat to human health of a residential receptor at the RFETS boundary. Average activities were not estimated for contaminated debris resulting from D&D actions. The WAC will need to ensure that levels of radionuclides in debris are controlled within acceptable limits by predisposal decontamination or packaging.

7.4 Technical and Administrative Controls

Technical and administative controls are implemented in order to ensure that human health and the environment are protected from areas where present or past activities preclude unrestricted access or use, controls are implemented. The technical and administrative controls meet the requirements in RFCA paragraph 80 for a CAMU. For the RWSF, controls can be grouped into four major elements:

- Engineering Controls
- Facility Monitoring
- Operational Controls
- Administrative Controls

Engineering Controls - There are specific engineering controls designed into the facility in order to support protection of human health and the environment throughout the operational life of the facility. These include:

- A double liner system designed to detect and collect any leachate generated during operations;

- Interim cover designs which eliminate infiltration to the greatest extent practicable; and

- An internal infrastructure designed to facilitate placement and retrieval of wastes;

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Facility Monitoring - In addition to a fully instrumented leak detection system, an extensive monitoring network will ensure no releases pass undetected from the unit boundary. This includes air monitoring stations, groundwater monitoring wells, and surface water monitoring stations. These requirements will also be integrated into the overall RFETS monitoring program to ensure that a comprehensive network is in place to help protect human health and the environment.

Operational controls. Operational controls are put in place to ensure that waste management operations are conducted in such a way as to minimize the risk of release from the facility or exposure to personnel. These include:

- An agency-approved waste acceptance criteria specifying a safety envelope for chemical and physical waste parameters including appropriate treatment requirements.
- An operational health and safety plan approved by the agencies designed to provide operational constraints for personnel protection, weather conditions, decontamination procedures, training requirements, emergency response, and health and safety monitoring.
- Standard operating procedures that establish clear repeatable guideline for conduct of operations.
- Numerous quality assurance procedures from construction quality assurance to procedural audits all designed to ensure the facility and operations meet designated performance standards.
- Closure plans that define how the facility will be decommissioned after the life of the operations and what performance standards need to be met upon closure.

- Contingency and spill response plans will define how the facility responds to a release of waste or constituents from the RWSF.

Administrative controls. Administrative controls are defined to ensure that risk of exposure during construction, operations, and closure are minimized. These include:

- Land use restrictions as defined by future land used plans identified in the RFCA.
- Security plans define site restriction requirements throughout the life of the project.
- Clean up standards which define the level of clean up necessary to certify closure.

In summary, numerous technical and administrative controls will be in place to ensure that all aspects of this effort are conducted in such a way that risks to human health and the environment are minimal.

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7.5 NEPA VALUES

The proposed RWSF will be authorized using a single, integrated Decision Document that will be signed by the DOE, and the State of Colorado, when approved. The Decision Document and review process will satisfy the documentation and procedural requirements of the RFCA. The National Environmental Policy Act (NEPA) process has been integrated into the RFCA documentation and procedure, especially public involvement and decision-making, to reduce duplication and paperwork, and streamline the combined NEPA/CERCLA process. In accordance with the DOE Secretarial Policy issued in June 1994, integrated CERCLA/RCRA documents for environmental clean up activities are to incorporate NEPA values to the extent practical. This policy is intended to minimize the cost and time for document preparation and review while meeting the requirements of both acts.

The analyses required by NEPA are integrated throughout the Decision Document, with a summary of the analyses provided in Appendix I. Based on the analyses, the decision-making process requires no further documentation to complete the NEPA process.

7.6 CONCEPTUAL WASTE ACCEPTANCE CRITERIA

Waste acceptance criteria (WAC) will be developed for the RWSF to ensure that remediation wastes comply with applicable regulatory and site requirements. The WAC will set levels for those criteria that can be quantified. The WAC will undergo review and approval by regulators as part of the detailed Title II design review process. The following objectives would be achieved in compliance with the WAC:

1. Remedial wastes are effectively isolated from potential natural environmental pathways to protect the public health and the environment.

2. RWSF operating personnel and generators ensure continuous protection to the public health and the environment.

3. Characterization data of the remediation waste is documented.

The RWSF would receive remediation wastes from the Site Accelerated Actions and D&D cleanup activities which include the following waste types: RCRA; TSCA; LLW; and/or LLMW. The majority of remediation waste would be handled in large bulk volumes, such as roll off containers or tandem dump trucks, rather than small containerization, such as drums or crates.

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7.6.1 Physical and Chemical Compatibility Criteria

The WAC will provide physical and chemical limitations and requirements of the remediation waste and for the proper management. Process knowledge and/or chemical and radiological analyses will become the tools to document accurate characterization of the remedial waste. The following areas represent physical and chemical criteria for remedial waste compliance:

General Requirements

1. Waste in monolithic or particulate form will be accepted for disposal.

2. Waste will contain no free liquids.

3. Lack of free liquids shall be demonstrated by EPA Test Method 9095 (Paint Filter Test) or by EPA Test Method 9096. If the generator determines that the waste form is not conducive to either test method, then documentation must be provided to substantiate the claim that no free liquids are present.

4. Gaseous waste will not be accepted. Compressed gases as defined by Title 49, CFR 173.300, including unpunctured aerosol cans, will not be accepted.

5. Aerosol cans will have punctures. Expended gas cylinders must have the valve mechanism removed and shall meet the requirements of Section 3.2.4 for debris.

6. Pyrophoric waste will not be accepted.

7. Sanitary waste will not be accepted.

8. Personnel protective equipment will be accepted.

Physical Requirements

1. Physical properties of monolithic bulk wastes (e.g. maximum size range, specific weight, moisture content)

2. Physical properties of wastes classified as debris (e.g. maximum size range, specific weight, biodegradable)

3. Conditions for filled and emptied containers (6 CCR 1007-3 Subpart N 264.315)

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4. Prohibitions of containerized gases, free liquids, pyrophorics, and sanitary wastes (6 CCR 1007-3 Subpart N 264.312, 313, and 314)

5. Management of personal protective equipment (e.g. radiological screen of PPE after usage; followed by disposal)

Chemical Requirements

1. Chemical Analyses, acceptable analytical methods, and detection ranges.

2. Prohibited constituents and chemical characteristics including reactive or ignitable substances (e.g. pyrophoric uranium. See 6 CCR 1007-3 Subpart N 264.312.)

3. Chemical compatibilities (6 CCR 1007-3 Subpart N 264.313).

4. pH limitations

5. Composition of waste

7.6.2 Health and Safety - Radioactive Dose Criteria

The WAC will address the radiological limitations and requirements for the waste to meet the CAMU goals and objectives. The RWSF has been categorized as less than a Category 3 Facility and designated as a Radiological Non-nuclear Facility based on a hazard categorization analysis for preliminary threshold quantity of plutonium and other radioactive isotopes (Kaiser-Hill, 1996a). All projects at RFETS are designated under two areas, safety class or non-safety class (NSC). The safety class is further defined by categories such as Category 1 and 2, with Category 1 being the higher risk. Under the non-safety class, Categories 3 and 4 exist. The RWSF was designated as less than a Category 3 Facility which, by definition, is a non-safety class in accordance with the Conduct of Engineering Manual (COEM) Volume 2, Classification of Systems, Components, and Parts; 2-D03-COEM-DES-223 Revision 1. This categorization analysis was based on sampling data from some of the more radioactive IHSSs, such as the Solar Ponds, the 903 Pad, and Lip Area, and the original Process Waste Lines. To be conservative, the highest activity concentration was used. This categorization is the lowest level of risk categorization. The facility will not receive transuranic (TRU) waste. Radiological requirements specified by the WAC include the following:

1. Radiochemical analyses for characterization

2. Threshold limits of radionuclides for the RWSF

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7.7 REMEDIATION WASTE STORAGE FACILITY OPERATIONS

The RWSF will be operated and maintained under a number of administrative requirements to ensure compliance with applicable regulations. Administrative controls will be administered for activities of waste operations in the following areas:

1. WAC documents and forms - These are required to demonstrate compliance with the RWSF WAC.

2. Operating procedures - Procedures for handling and placement of waste, facility maintenance and documentation to ensure safe and efficient operation of the RWSF.

3. Training plans - A plan to administer required training for operating personnel in procedures, safety, and quality assurance.

4. Health & Safety plans - The health and safety requirements for operating personnel to conduct operations in a safe manner.

5. Emergency procedures and plans - The procedures and requirements for operating personnel to enact in the event of an emergency; also known as contingency plans.

6. Limiting operating conditions - Identification of abnormal events which would require operations to temporarily stop activities (e.g. excessive wind velocities, and other weather conditions) to ensure safety to the public, the workers, and the environment.

7. Administrative procedures and plans - Additional procedures and plans to ensure compliance with regulations, DOE orders, and Site rules and policies.

8. Control of fugitive dust emissions - Plan to reduce dust emissions and monitor results to protect the public and workers.

9. Closure Plan - This includes the requirements, procedures, and performance standards used to close the Facility after the end of its operational life. This will be developed in accordance with the applicable state regulations that govern closure of this type of facility including 6 CCR 1007-3 Subpart G.

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Additional requirements addressed in the WAC or Facility Operations Plan for compliance are areas addressing administrative controls. The following requirements will ensure the RWSF to be operated in a safe manner:

- Recordkeeping and documentation;
- Waste information from process knowledge and/or sampling and analysis data for waste characterization;
- Quality assurance/quality control (QA/QC) certification program and verification;
- Status reports and waste forecasts;
- Shipment notification; and
- Packaging and labeling requirements.

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Regina Sarter
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8.0 SCHEDULE

This Gantt chart presents project task information as both text and graphics. Information about each task is listed in the Gantt table on the left side of the figure. The Gantt bar chart displays task durations and start and finish dates on a time scale. The relative positions of the task bars show which tasks start and finish before each other and which task overlap other tasks.

In paragraph 109 of RFCA, subparagraphs (b) and (c) durations for the CAMU designation process are given as such:

b. Within 45 days of receipt of DOE's draft IM/IRA, CDPHE shall determine whether the IM/RA meets or fails to meet the criteria in subparagraph (a). If CDPHE determines that the draft fails to meet the criteria, the draft shall, at the end of a 45-day review, explain with specificity the necessary modifications and allow the DOE to resubmit within 30 days, or to invoke dispute resolution within 14 days. If the CDPHE determines that the application meets the criteria described in subparagraph (a), the CDPHE shall issue the draft IM/IRA for public comment for a period of 60 days.

c. Within 30 days of the close to the public comment period, the CDPHE shall review the comments received and modify the draft, if appropriate. The agency shall also prepare a response to significant public comments at this time. At the end of this 30-day period, if the CDPHE still agrees that the IM/IRA, as modified, meets the regulatory criteria for designation and the criteria in paragraph 80, the CDPHE shall designate the storage CAMU. If the CDPHE has determined that the IM/IRA does not meet these same criteria, the CDPHE shall state the changes that DOE must make to receive approval."

Once the CAMU designation is complete, design and construction of the RWSF will be dependent on the need for a contingency to the TYP. Construciton of the facility, including design, is estimated to take a little more than two years. Placement of remediation waste in the facility is dependent on the progress of D&D and remediation activities. The schedule for eventual shipment of the waste offsite has not been determined. The TYP assumes that all low-level mixed waste would be disposed offsite by the year 2007.

The schedule for implementation of this Decision Document is provided as a Gantt Chart in Figure 8-1.

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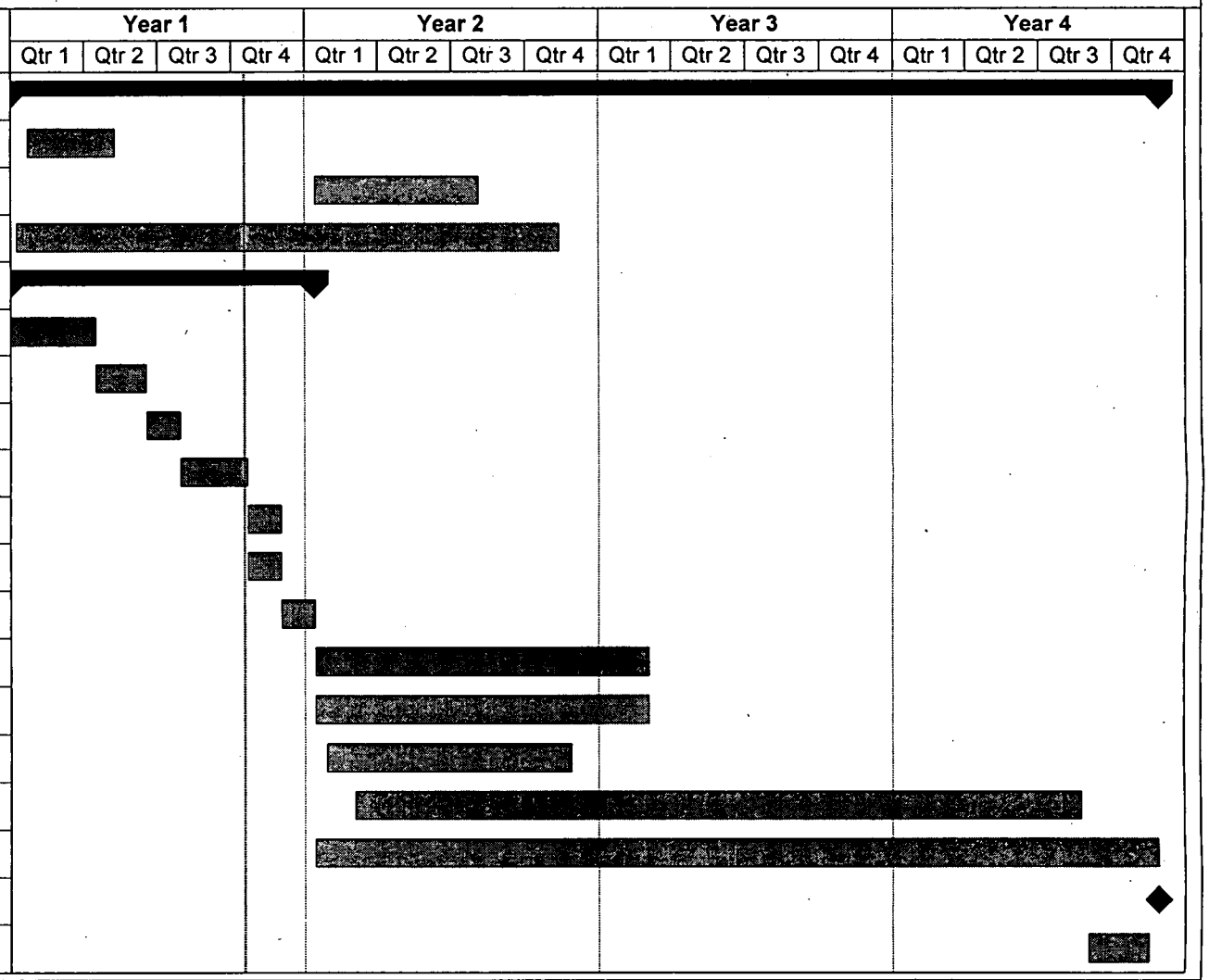
FIGURE 8-1: PROPOSED REMEDIATION WASTE STORAGE FACILITY SCHEDULE

Task Description	Dur
RWSF - DESIGN AND CONSTRUCITON	1021d
GEOTECHNICAL INVESTIGATION	78d
DEVELOP WASTE ACCEPTANCE CRITERIA	145d
PREPARE CONCEPTUAL DESIGN	482d
DECISION DOCUMENT	271d
PREPARE DECISION DOCUMENT (DD)	76d
CDPHE REVIEW DD	45d
MODIFY DD BASED ON CDPHE COMMENTS	30d
PUBLIC COMMENT PERIOD ON THE DD	60d
MODIFY DD BASED ON PUBLIC COMMENT	30d
PREPARE RESPONSIVENESS SUMMARY	30d
FINAL APPROVAL OF DD	30d
PREPARE DETAILED DESIGN	297d
PRECONSTRUCION PLAN PREPERATION	297d
PREPARE SITE FOR CONSTRUCTION	218d
CONSTRUCTION OF PREFERED ALTERNATIVE	645d
OPERATIONAL PROCEDURES & TESTING	750d
BEGIN OPERATIONS	0d
PROJECT CLOSE-OUT	55d



PROPOSED REMEDIATION WASTE STORAGE FACILITY SCHEDULE

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

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9.0 REFERENCES

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Appendix A

(This Appendix has been deleted)

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Appendix B

Draft Evaluation of Onsite Versus Offsite Remediation Waste Management Options

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Foreword:

This document was developed in March 1996 to compare various onsite and offsite disposal options. The focus of the low level, low level mixed, and hazardous remediation waste program at that time was to determine which option was most favorable and to recommend that option for implementation. The final recommendation reached was to use an onsite waste disposal facility with appropriate monitoring and retrievable features. The negotiation process in achieving the Rocky Flats Cleanup Agreement (RFCA) and the responses and comments from various Stakeholders has caused a reevaluation of the original recommendation for onsite disposal.

In keeping with RFCA and the Draft DOE Ten Year Plan, there is a renewed focus on maximizing the amount of remediation waste which will be treated and disposed of offsite. With the possibility of lower volumes of remediation waste requiring treatment and disposal, because of less restrictive cleanup levels, the cost competitiveness of offsite treatment and disposal shows more promise. Thus, the conclusions from this document for onsite disposal are not as clearly distinct as the volume of remediation waste decreases. The use of the storage facilities described in the main document accompanying this appendix is evidence of the shift to more flexible options.

The data presented in this appendix remain valid in demonstrating that a thorough cost analysis was conducted to evaluate offsite disposal and that significant up front cost savings can be achieved through the use of onsite storage. The use of storage facilities will help the RFETS achieve safe and effective cleanup consistent with RFCA and the draft Ten Year Plan.

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ABBREVIATIONS, ACRONYMS, AND INITIALISMS

ASAP	Accelerated Site Action Project
CAMU	Corrective Action Management Unit
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CY	calendar year
cy	cubic yard
DOE	Department of Energy
DOT	Department of Transportation
EPA	Environmental Protection Agency
ER	Environmental Restoration
FY	fiscal year
HW	hazardous waste
IA	Industrial Area
IDM	Investigation-Derived Material
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
LDR	Land Disposal Restrictions
LLMW	low-level mixed waste
LLW	low-level waste
nCi/g	nanocuries per gram
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Act
OU	Operable Unit
PCB	polychlorinated biphenyls
PPRG	programmatic preliminary remediation goal
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RSR	Radioactive Waste Shipment and Disposal Record
Site	Rocky Flats Environmental Technology Site
Site Vision	Rocky Flats Conceptual Vision
TSCA	Toxic Substance Control Act
VOC	volatile organic compounds
WAC	waste acceptance criteria
WMF	waste management facility

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EXECUTIVE SUMMARY

The purpose of this evaluation is to select the best waste management option for remediation waste at the Rocky Flats Environmental Technology Site (Site). It is part of the decision-making process for an Interim Measure/Interim Remedial Action (IM/IRA) to address remediation waste, and the intent is to reflect the current waste and environmental strategies and to be consistent with input from stakeholders. Onsite waste management was selected as the best of three options: onsite disposal, offsite disposal, and no action. The selection of onsite waste management was based on the following:

- Projected costs for onsite waste management were lower than for offsite disposal.
- Accomplishment of more risk reduction activities in support of the Rocky Flats Conceptual Vision (Site Vision). These activities could be accomplished in less time, and at a lower cost.
- Less public exposure during transportation, along with less involuntary risk.
- Less risk of spills in handling and transportation.
- Greater capacity for onsite waste management compared to offsite disposal. An onsite facility would be more accessible and more available when needed.
- Fewer schedule restrictions for an onsite facility.
- Fewer analytical requirements for an onsite facility because there is less redundancy in sampling requirements.

Ultimately, the most important difference between the onsite and offsite options is total cost and the effect of cost for reducing risk at the Site. In essence, the more it costs to dispose of a cubic yard (cy) of contaminated material, the fewer cubic yards of material the Environmental Restoration (ER) program will be able to clean up in a given timeframe. This prolongs the cleanup efforts at the Site and allows contaminated materials to remain uncontrolled in the environment for much longer periods of time. In turn, this increases the overall risk at the Site to human health including the offsite population, the onsite workers, and the environment.

In the past, environmental restoration activities at government facilities have been regarded as having unlimited budgets. Funding was expected to increase with each fiscal year and all restorations were expected to be funded. Hard choices are now necessary because federal spending reform has imposed limits on funding for environmental restoration. As part of this evaluation, it was necessary to select the waste management option that could best reduce the overall risk to human health and the environment while remaining fiscally responsible. Budget restraints now directly affect the degree of risk reduction possible. Because the onsite option can more effectively reduce the overall risk to both the public and the environment at a lower cost, it is clearly the best selection. With a given budget to

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perform work onsite, more cleanup actions can be performed more effectively, and therefore, the Site can be made safer with onsite waste management.

B.1 INTRODUCTION

As part of risk reduction activities at the Rocky Flats Environmental Technology Site (Site), a projected 100,000 cubic yards (cy) of remediation waste will be excavated and appropriately managed over the next several years. This remediation waste from high risk Individual Hazardous Substance Sites (IHSSs), hot spots, and the Solar Evaporation Ponds primarily consists of either excavated media with hazardous constituents or with mixed hazardous/low-level radioactive constituents. The reduction of environmental risk is directly dependent on the ability to disposition remediation waste. This document addresses the overall approach to the disposition of remediation waste, and evaluates whether this remediation waste should be managed onsite or offsite.

The following three objectives were developed to reflect risk reduction goals as well as safety:

1. **Ensure the safety of the public, onsite workers, and the environment through safe management of remediation waste in a timely manner**

2. **Develop a viable means of consolidating and managing of remediation waste to support the Rocky Flats Conceptual Vision (Site Vision), Accelerated Site Action Project (ASAP), and risk reduction goals in the near term while addressing liability and safety issues in the long term.**

3. **Provide a cost-effective solution that can support aggressive environmental remediation and be implemented under existing budgetary constraints.**

The general approach of this evaluation is as follows:

1. Define the objectives needed to support risk reduction at the Site.

2. Develop three waste management options: no action alternative, onsite waste management, and offsite disposal. The no action alternative was evaluated as an option to not implementing or not resolving the other two options.

3. Evaluate the options in terms of cost, schedule, risks, capacity, and availability. Emphasis was placed on the ability of each option to support overall risk reduction and the Site Vision.

4. Recommend an option based on the above criteria.

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This document is organized as follows:

Section B.2 - Strategic Ties to the Accelerated Site Action Project and the Site Vision describes the importance of resolving remediation waste disposal to achieve the goals of the Site Vision.

Section B.3 - Planned Remedial Activities summarizes the remediation activities scheduled for fiscal year (FY) 96 through FY98 that will require disposal of remediation waste.

Section B.4 - Description of Options describes the different options evaluated for remediation waste management.

Section B.5 - Cost Analysis evaluates each of the options based on estimated cost.

Section B.6 - Schedule Analysis compares the time required for disposal of remediation wastes for each option.

Section B.7 - Risk Analysis evaluates the risks associated with each option.

Section B.8 - Capacity and Availability evaluates the storage capacity and ability for each option to accept the remediation waste as generated.

Section B.9 - Recommendations presents the recommended option and supporting rationale.

The evaluation focuses on risk reduction activities scheduled for the near term in the Environmental Restoration (ER) budget baseline. These activities target areas with the greatest risk based on currently available data from documented environmental releases. Contamination levels, contaminant-specific risks to human health and the environment, and potential exposure pathways were considered in selecting these areas. The goal of these early actions is to remediate most of these areas in the near term. To achieve this goal, a cost-effective waste management facility (WMF) needs to be operable as soon as possible. This facility must demonstrate protectiveness for human health and the environment within a limited budget. In addition, any WMF must have the capacity to accept large quantities of remediation waste in a short timeframe to support the more streamlined and aggressive cleanup program required for the Site Vision.

B.2 STRATEGIC TIES TO THE ACCELERATED SITE ACTION PROJECT AND THE SITE VISION

Under the Site Vision, the United States Department of Energy (DOE) will remediate the Site in a manner consistent with future projected land and water uses. The future land use of the buffer zone, as recommended by the future Site Use Working Group and the Site Vision, is for open space; whereas the Industrial Area (IA) is projected to be used for industrial use. Low-level radioactive and hazardous waste will be left onsite in a stable configuration. The goal of the Site Vision is to reach an operational state in which all of the plutonium at the Site will be consolidated and stabilized, and most of the risk reduction activities completed. Under the Site Vision, high risk and no further action Individual Hazardous Substance Sites (IHSSs), including the former Operable Unit (OU) 5 (IHSS 115 of the Industrial Area OU [formerly OU 5]) and OU 7 landfills outside of the IA, will undergo closure. Many of the contaminants are not amenable to treatment and will require excavation and placement in a facility.

To implement the Site Vision, an overall approach to remediation waste management is needed. Continued use of temporary storage at the Site is not feasible because of the shortage of permitted space and the logistics of storing and monitoring the anticipated large volumes of remediation waste. The volume of remediation waste and the logistics of handling it, require that a WMF (onsite or offsite) be available to accept the remediation waste as it is excavated. A decision on the approach to remediation waste management must be determined early and implemented prior to excavation to support environmental risk reduction, and the Site Vision. Without a waste management pathway, not only will specific near-term risk reduction actions not be possible, but long-term activities will also be impacted.

Plans for the disposition of the remediation waste must fit into the Site Vision. In particular, a waste management approach must be incorporated into a Site closure strategy. Likewise, all waste management options must integrate with the overall Site closure strategy and the Site Vision statement. Each option must be evaluated according to its ability to meet the schedule requirements for Site closure, to support individual closure activities, to maximize land use flexibility, to meet cleanup standards relative to the projected land use, and to mesh with building closures and the planned capping of the IA.

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B.3 PLANNED REMEDIAL ACTIVITIES

A means for dispositioning remediation waste must be available to support planned activities on high risk areas in the near term. These activities include the following:

- The Solar Evaporation Ponds remediation waste, which will include materials from the solar pond liners, basecourse, sludge, miscellaneous debris, and some vadose zone soils (now on hold) will require disposition
- The excavation of East Trenches (i.e., trenches T-1, T-3, and T-4), the 903 Pad and Lip Areas, and the Mound Area. The typical excavated media from these locations will be soils, sanitary sludges, and decomposed drums
- The excavation of soil and debris from the cleanup of Industrial Area OU tanks T-2, T-3, T-9, T-10, T-14, T-16, and T-40 from IHSS 121 and tanks from IHSS 129
- The excavation of remediation waste and IHSS 119.1 in OU 1
- The excavation of remediation waste from hot spots
- The disposition of the remaining precasting volume of Investigation-Derived Materials (IDM) from drilling activities
- The decontamination and decommissioning of Site facilities

Remediation wastes include, but are not limited to, the following:

- Contaminated soils and debris collected from accelerated actions and hot-spot removal
- Pond sludge currently stored in Resource Conservation and Recovery Act (RCRA)-certified tanks
- Sediments
- Toxic Substance Control Act (TSCA) waste, such as asbestos and polychlorinated biphenyls (PCBs)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions
- IDM from characterization activities, such as wells and borings, are also defined as remediation waste

- Debris from decontamination and decommissioning activities

Only remediation wastes are considered in this evaluation; process waste is not included. For the purposes of this document, saltcrete and pondcrete generated from the Solar Ponds are considered as process waste. The contaminants of concern in these media can be summarized as: radionuclides (e.g., plutonium and americium), heavy metals (such as cadmium and chromium), volatile and semivolatile organic compounds, asbestos, and PCBs.

Waste volume estimates and the dates when these wastes would be generated from planned risk reduction activities over the next three years are presented in Table B-1. These waste volume estimates include only near-term accelerated actions. Additional remediation waste, including remediation waste from decommissioning activities could also be disposed of in the near term. A basis of 100,000 cubic yards (cy) was used for comparing the options to ensure that planned early actions were covered as well as near-term decommissioning activities. It is assumed that soils contaminated with volatile organic compounds (VOCs) would be treated by thermal desorption, after which the residuals would be disposed of at the original excavation location if they comply with the programmatic preliminary remediation goals (PPRGs). The assumptions for this estimate are presented in Attachment 1.

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Table B-1 Waste Identification and Volumes for a Waste Management Facility

Waste Source (OU/IHSSs)	Description of Media	Waste Type	Estimated Total Volume (cy)	Anticipated Volume after Thermal Desorption (cy)
Solar Ponds				
Liners	Asphaltic Material	LLMW (rads/metals)	11,800	11,800
Liners Basecourse	Soils	LLMW (rads/metals)	11,800	11,800
Sludge	Solidified Sludge	LLMW (rads/metals)	6,000	10,000
Vadose Soil	Soil	LLMW (rads/metals)	20,000	20,000
Debris	Building Materials	LLMW (rads/metals)	700	700
Subtotal for Solar Ponds			50,300	54,300
Potential Early Actions - Top IHSSs				
Trench T-1	Soil, Drums, Pyrophoric Uranium	LLMW (rads/VOC)	3,000	1,000
Trench T-3	Soil, Drums, Sanitary Sludge	LLMW (rads/VOC)	2,700	300
Trench T-4	Soil, Drums, Sanitary Sludge	LLMW (rads/VOC)	2,500	300
Trenches T-5 through T-11	Soil, Sanitary Sludge, Planking	LLMW	6,000	1,000
Mound Area	Soil and Drums	LLMW (rads/VOC)	5,000	1,500
903 Pad and Lip Area	Soil and Asphaltic Material	LLMW (rads/VOC)	13,200	13,200
Tanks 9 and 10 (includes OU 8 IHSS 118.1)	Soil, tanks, piping	LLMW (rads/VOC)	2,000	500
Tanks 2 and 3	Soil, tanks, piping	LLMW (rads/VOC)	500	500
IHSS 119.1	Soil	LLMW (rads/VOC)	1,500	50
Tanks 14 and 16	Soil, tanks, piping	LLMW (rads/VOC)	4,450	3,340
IHSS 129	Soil	HW (VOC)	2,200	0
Tank 40	Soil, tanks, piping	LLMW	1,300	130
Miscellaneous Hot-Spot Removals	Soil	LLMW	50	50
Subtotal for Potential Early Actions			44,400	21,870
Investigation-Derived Material (IDM)	Drill Cuttings/Soil	LLMW, HW, LLW	1,200	180
Subtotal			95,900	76,350
Expansion Factor; 15%			14,385	11,453
Grand Total			110,285	87,803

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B.4 DESCRIPTION OF OPTIONS

The options for onsite waste management and offsite disposal of remediation waste were evaluated for all waste management activities including transportation to the disposal/storage facility, operations at the facility, and closure. The onsite waste management option, requires the design and construction of a new WMF, because an onsite facility that can accept this type or volume of material does not exist.

B.4.1 ONSITE WASTE MANAGEMENT OPTION

In the onsite waste management option, remediation waste would be managed in an onsite WMF designed to handle remediation waste. Appendix C, Onsite Waste Management Facility Siting Study, evaluates seven onsite locations, that would be potentially suitable for a WMF. For this onsite option, it was assumed that the remediation waste must be placed as bulk into a cell; however, the cell would be segregated for differing wastes types to support retrievability. The design of the cell would meet RCRA Subtitle "C," 6 Code of Colorado Regulations (CCR) 1007-3, Subpart S, Corrective Action of 264.552, 6 CCR 1007-3, and 6-CCR 1007-2, Part 2, "Requirements For Siting of Hazardous Waste Disposal Sites." The facility would accept media with low-level radioactive (e.g., less than 100 nanocuries per gram [nCi/g]) and/or hazardous constituents. This would not preclude the shipment of remediation waste that could be more effectively and economically managed offsite. The facility would be designed and constructed to meet all of the applicable federal, state, and local regulatory requirements.

B.4.2 OFFSITE DISPOSAL OPTION

Several offsite locations were considered under this option. Low-level waste (LLW) can be sent to the Nevada Test Site (NTS); however, NTS cannot accept low-level mixed waste (LLMW) under their current waste acceptance criteria. The Waste Isolation Pilot Plant (WIPP) location does not accept LLW or LLMW as part of their waste acceptance criteria (WAC); the option therefore was not carried forward in the study. The best facilities for the disposition of remediation waste with only hazardous constituents are Subtitle "C" landfills, such as the RCRA landfill in Last Chance, Colorado. At this time, the only facility accepting mixed remediation waste is the Envirocare facility in Tooele, Utah. For near-term remedial actions, it is anticipated that 90% of the waste will be mixed and could therefore go to the Envirocare facility under this option.

The construction of a new offsite facility was considered; however, it was rejected because it would not meet the schedule requirements for the Site Vision. Depending on the location and the operator, many years would be required for a Nuclear Regulatory Commission License, an Environmental Impact Statement, a RCRA permit, land acquisition, and other requirements. Only existing facilities that could support the accelerated action schedule were considered.

B.4.3 NO ACTION ALTERNATIVE

This no action alternative is an option to the development of an ER waste management strategy. It was included in the evaluation to furnish a baseline for risk reduction at the Site that did not include the excavation and removal of remediation waste. In this option, all waste materials would be left in place with the exception of those materials that could be treated to remove organic compounds and still meet the PPRGs.

B.5 COST ANALYSIS

Based on the waste volume estimates discussed in Section B.3, Planned Remedial Activities, 100,000 cy was selected as the basis for this cost analysis. Two cost estimates were developed: one for offsite disposal and one for onsite waste management. The estimates are based on previously incurred costs, professional experience, vendor quotes, conceptual design information, current labor rates, and current adjustment factors.

The major factors that affect offsite disposal costs include handling, packaging, transportation, the waste acceptance criteria, amount of waste being shipped at one time, the time of year during placement, the treatment method used, and the amount of debris in the waste. Where possible, assumptions for offsite disposal were selected to lower the cost and improve the feasibility of this option. Based on these assumptions, a life-cycle cost of approximately $2,302/cy was estimated (see Table B-2 for the cost summary, Attachment 1 for assumptions, and Attachment 2 for the cost basis). This cost includes packaging, handling, treatment, characterization, transportation, and disposal charges. Previously published estimates included only treatment and disposal charges, not the entire life-cycle cost.

The life-cycle cost for onsite waste management will be approximately $948/cy. This estimate includes packaging, handling, transportation, treatment, characterization, cell design and construction, operations, cap design and construction, and postclosure care and monitoring (see Attachment 1 and Attachment 2). The magnitude of the cost differences between onsite waste management and offsite disposal is illustrated in Figure B-1.

It is important to note that both estimates are conceptual and are subject to variations as additional information is obtained. However, because offsite disposal is twice as expensive as onsite waste management, it has been concluded that the onsite waste management option is the only viable alternative, based on the rough order-of-magnitude estimates.

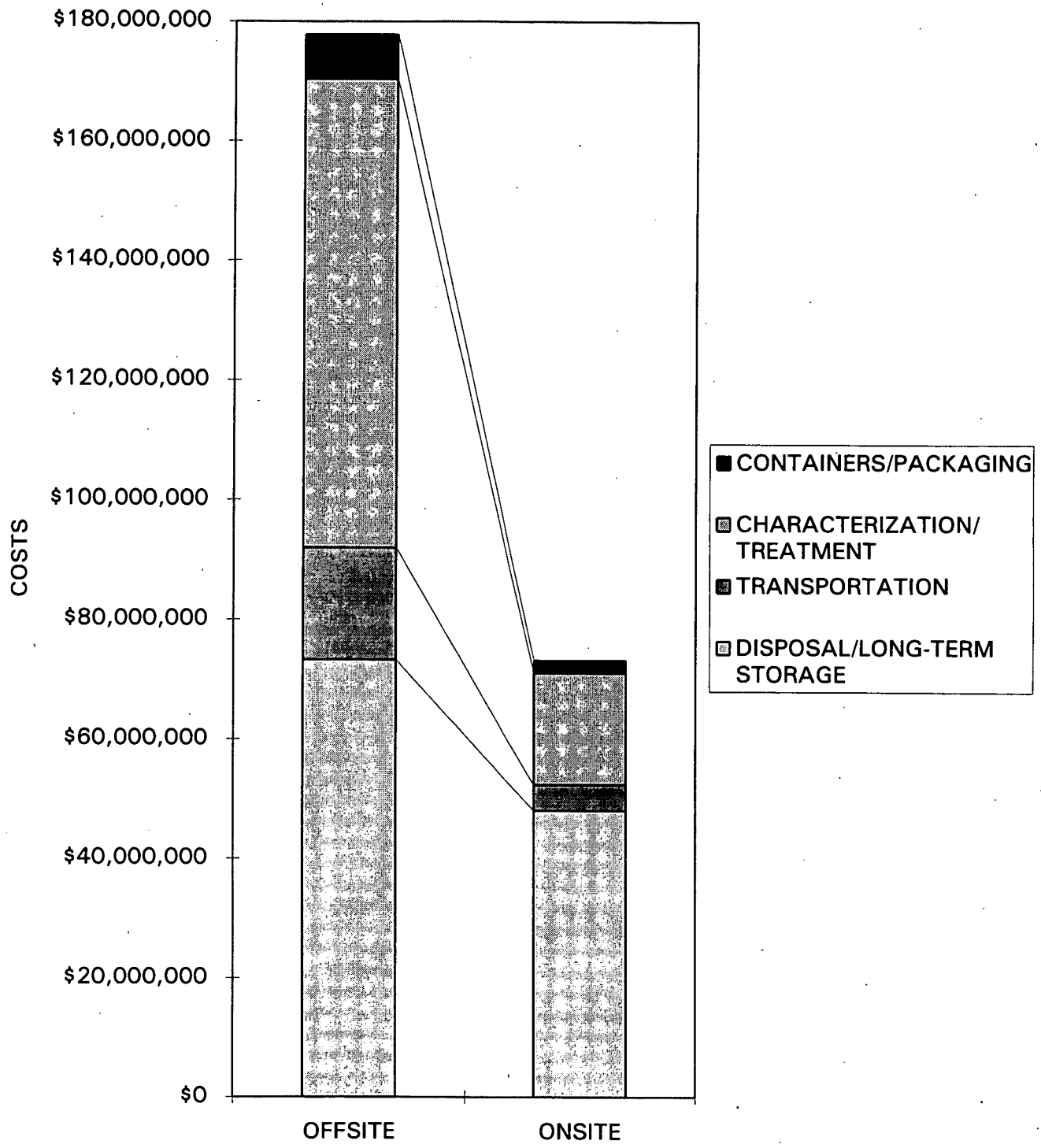
Table B-2 Onsite Vs. Offsite Disposal Costs

Activity	Offsite Disposal Total Cost	Offsite Disposal Cost/ cy	Onsite Management		Onsite Management Total Cost	Onsite Management Cost/ cy
Containers	$4,643,000	$46			-0-	-0-
Packaging	$2,855,000	$29			$2,100,000	$21
Treatment/Characterization	$78,352,000	$784			$18,722,000	$187
Transportation	$18,647,000	$186			$4,309,000	$43
Disposal	$73,322,000	$733	Onsite Management			
			- Design	$1,235,000		
			- Permitting	$300,000		
			- Cell Construction	$20,777,000		
			- Operations	$11,604,000		
			- Cell Closure	$796,000		
			- Post Closure Care	$13,378,000		
			Subtotal	$48,090,000	$48,090,000	$481
Total Costs	$177,819,000	$1,778			$73,222,000	$732
Contingency	$52,332,000	$523			$21,549,000	$215
Total Cost with Contingency	$230,151,000	$2,302			$94,771,000	$948

Note: All costs are in 1996 Dollars without contingency, except as noted. All are based on a waste volume of 100,000 cy managed or disposed.
Note: LAC updated the Offsite costs from the "new" Summary Tables E1-11 on 4/16/96 Specifically the No Action Table E-11
Note: LAC updated the Onsite costs from the CLC-B Summary Table E-2 on 4/3/96

FIGURE B-1: ONSITE WASTE MANAGEMENT VS. OFFSITE DISPOSAL COST COMPARISON

(Based on a 100,000 cy scenario)



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A big discrepancy in the treatment and characterization costs between the two options is shown in Table B-2 and Figure B-1. Under the Corrective Action Management Unit (CAMU) guidelines, the waste does not have to be treated to meet the Land Disposal Restrictions (LDR), however the waste must comply with onsite WAC. The treatment costs were developed from the actual costs for thermal desorption at the Site and the estimates for the Solar Pond sludge solidification process. Attachment 2 explains how the characterization costs were developed for the two options. Treatment costs were one of the major differences between the two options. This was mainly due to the expected costs of having to solidify some of the waste to meet the LDRS.

The total volume of remediation waste was another factor added to the cost difference between onsite and offsite options. If the total volume of remediation waste was sufficiently small, it would be less expensive to ship waste offsite; however, the projected total waste volume is approximately five times greater than that volume. The break-even point for managing waste onsite is 12,750 cy.

B.6 SCHEDULE ANALYSIS

One of the key factors for the comparative analysis of onsite waste management versus offsite disposal is schedule limitations. Cost and schedule are inseparable because one affects the other. Because of budget and schedule constraints, the concept of reducing overall risk to the public and the environment in less time, at a lower total cost, is more attractive than an extended waste removal process using offsite disposal. In the future, project expediency will become a significant factor in getting funding from Congress.

The no action alternative will obviously delay cleanup. The risk to the public and the environment will continue and will likely increase because of open pathways for contaminant migration. Schedule delays will not only impact the risk but will increase future costs when escalation of remedial actions is implemented.

Offsite disposal will require more time to disposition remediation waste than onsite waste management. The remediation waste at the Site is primarily LLMW and under the offsite disposal option most of the waste would go to the Envirocare facility, which currently is the only facility in the nation licensed to receive LLMW. As shown in the process flow diagram of Figure B-2, a long, arduous process is required before waste can be shipped offsite and accepted. Envirocare facility requirements that impact the schedule include:

- Documentation requirements that are more extensive for disposal at Envirocare than for onsite waste management. Most of the documentation is required prior to shipment. For any given wastestream, the documentation requirements are greatly reduced after the first shipment. An estimate of the waste volume must be submitted to Envirocare a full year prior to shipment.

- Waste acceptance contingent on the submittal of sampling and characterization data. The remediation waste must be sampled and analyzed several times prior to placement in the disposal facility. The initial analysis must be completed before submittal of Envirocare forms.

- Remediation waste meeting LDRs. Delays and additional costs will be incurred in treating the waste.

- Time-consuming logistics of handling and shipping the waste. Mixed waste must be containerized.

- Interim staging requirements for large bulk media for storing the waste while awaiting approval for shipment from Envirocare.

- The completion of manifests/travelers and compliance with U.S. Department of Transportation (DOT) criteria (which specify weight restrictions and other criteria) which creates additional delays and costs.

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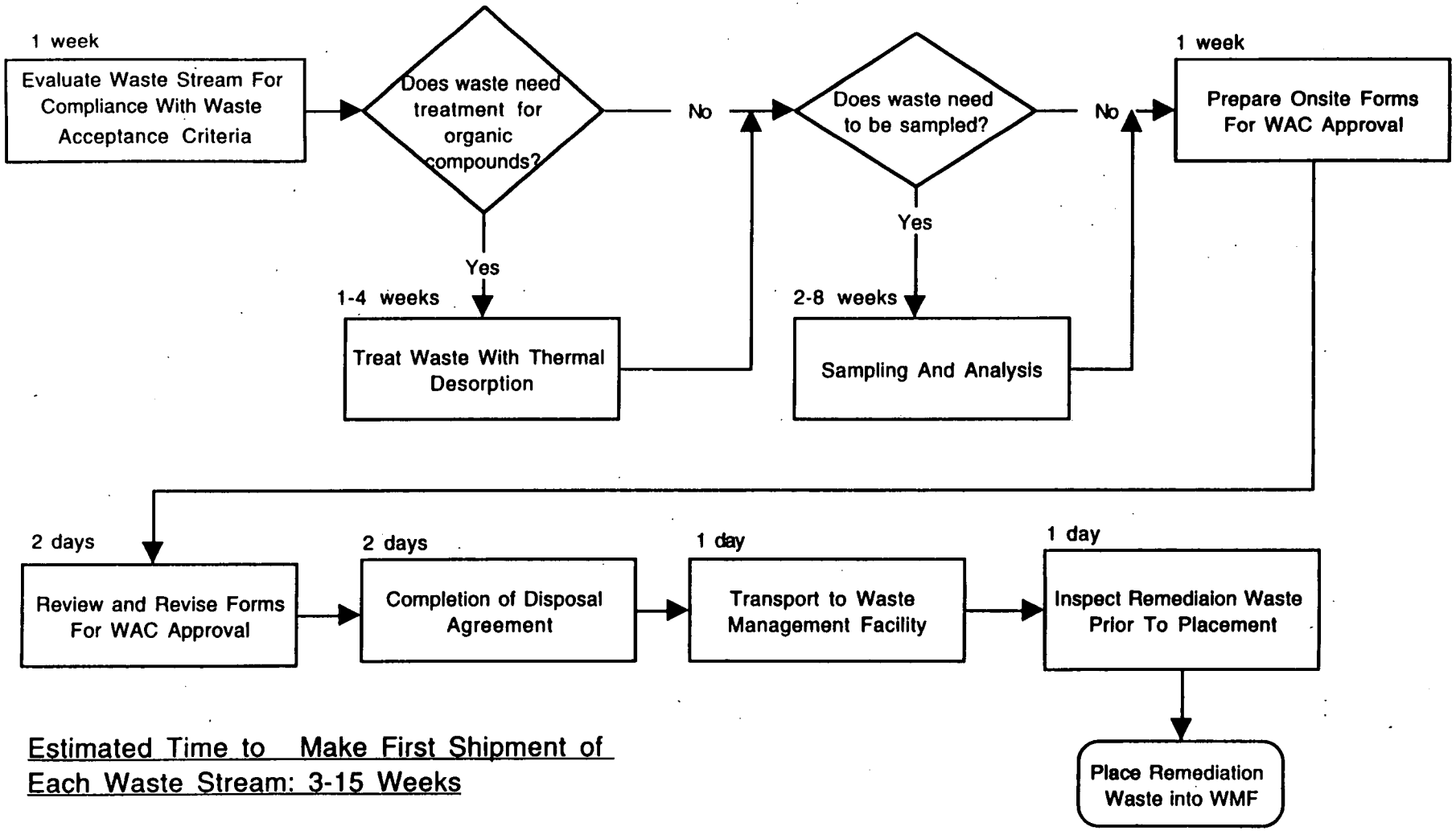
Onsite waste management has a shorter schedule than offsite disposal, once the WMF has been constructed. Like Envirocare, the onsite WMF would meet WAC; however, as shown in Figure B-3, the path from excavation to final placement would be less intensive and more expeditious. In general, only one sampling and analysis event would occur. The logistics of handling and disposal would be more straight forward because of the proximity of the disposal location. Likewise, DOT requirements would not be applicable because no state or interstate highways are traveled, and weight restrictions could be modified. Schedule problems that impact onsite disposal include:

- The placement of waste in an onsite WMF will be delayed until the facility is constructed. This is likely to cause handling problems for remediation waste excavated prior to the completion of an onsite facility.

- Additional security requirements could hamper the transport of remediation waste, although these requirements are insignificant compared to the packaging and manifesting requirements for offsite transport.

A schedule of the onsite waste management and offsite disposal options is shown in Figure B-4 for comparison.

Figure B-3 Process Flow Diagram For Onsite Waste Disposal Option



Estimated Time to Make First Shipment of Each Waste Stream: 3-15 Weeks

Estimated Time to Make Each Additional S hipment of Each Waste Stream: 3-15 Weeks

Figure B-4: Onsite and Offsite Approval Schedules

ID	Task Name	Dur
1	**ONSITE WASTE MANAGMENT FACILITY**	**51d**
2	Evaluate Waste Stream for Compliance with WAC	5d
3	Decision Point - Does waste need treatment for organic compounds	0d
4	Treat Waste With Thermal Desorption	10d
5	Decision Point - Does waste need to be sampled	0d
6	Sampling and Analysis	25d
7	Prepare Onsite Forms for WAC Approval	5d
8	Review and Revise Forms	2d
9	Completion of Disposal Agreement	2d
10	Transport to WMF	1d
11	Inspect Remediation Waste Prior to Placement	1d
12	**OFFSITE DISPOSAL**	**195d**
13	Envirocare sends Instructions and forms to the Site	0d
14	Evaluate Waste Stream for Compliance with WAC	5d
15	Decision Point - Is treatment required to meet LDR's	0d
16	Sample waste stream	3d
17	Treat to meet LDR's	25d
18	Representative Samples are analyzed at Lab (use Utah Certified Labs)	40d

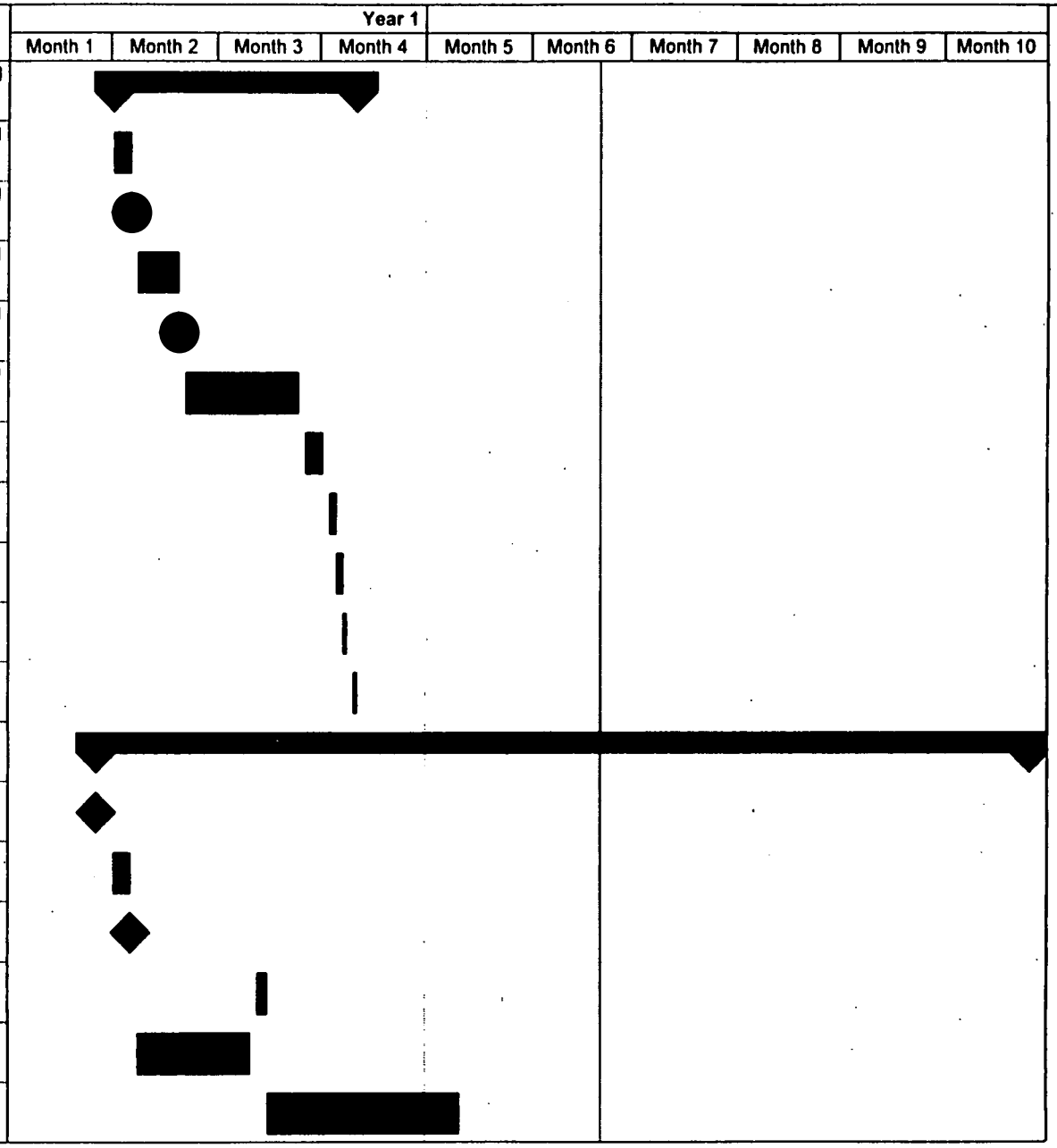


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Figure B-4: Onsite and Offsite Approval Schedules

ID	Task Name	Dur
19	Decision point - Does waste meet LDR's	0d
20	Site completes Envirocare Profile Forms	5d
21	Site Reviews and Revises Forms	2d
22	Submit Lab Analysis, Forms and Pre-Shipment Samples to Envirocare	3d
23	Envirocare Evaluates Material for acceptability and approves waste profile forms	10d
24	Envirocare Analysis of Pre-Shipment Samples & establishes "Fingerprint" Acceptance Parameters	20d
25	Completion of Disposal Agreement	5d
26	Prep and Submit Radioactive Waste Shipment & Disposal Record, Manifest, and Transportation Plan	5d
27	Evirocare Approval of Disposal Record and manifest	0d
28	Envirocare Signs and Sends Notice to Transport and Pre-Shipment Sample Lab Results	5d
29	Site sends 3-day shipment notification	1d
30	Make First Shipment of a single half-crate	10d
31	Envirocare inspects incoming shipment and takes samples for fingerprinting and independent analysis	2d
32	Fingerprint parameters verified to allow unloading of waste	0d
33	Acceptable independent third-party analysis confirms shipment compliance	5d
34	Envirocare sends confirmation of disposal to the Site	0d
35	Decsion Point - Does Waste meet LDRs	0d
36	Treat to Meet LDRs	25d

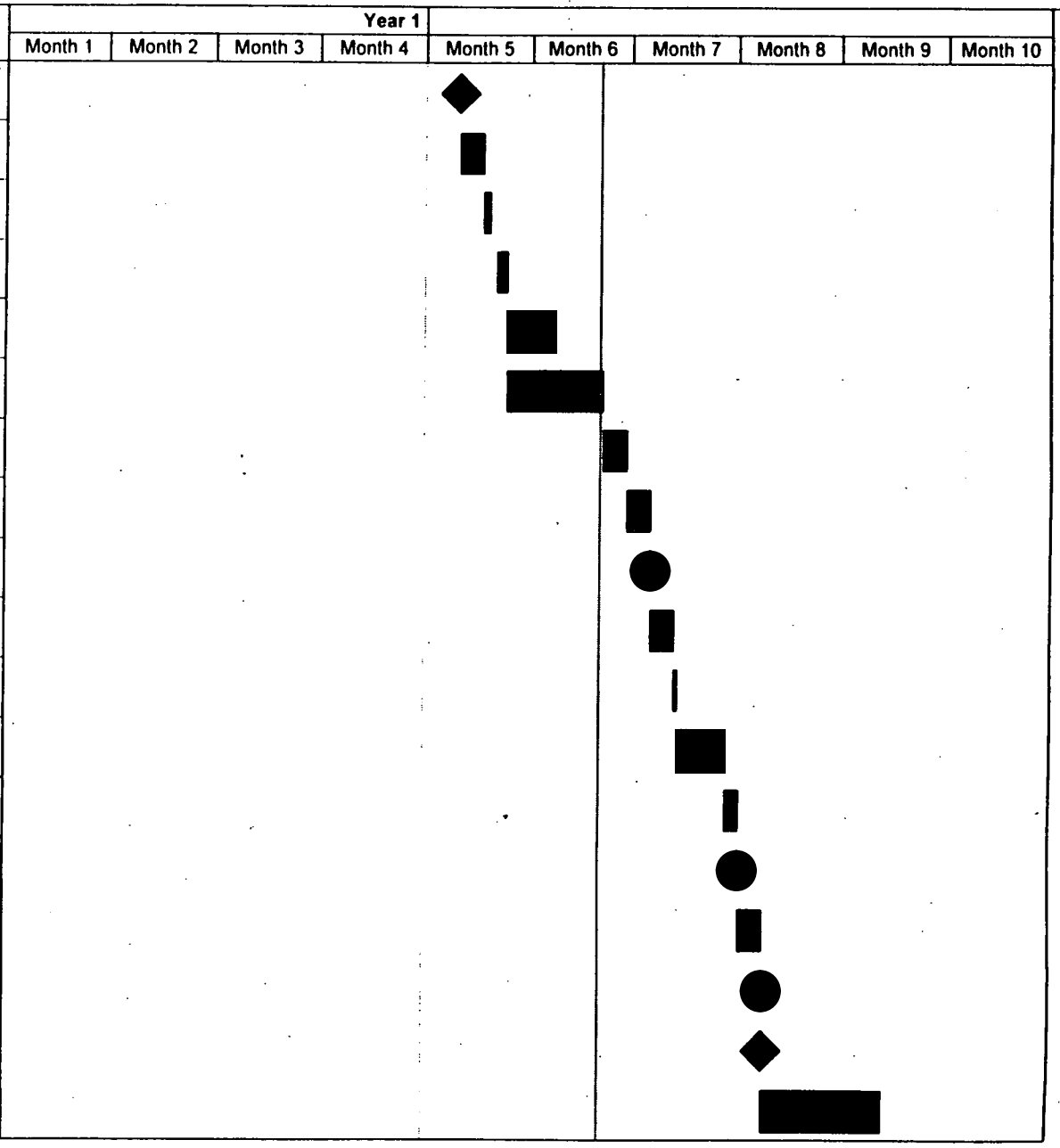

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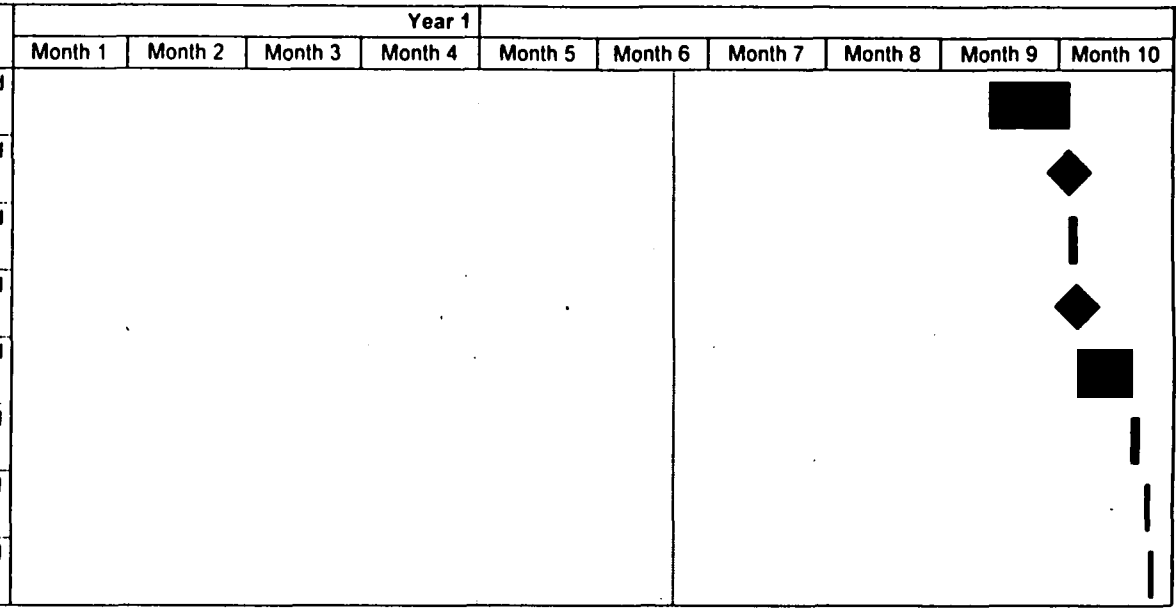
Figure B-4: Onsite and Offsite Approval Schedules

ID	Task Name	Dur
37	Take Composite Samples And Analyze	15d
38	Decision Point - Does Waste Meet LDRs	0d
39	Prepare Envirocare Forms	2d
40	Site sends 3-day Shipment Notification	0d
41	Regular Shipment of Containerized Waste	10d
42	Envirocare inspects incoming shipment and takes samples for fingerprinting and independent analysis	2d
43	Envirocare sends confirmation of disposal to the Site	1d
44	Fingerprint parameters verified to allow unloading of waste	1d



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B.7 RISK ANALYSIS

The risk analysis evaluated three types of risks: human health risk, liability risk, and risks to the environment.

B.7.1 HUMAN HEALTH RISKS TO THE SITE WORKERS AND THE PUBLIC

For the purposes of this evaluation, human health risk or hazard resulting from exposure to chemicals in the soil or water is defined as the increased chance or probability of developing cancer or other adverse health effects as a result of that exposure. Exposure may occur through ingestion of soils or waters, absorption of chemicals through the skin, or by inhalation of airborne particulates or vapors. The health effects from these exposures could vary from minor skin irritations to cancer, depending on the chemical, the concentration, the exposure pathway, the length of the exposure, and the susceptibility of the receptor.

The nature of the health risks to individuals can be classified as involuntary or voluntary, and as uncontrolled or controlled. Acceptability of a risk depends on its nature. Health risks to hazardous waste/remediation workers at the Site is minimized by compliance with the Occupational Safety and Health Act (OSHA) and DOE orders. Health risks are controlled through safety and awareness training, use of personal protective equipment, and monitoring systems. The risk is voluntary because the worker has the option to either accept or decline the task. Furthermore, the risk is clearly communicated, controlled, and accepted by the worker. Risks to the community from future land uses at the location or from remedial activities are generally involuntary and cannot be controlled to the same extent as risk to a worker. If the decision is made to take no action or to transport wastes offsite, the ability to minimize human health risks to the community is greatly diminished.

For the three options, the human health risk evaluation must consider very different ways in which people could be exposed to radiological or hazardous contaminants (exposure scenarios). Worker safety is a factor for both onsite and offsite disposal. Risks to public safety due to accidents in transportation and handling of the waste is a factor for the offsite disposal option. Public safety risks include transportation- and construction-related injuries and fatalities, in addition to accidental radiological or hazardous releases.

Of the three options, the no action alternative could present the greatest human health risk to the community in the long term and least risk in the short term. The magnitude of the risk depends upon the types of exposures to the public, the concentrations, and types of chemicals present. This is dependent on the actions taken to prevent offsite migration and on the future land use permitted at the Site.

Risk assessments have been completed on areas in the buffer zone that initially were thought to be contaminated. The human health risks for OU 1 and the former OUs 2, 5, and 6 have been

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characterized as part of the RCRA Facility Investigation/Remedial Investigation process. These assessments characterize the human health risks of the no action alternative.

Exposures to a potential office worker and to an open-space recreational user present the highest risk estimates. Cancer risks for office workers from contaminant exposure in buildings projected for the above OUs varied from 2 in 10,000 in OU 1, to 5 in 100,000 in the Walnut Creek area. This means that if 10,000 office workers worked in the highest risk area for 25 years, not more than 2 workers would be expected to develop cancer due to exposure to chemicals or radionuclides. The estimated risks to open space users were even lower, varying from 1 in 100,000 to less than 1 in 1,000,000. This means that for every person who uses the buffer zone for open-space recreation for 10 hours a month over
a 25-year period 1 in 100,000 might develop cancer due to contaminant exposure. These risks are very low when compared to the background rates of 25 to 30 people out of 100 who develop cancer during their lifetimes.

Risks have also been calculated for the exposure of offsite residents to contaminants in 903 Pad Mound and East Trenches. The risk of cancer to a resident living near the location due to offsite migration of 903 Pad Mound and East Trenches contaminants is much less than 1 in 1,000,000, varying from 1 in 10,000,000 to 1 in 100,000,000,000. These risks are considered too low to be of consequence. Data from recent accelerated actions indicate that 903 Pad Mound and East Trenches subsurface contaminant concentrations could be significantly higher than originally estimated and likewise the human health risks to construction workers could be higher if the no action alternative were implemented.

Risk assessments for the IA have not been conducted. It is expected that the human health risks will be higher than in the buffer zone because of the intense industrial activity that has taken place there for the last 50 years. Investigation data suggest that contaminant concentrations are significantly higher than levels in the buffer zone, and therefore, if no action is taken, the risks to Site workers would be higher. Without source removal, there is also a greater potential for release to the community following Site closure.

The remaining two options are onsite waste management and offsite disposal of remediation wastes. After the remediation waste has been placed in a WMF, the risks associated with these options should not be significantly different. However, the risks to both the Site workers and the public are expected to vary greatly in the handling and the movement of wastes to a facility. The differences in risks are due to uncertainties associated with transportation of the wastes.

Onsite transportation involves the movement of wastes by truck for a distance of less than 3 miles, through a controlled environment (the site). Risks associated with this movement can be tightly controlled, especially with respect to the community and worker exposure. Offsite transportation involves the movement of LLW, LLMW, and HW for distances of approximately 700 miles by rail and/or trucking. It is estimated that during the disposal effort, over 2.5 million miles would be logged

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by trucks offsite. For the total waste volume, national statistics in Accident Facts from the National Safety Council published in 1994, suggest that five accidents would occur during transportation to the offsite repository. These accidents would not necessarily be fatalities but could result in personal injuries, property damage, or an accidental spill. As a result of these accidents, communities along the route from the Site to the disposal cell could be exposed to both chemical and radiological contamination. The magnitude of these risks are difficult to quantify; however, these exposures would be both involuntary and uncontrolled and, as such, may not be acceptable to potentially exposed communities (but probable low, given the nature of the waste).

Human health risks from onsite construction and transportation are much lower. Only about 6,000 miles would be logged by trucks onsite. The risk of uncontrolled releases of toxic substances will be greatly reduced. The risk to the public will be negligible and Site worker risk is controlled. Risks will also be controlled through dust suppression, personal protective equipment, training, continuous monitoring, and other safety measures.

In summation, onsite waste management is the best option in terms of human health risks for the following reasons:

- The no action alternative would provide no risk reduction.
- Additional handling and transportation to the offsite facility increases the likelihood of accidents resulting in injuries or spills.
- The offsite disposal alternative creates involuntary and uncontrolled risks to the public.
- The onsite waste management option is more amenable to risk management because risks can be tightly managed and controlled. Health risks to the workers would be better known and more risks would be voluntary.
- Finally, fewer overall risk reduction activities (including source removal) would be able to occur when using offsite disposal because less funding would be available.

The onsite waste management option offers the greatest overall risk reduction. Risk management could be conducted in a tightly controlled manner. Remediation waste would not be moved through communities where the public could be involuntarily subjected to accidental spills. Additional risk reduction could occur sooner and at a lower cost reducing exposure pathways through the air, surface waters, and groundwater.

B.7.2 LIABILITY RISKS

In evaluating liability, both near-term and long-term liability risks were analyzed. Near-term risks include the liability from spills that could occur in handling, storing, and transporting the remediation waste. Long-term liability risks include the ability to manage materials safely over time and long-term fiscal liability. These long-term risks could exist because some contaminants present in the remediation waste are resistant to natural degradation processes.

The liabilities involved with the no action alternative present the greatest risk because of the potential that contaminants could migrate offsite as airborne particulates or through surface waters to private and public lands, and bodies of water. Potential costs for cleanup of larger areas of contamination and possible payments for damage to human health and the environment are significant. The increased number of potential exposure pathways create a greater possibility for contamination of offsite lands, thus creating more liability from lawsuits for damage of property than either onsite waste management or offsite disposal of remediation waste. There could be additional exposure to the public if future land uses of the Site allow greater public access. Without some removal of contaminants, the Site cannot be released for other uses.

If remediation waste is disposed of offsite, it reduces no-action risks but there are the increased liabilities. The offsite disposal option could cause spills that could occur during transportation because of the additional mileage to offsite facilities, including damage caused by contaminated media being spread on uncontaminated roads and offsite property. The costs for offsite spills could be greater because there is a greater potential of larger and more pristine areas to become contaminated. Additionally, physical damage could occur to people, vehicles, and property.

Long-term waste management options, both onsite and offsite, were deemed to be equally effective in containing contaminants because of similar design and similar regulatory requirements. The Site and NTS are both DOE facilities. Other facilities are under private ownership. NTS cannot accept RCRA-listed waste, which severely limits the volume of waste that NTS can accept from the Site. For the offsite disposal option, most of the remediation waste would have to be managed in facilities that rely on the viability of a private firm to ensure continued operation. For the DOE, this reliance on a private firm is a risk in terms of liability, because there is no guarantee of continued effective operation. There is also no guarantee that the facility will remain effective over the hundreds or even thousands of years that the waste will pose a risk. Under CERCLA liability, waste remains the responsibility of the generator forever. A comparison of liability risks is presented in Table B-3.

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Table B-3 Comparison of Liability Between Onsite Waste Management and Offsite Disposal Options

Liability	No Action Alternative	Onsite Waste Management Option	Offsite Disposal Option
Transportation Risks	Not Applicable	Reduced mileage to WMF would reduce likelihood of a spill. If a spill did occur it would be on DOE property, and therefore, would not affect private or public property.	Increased risk due to additional distance to WMF. Spill or accident could threaten public health or damage public or private property.
Handling Risks	Not Applicable	Less handling prior to shipment would reduce worker exposure and accidents.	Additional handling prior to shipment could increase liability risk from worker exposure and accidents.
Long-Term Fiscal Liability	Liability risk due to potential migration of contaminants via groundwater, surface water, and airborne particulates.	Liability due to leaks and spills.	Liability due to leaks and spills.
Fiscal Risk	Mitigation costs of offsite land and surface water.	Reduced fiscal risk-WMF remains on government property. DOE retains better control of costs in the event of a spill.	Possibility that operator might not exist in future. Liability for remediation waste could fall back to DOE based on CERCLA, or if trusts are consumed.
Long-Term Effectiveness	Not effective - Contaminated materials continue to be exposed to the environment. Cleanup costs increase because of the increase in areas of contamination.	Because of similar engineering design requirements, onsite and offsite are approximately the same.	Because of similar engineering design requirements, onsite and offsite are approximately the same.

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B.7.3 IMPACT TO THE ENVIRONMENT

Environmental impacts to air quality, surface water, groundwater, soils, and ecosystems were considered for the three options. Impacts due to construction and/or expansion of offsite facilities were not considered because it was assumed that these impacts had already occurred. Environmental impacts from source removals were assumed to be similar between the onsite and offsite options. Dust suppression, erosional control, and other efforts will be used to minimize the impact. Because of regulatory requirements, both onsite and offsite options were assumed to be adequately designed to protect the environment once the remediation waste had been placed in the WMF.

B.7.3.1 No Action Alternative

The no action alternative would have the most detrimental impacts to the environment because the least amount of effort would be put into restricting the migration of contaminants.

Impact to Air Quality

There could be local air quality impacts due to the dispersion of contaminated soils which were not remediated. Emission rates of volatiles in subsurface soils will be dependent upon future activities at the location. Potential exposures or releases could result from future events, such as construction or erosion.

Ecological Impact

Impacts to ecosystems are not expected to be significant. Minor impacts to plants and wildlife could slowly increase as contaminants migrate. Contaminants could move from sources to groundwater and from groundwater to surficial waters which, in turn, increases exposure to surficial ecosystems; however, many of these contaminants will be destroyed, volatilized, or adsorbed by the soil prior to exposure by this pathway.

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Impact to Soils And Sediments

The volume of contaminated subsurface soil will increase slowly as free-phase solvents and contaminated groundwater spread out. Sediments could be impacted as airborne contaminants settle in drainages, seeps bring contaminants to the surface, and/or erosion occurs. This is not consistent with intent of Rocky Flats Cleanup Agreement (RFCA).

Impact to Water Quality

Groundwater plumes will continue to spread due to diffusion and advection. Additional contaminants will leach into groundwater and surface waters because the sources of contaminants have not been removed.

B.7.3.2 Offsite Disposal

Impact to Air Quality

Direct environmental impacts include vehicle exhaust during excavation and transportation of the excavated materials and particulates from excavation, placement of contaminated media, and transportation over dirt roads. There is a potential for a spill to occur during handling and transportation, resulting in the dispersion of contaminated dust or vapors. Dust control during the spill cleanup should reduce this impact.

Ecological Impact

No direct impact to the ecosystem is anticipated, except if a spill were to occur during handling or transportation. If excavation of a spill were required, plants and/or habitats could be destroyed and irreversible harm could occur, if the replacement of these plants and/or habitats were not successful.

Impact to Soils And Sediments

As with the other environmental impacts, if a spill occurred during handling or transportation, there could be a direct impact to soils. Excavation of the contaminated soil would be required and, based on the characterization of the spill area, a greater volume of contaminated soil could require remediation.

Impact to Water Quality

No direct environmental impact is anticipated, except if a spill occurs during handling or transportation. Contamination of the surface water is possible depending on the location of the spill.

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B.7.3.3 Onsite Waste Management Option

This option assumes that the location of a WMF will be at the Site (see Appendix C, Onsite Waste Management Facility Siting Study). Environmental impacts are location-specific and this evaluation could change based on the selected location.

Impact to Air Quality

Direct environmental impacts include vehicle exhaust during excavation and transportation of the excavated materials and particulates from excavation, placement of contaminated media, and transportation over dirt roads. There is a potential for a spill to occur during handling and transportation, resulting in the dispersion of contaminated dust or vapors. Impacts would be controlled by operational control of particulate and airborne contaminants.

Ecological Impact

Impacts to plant communities, wetlands, and other habitats will be minimized at the selected location. Likewise, the impact to threatened and endangered species is also expected to be minimal.

Impact to Soils and Sediments

Minimal damage will occur to the top soil at the selected location of the WMF. A higher erosional impact could also occur particularly if the WMF is situated close to areas with high natural erosion rates, such as drainage basins and slopes; however, through siting and erosional controls this effect will be minimized. Spills or leakage through the cell liner could also occur that could impacts surficial soils.

Impact to Water Quality

Based on the siting requirements in 6 CCR 1007-2, the WMF would be designed to isolate wastes for a thousand years from natural environmental pathways that could expose the public. Therefore, no impact on water quality is anticipated for the onsite option. An onsite WMF would include a postclosure (30 years) groundwater monitoring system for early detection of contaminant migration. There is a possibility of spills during transportation and handling; however, this risk is much less than the offsite option because of the close proximity of the WMF and fewer labor-intensive handling requirements prior to placement of the remediation waste. A summary of potential environmental impacts is given in Table B-4.

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Table B-4 Summary of Environmental Impacts

Option	Air Quality Impact	Ecological Impacts	Soil and Sediment Impacts	Water Quality Impacts
No Action Alternative	Airborne dispersal of contaminants in soils.	Damage to local ecology due to unchecked migration of contaminants.	Increase in contaminated areas due to unchecked migration of contaminants.	Increase in plume size and increased transport of contaminants to surface water.
Offsite Disposal Option	Possible impact due to spills, otherwise minimal.	Possible impact due to spills, otherwise minimal.	Possible impact due to spills, otherwise minimal.	Possible impact due to spills, otherwise minimal.
Onsite Waste Management Option	Possible airborne particulates/ contaminants generated during construction depending on location. Possible impact due to spills.	Dependent on location. Impacts to plants, animal habitat, and threatened and endangered species can be minimized through location selection process.	Dependent on location. Possible impact to the topsoil. Erosional impacts are also possible.	Minimal impact.

B.8 CAPACITY AND AVAILABILITY

The capacity and availability for accepting remediation waste of the three different remediation waste management options are significant factors in the decision-making process. As a permitted treatment and storage facility (e.g. existing RCRA Permit #91-09-30-01 for storage), the Site has temporarily stored waste for the short and the long term until offsite disposal could occur. The cost impacts have been enormous in providing capital investment for storage facilities, and the required routine maintenance and scheduled walkdowns of waste inventories.

As mentioned previously, the majority of ER remedial waste media is projected to be contaminated soils and designated as LLMW. The most cost-effective and efficient manner in handling this waste media is in bulk (e.g., tandem dump trucks or large roll-off containers) versus drums or crates. The Site has a permitted storage capacity of 23,700 cy for LLMW. An inventory of LLMW, as of January 1995, accounts for 19,300 cy, which leaves 4,400 cy of usable storage space (see Table B-5, Permitted and Interim Status Storage Units). The permitted capacity of several of the RCRA units is larger than the available physical capacity of the unit. The permitted capacity can never be realized because of the physical limitations of the facility. A majority of the permitted facilities are structured for the storage of drums and crates and not for roll-off containers used for bulk ER waste material. As shown in Table B-1, the ER waste generation rate would surpass the existing available onsite storage space before offsite shipment could occur. Common sense dictates that waste should not be generated unless the material can be immediately disposed of offsite or managed onsite.

For the no action alternative, there is no driving factor because no removal action will take place. The waste material would remain as is with a higher level of risk to the public and the environment; therefore, capacity and availability have no significant impact.

For the offsite disposal option, capacity and availability are significant factors. Oak Ridge National Laboratory (ORNL) is the DOE facility that has contracted collectively on behalf of all DOE facilities with Envirocare of Utah for waste disposal. The contractual maximum waste limit which in all DOE facilities collectively can ship to Envirocare is 350,000 cy over the entire contract life (e.g., 5 years). A further breakdown of this value is 70,000 cy/year by all combined facilities. However, the WAC imposed by Envirocare to waste generators requires a rigorous process of verification and assurance for compliance with the LDR. A process flow diagram that outlines the duration of these requirements is shown in Figure B-2 and illustrates that waste generated cannot be shipped offsite until approval is granted from the disposal location (Envirocare).

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Table B-5 Permitted and Interim Status Storage Units (Reference: 1995 Comprehensive Waste Management Plan)

Unit	Unit Name	Waste Type	Permitted/Interim Status Storage Capacity		Physical Capacity (m3)		On-Hand Inventory (m3)		Remaining Capacity (m3)			Comment
			Liquid	Total	Liquid	Solid	Liquid	Solid	Liquid	Solid	Total	
1	Main Hazardous Waste Storage Area	LLM	466.85	466.85	313.93	313.93	12.83	0.00	301.10	301.10	301.10	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity. Administrative limit of 200 cu yd for HAZ waste.
		HAZ	466.85	466.85	152.92	152.92	79.19	49.23	24.50	24.50	24.50	
		Total	466.85	466.85	466.85		92.20	49.23	374.65	325.60	325.60	
6	Chip Drum Storage Area: Building	LLM	4.43	4.43	4.43	4.43	0.00	0.63	3.80	3.80	3.80	
		Total	4.43	4.43	4.43		0.00	0.63	3.80	3.80	3.80	
10	Drum Storage Area: Building 561	LLM	78.74	78.74	78.74	78.78	61.92	0.00	15.43	15.43	15.43	Total on-hand inventory includes nonhazardous waste stored in this unit.
		Total	78.74	78.74	78.74		63.31	0.00	15.43	15.43	15.43	
11 (Includes Units 61 & 62)	Container Storage Area Building 776, Room 134	LLM	0.00	255.88	4.78	14.34	0.00	39.36	4.78	20.08	24.86	Total on-hand inventory includes nonhazardous waste stored in this unit. Twenty five percent of LLM physical capacity reserved for repacking
		TRM	0.00	113.93	0.00	113.93	0.00	39.06	0.00	24.86	24.86	
		Total	0.00	255.88	133.05		0.00	108.19	0.00	24.86	24.86	
12	Drum Storage Area: Building 776, Room 237	LLM	37.89	37.89	35.17	35.17	0.00	29.13	0.17	0.17	0.17	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity. Total on-hand inventory includes nonhazardous waste stored in this unit.
		Total	37.89	37.89	35.17		0.61	34.39	0.17	0.17	0.17	
13	Mixed Waste Storage: Building 884	LLM	139.91	209.86	194.82	194.82	0.42	168.78	20.10	20.10	20.10	Total on-hand inventory includes nonhazardous waste stored in this unit.
		Total	139.91	209.86	194.82		0.42	174.30	20.10	20.10	20.10	
14	Centralized Waste Storage Facility: Building 906	LLM	0.00	3975.92	0.00	2857.70	0.00	0.00	0.00	2857.70	2857.70	Liquid storage not allowed. Physical capacity assumes 1:1 ratio of crates to 55 gallon drums.
		HAZ	0.00	3975.92	0.00	2857.70	0.00	0.00	0.00	2857.70	2857.70	
		Total	0.00	3975.92	2857.70		0.00	0.00	0.00	2857.70	2857.70	
15A	904 Pad and Cargo Containers	LLM	60.31	844.28	60.31	478.18	0.84	383.81	59.47	94.37	153.84	Physical capacity limited due to stacking and large container constraints.
		Total	60.31	844.06	538.49		0.84	383.81	59.47	94.37	153.84	
15B	Mixed Waste Storage Area: 904 Pad	LLM	8181.22	8181.22	8181.22	8181.22	0.00	5041.73	3139.49	3139.49	3139.49	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity.
		HAZ	8181.22	8181.22	8181.22	8181.22	0.00	0.00	3139.49	3139.49	3139.49	
		Total	8181.22	8181.22	8181.22		0.00	5041.73	3139.49	3139.49	3139.49	
17	Mixed Waste Storage: Building 777, Room 423C	LLM	0.00	1.25	0.00	0.84	0.00	0.84	0.00	0.00	0.00	Liquid storage not allowed.
		Total	0.00	1.25	0.84		0.00	0.84	0.00	0.00	0.00	
18.03	Environmental Waste Drum Storage, Tent 1	LLM	718.74	718.74	718.74	718.74	0.00	8.40	472.34	472.34	472.34	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity.
		HAZ	718.74	718.74	718.74	718.74	0.00	238.00	472.34	472.34	472.34	
		Total	718.74	718.74	718.74		0.00	8.40	710.34	710.34	710.34	
18.04	Environmental Waste Drum Storage Unit	LLM	416.30	416.30	416.30	416.30	0.00	76.27	340.03	340.03	340.03	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity.
		HAZ	416.30	416.30	416.30	416.30	0.00	0.00	340.03	340.03	340.03	
		Total	416.30	416.30	416.30		0.00	76.27	340.03	340.03	340.03	
19	Mixed Waste Storage Area: Building 374, Room 3813	LLM	180.45	180.45	135.49	135.49	0.00	49.12	0.00	0.00	0.00	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity. Total on-hand inventory includes nonhazardous waste stored in this unit.
		TRM	105.51	105.51	105.51	105.51	0.00	45.99	0.00	0.00	0.00	
		Total	180.45	180.45	135.49		0.00	135.49	0.00	0.00	0.00	
20	Shipping Storage Area: Building 664	LLM	1911.50	1911.50	601.74	601.74	0.00	80.36	70.83	70.83	70.83	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity. Total on-hand inventory includes nonhazardous waste stored in this unit.
		HAZ	1911.50	1911.50	601.74	601.74	0.00	1.05	70.83	70.83	70.83	
		TRM	448.82	448.82	448.82	448.84	0.00	183.77	70.83	70.83	70.83	
		Total	1911.50	1911.50	601.74		0.00	530.91	70.83	70.83	70.83	
24	Mixed Waste Storage: Building 964	LLM	0.00	466.36	0.00	442.93	0.00	438.69	0.00	4.24	4.24	
		Total	0.00	466.36	442.93		0.00	438.69	0.00	4.24	4.24	
25	Mixed Waste Storage	LLM	10704.40	10704.40	10704.40	10704.40	0.00	5753.80	4950.60	4950.60	4950.60	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity.
		HAZ	10704.40	10704.40	10704.40	10704.40	0.00	0.00	4950.60	4950.60	4950.60	
		Total	10704.40	10704.40	10704.40		0.00	5753.80	4950.60	4950.60	4950.60	
27	Mixed Waste Storage: Building 776	LLM	10.41	10.41	10.09	10.09	7.56	0.84	0.43	0.43	0.43	Liquid permitted/Interim status capacity equals total permitted/Interim status capacity. Total on-hand inventory includes nonhazardous waste stored in this unit.
		Total	10.41	10.41	10.09		7.56	2.10	0.43	0.43	0.43	

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The requirement that all waste characterization be conducted by certified State of Utah laboratories further restricts the availability of resources. Additionally, the assumption of transporting the majority of waste by rail to Envirocare would have both substantial cost and time savings versus waste shipment by trucking. DOT imposes restrictions on trucking for maximum load capacities on federal and state highways, which ultimately reduces the volume of waste per shipment. However, the logistics of handling and shipping waste by rail car are presently not available at the Site. A loading facility would be required to handle the shipments by rail.

Capacity and availability appear more attractive for onsite waste management. The waste disposal cell would be designed and constructed for a net volume of 100,000 cy. No restriction on the annual volume of waste would be imposed on the generator. In fact, the operations onsite could probably accept up to 500 cy/day. It is unlikely that the rate of removal and treatment of remediation waste could exceed the acceptance rate. In other words, removal actions would not be impeded by utilization of an onsite WMF. The WAC required for the onsite WMF unit would be less complicated than the offsite option and would be the process shown on Figure B-3, not become the lengthy process shown in Figure B-2. Characterization and certification could be obtained through a quality controlled program maximizing the use of field instrumentation techniques that could significantly reduce costs and schedules. Also, DOT load capacity requirements are not as stringent because state or interstate highways are not used. As a summary of comparisons, Table B-6 summarizes the capacity and availability of each option.

Table B-6 Comparison of Capacity and Availability of Waste Management Options

Options	Maximum Capacity (Volume)	Availability	Advantages/ Restrictions
No Action Alternative	4,425 cy *	No impact	Capacity is restricted by the current Site capability to store waste.
Onsite Waste Management	100,000 cy	Readily available (once constructed) and limited by maximum capacity.	1. No restrictions on the volume accepted except total capacity. 2. The WAC is not as stringent. 3. DOT requirements are not applicable.
Offsite Disposal	70,000 cy**	5 years***	1. Approval granted by Envirocare. 2. Waste characterization done by certified State of Utah laboratories. 3. DOT requirements for trucking on highways.

Notes:

* Remainder of the space available at the Site for the storage of LLMW (based on the inventory as of January 1995).

** Maximum waste limit that can be shipped to Envirocare per year for 5 years from all DOE facilities according to the contract with the DOE. The maximum waste capacity for all DOE facilities for Envirocare during the life of the contract is 350,000 cy.

*** Based on the current contract expiration with Envirocare. Conditionally, contract may be approved for extension after 5 years.

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B.9 RECOMMENDATIONS

Overall the evaluation indicates that the onsite management of remediation waste is the best option. The main advantages are:

- Cost-effectiveness
- The possibility of offsite spills is negated
- There is better support of the Site mission as embodied in the Site Vision
- Greater support for the reduction of risks to the public and the environment is provided

The main cost benefit for onsite waste management is that under a CAMU designation, remediation waste would not have to be treated to meet the LDR; it would only need to be treated to ensure that the contaminants are immobile.

This evaluation was based on the assumption that an onsite CAMU would be operated for an indefinite period of time. Should the CAMU serve only as a temporary unit, then final action costs could warrant the consideration of offsite facilities. Although an onsite facility is designed for retrievability, should the remediation waste need to be removed or it becomes economically or technologically feasible to treat the contamination, the intention is that it be managed as any other CAMU, and like other CAMUs, it is intended to be the final action for most of the waste placed into it.

To compare the effects of onsite waste management versus offsite disposal, a hypothetical model (see Table B-7) was developed that tied in costs, waste volumes, and accelerated actions. The accelerated actions and waste volumes in Table B-7 were evaluated under a fixed budget of $20M per year until all of the actions were completed. Waste minimization of remediation waste by thermal desorption treatment was incorporated into the model. These soils were assumed to be returned to their source areas and were not placed in a WMF. As shown in Figures B-5 and B-6, an equal volume of remedial waste is dispositioned in 5 years with onsite waste management versus 16 years under the offsite disposal option. A description of the hypothetical cost model is presented in Attachment 3.

The onsite waste management option not only manages the waste in a more expeditious time frame and reduces risk to the environment and the public, but total costs expenditures are reduced significantly. As mentioned earlier, funding from Congress for future environmental cleanup is being reduced and will become more difficult to justify. Onsite waste management is less expensive than offsite disposal, and would enable an expedient reduction of environmental risks at the Site because the annual budget would not be consumed by offsite disposal costs. This, in turn, would result in greater overall risk reduction and long-term protectiveness of human health and the environment.

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The primary challenge associated with an onsite WMF will be to obtain approval for an onsite CAMU, and obtaining public approval. Offsite facilities are currently permitted and are ready to accept waste for disposal despite problems with logistics and higher costs than onsite facilities.

Clearly, onsite waste management is the most cost-effective and viable option for the management of remediation waste at the Site.

Table B-7 Remediation Waste (cy) Treated By Fiscal Year

Fiscal Year	Onsite Option Waste Management (cy)	Onsite Option Thermal Desorption Treated Soil (cy)	Onsite Option Total Waste Volume (cy)	Offsite Option Waste Disposal (cy)	Offsite Option Therm Desorption Treated Soil (cy)	Offsite Option Total Waste Volume (cy)
Year 1	0	6,800	6,800	0	6,800	6,800
Year 2	12,348	0	12,348	7200	0	7,200
Year 3	6,032	4,090	10,122	7,034	144	7,179
Year 4	6,104	4,020	10,124	4,016	3,686	7,702
Year 5	11,946	0	11,946	3,519	4,280	7,799
Year 6	11,946	0	11,946	7,059	0	7,059
Year 7	11,946	0	11,946	7,059	0	7,059
Year 8	11,946	0	11,946	7,059	0	7,059
Year 9	3,352	6,170	9,522	7,059	0	7,059
Year 10	730	2,470	3,200	7,059	0	7,059
Year 11				7,059	0	7,059
Year 12				7,059	0	7,059
Year 13				3,958	3,770	7,728
Year 14				1,210	4,870	6,080
Total	76,350	23,550	99,900	76,350	23,550	99,900

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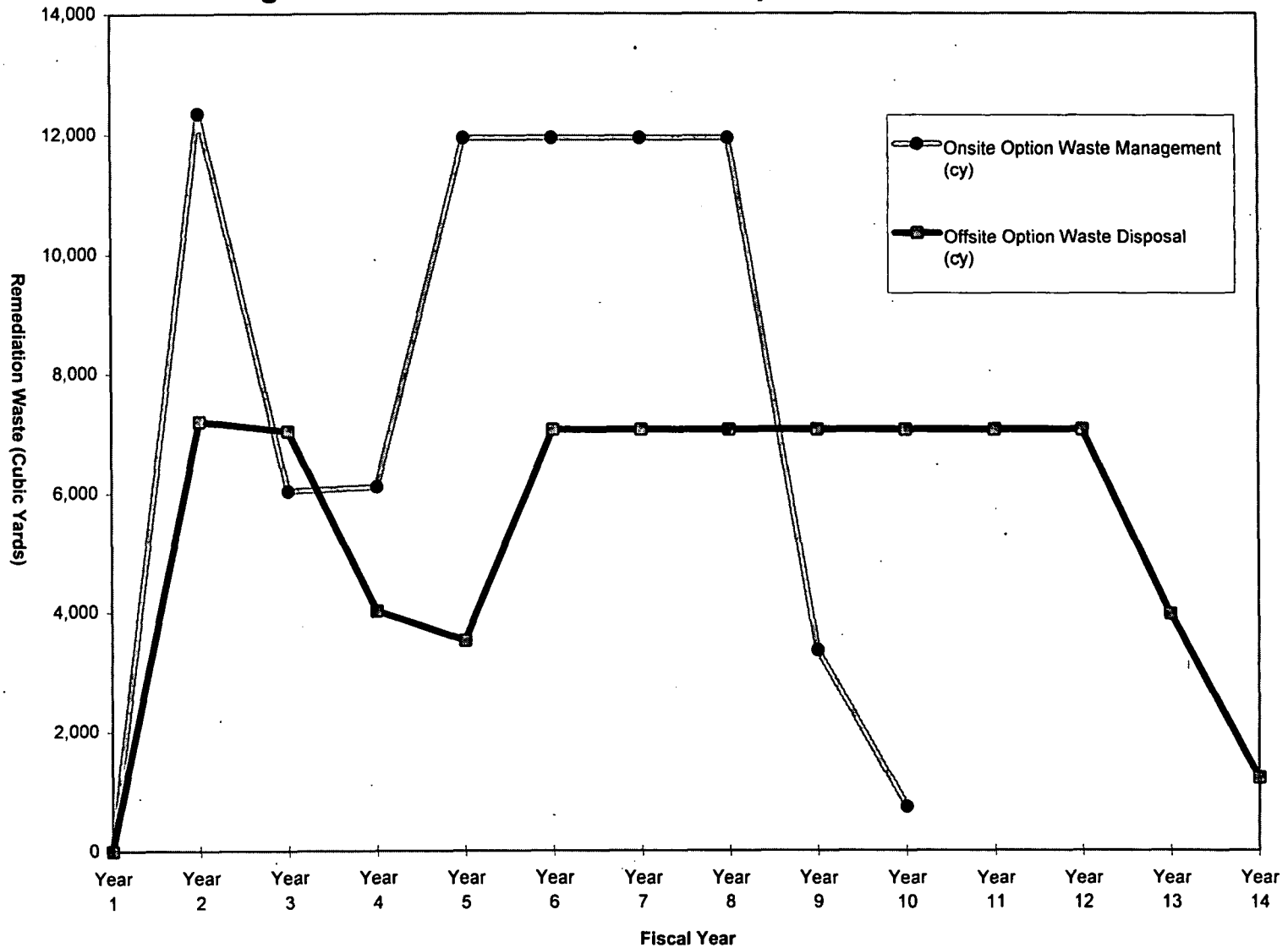
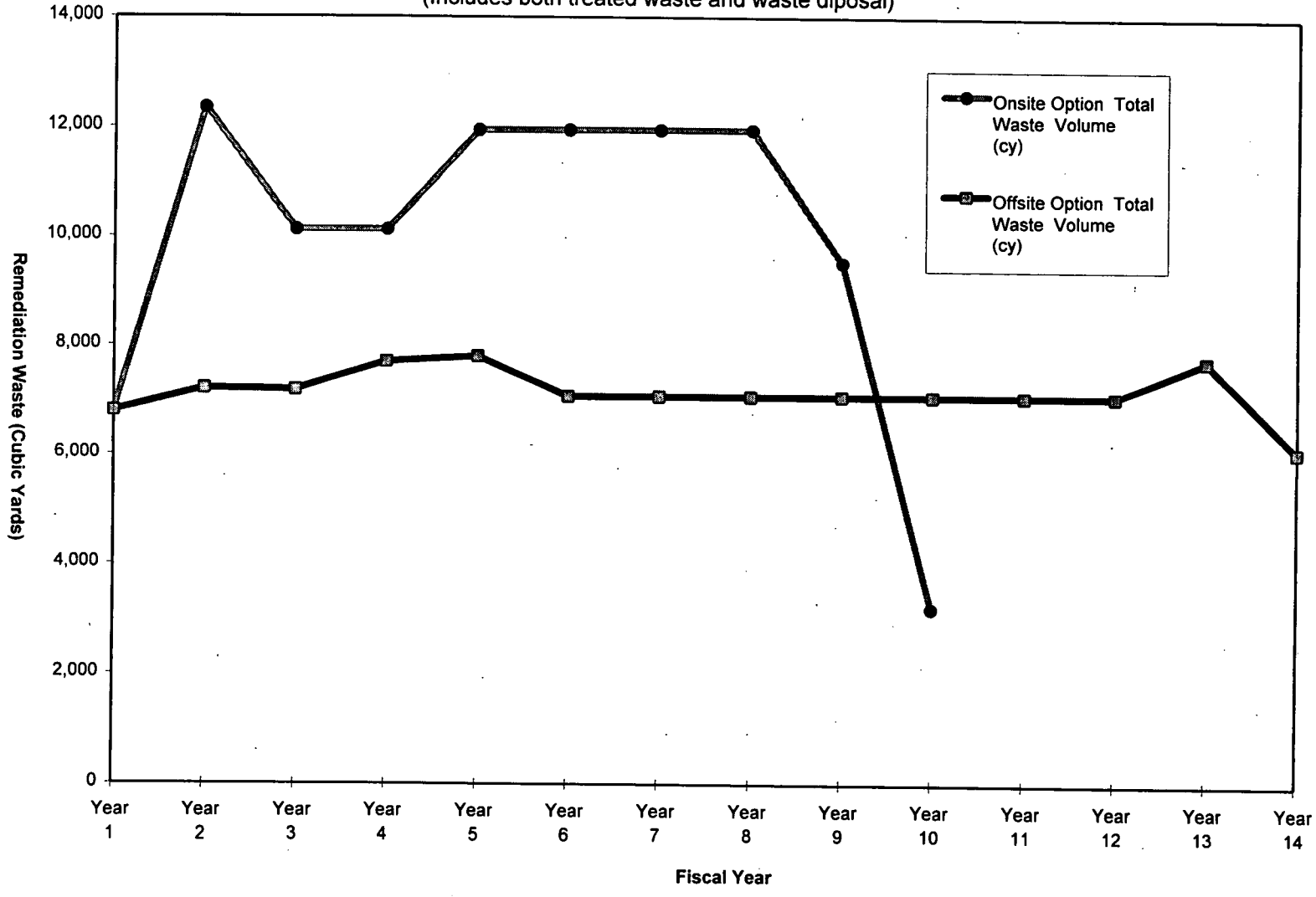
Figure B-5 Remediation Waste Disposal Versus Fiscal Year



879

Figure B-6 Total Waste Dispositioned From Accelerated Actions Versus Time

(Includes both treated waste and waste diposal)



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Attachment 1

Assumptions

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General Assumptions

1. Assume that onsite waste management would be conducted under CAMU guidance (Subpart S, Corrective Action, Section 264.552 of 6 CCR 1007-3).

2. Assume that the onsite WMF would be designed to not pose a risk to the public or the environment for a thousand years in accordance with 6-CCR 1007-2, Part 2, Requirements For Siting of Hazardous Waste Disposal Sites.

3. Assume that high-level volatile and semivolatile organic constituents in the remediation waste would be treated using thermal desorption. Assume that contaminated soils would be treated; if PPRGs are met, the soils would be returned to their original point of excavation; if PPRGs are not met, the soils would be managed in the WMF.

4. No new interim storage facilities will be planned or budgeted for future storage of waste.

5. A limited budget in FY96 exists for the ER program. Outyear budgets have not been confirmed, however, a reduced budget for FY97 and outyears is assumed.

6. The use of railway shipment for bulk waste offsite would require upgrades or modifications to the existing system and a new loading facility.

7. No TRU waste was evaluated.

8. Under all of the options, groundwater monitoring will be integrated into the existing sitewide monitoring program. For an onsite facility, it was assumed that some additional wells would be necessary and that existing wells could also be used.

9. For all of the options, it was assumed that the level of all monitoring currently used at the Site would be continued. For the onsite option, additional monitoring would be required during construction and operation for health and safety purposes.

Assumptions of the Waste Volume Estimate (as presented in Table B-1)

1. The total volume estimated for the Solar Ponds ranges from 10,700 to 160,000 cy as referred by the *OU 4 IM/IRA Decision Document.* The value chosen assumes the vadose and surficial soils will require minimal remedial action based on the risk to human health and the environment. Pondcrete and sludge will be accepted without further treatment for free liquids. Sludge and pondcrete waste forms can be intermixed with soils to meet moisture content requirements.

2. The waste types exhibited are LLMW, HW, and LLW.

3. Assume that approximately 60% of the IDM drums (3,000 drums) will be going to the WMF, the remaining 2,000 drums will be disposed of in the present sanitary landfill under 4-U50-REP-1006.

4. Potential Early Actions waste will be disposed of in the WMF if the treated waste cannot be returned to the source location.

5. Table B-1 does not include volumes for the remaining IHSSs in the Industrial Area. Because of budgetary constraints, insufficient sampling results are available to project potential remediation waste volumes. Remediation activities in OUs 1, 3, and Walnut Creek Area are not anticipated to generate significant waste volumes. IHSS 115 and OU 7 landfills are assumed to be capped.

6. The total estimate of 85,629 cy of remediation waste is based on a 15% fluff/expansion factor.

7. The schedule for accelerated actions is presently unknown because of potential budgetary constraints. The volumes of the accelerated action removals do not represent the total cleanup of the Site.

Cost-Analysis Assumptions

1. For offsite disposal, all LLMW and HW will go to Envirocare.

2. For offsite disposal only, small quantities of waste will be packaged in crates.

3. The remaining waste (approximately 98%), destined for offsite disposal, will be packaged in bulk in roll-offs. Roll-offs are large, rectangular containers constructed of steel which can be placed on tractor trailers or rail cars. The roll-offs were assumed to have a capacity of 20 cy.

4. All waste destined for offsite disposal will be packaged in roll-off containers.

5. No waste will be required to be packaged in crates for onsite waste management.

6. Envirocare will accept waste in roll-off containers and will allow the waste to be disposed of in bulk. They will proceed to decontaminate the roll-off containers allowing them to be used again. For this reason, no more than a two-month supply of roll-off containers will be needed. It is assumed that 500 cy (on average) will be shipped offsite every 2 months. Therefore, 34 roll-off containers will be procured (see Attachment 2 for the calculation).

7. The Site will have the capability to handle and manage the roll-offs. Currently the Site does not have the equipment or facilities to handle and manage large amounts of shipments via roll-offs.

8. Waste characterization costs will be similar to the actual costs of the OU 1 hot-spot removal.

9. The overhead costs at the Site and subcontractor costs will remain the same in the future.

10. Rail transportation will be available for LLMW shipments to Envirocare.

11. NTS does not currently have a rail spur and doesn't appear that one will be built in the near future. So all LLW being shipped to NTS will be done in roll-offs via truck (approximately 5% of the total waste volume estimate). All waste shipments are currently being shipped via truck, therefore, it is safe to assume that this practice will continue. Also, it was assumed that 25% of the total waste amounts will be shipped by truck and the remaining 75% of the total waste will be shipped by rail.

12. The NTS tipping fee will remain at $17/cubic foot.

13. The Site will be allowed to utilize the Envirocare"Above 25,000 Cubic Yard" price schedule (least expensive of three options).

14. Each of the roll-offs will be decontaminated for return to the Site by Envirocare and will not be disposed of in their cell.

15. Seventy percent of the waste will be shipped in the summer, and 30% of the waste will be shipped in the winter.

16. The Site will not ship any small waste streams (less than 4,000 cy).

17. No material will be shipped with dimensions greater than 10 inches (demolition debris is excluded from this analysis).

18. All treatment will be accomplished through thermal desorption and/or solidification.

19. Waste managed in the onsite cell will be managed under CAMU guidelines.

20. Postclosure care and monitoring will be done on a quarterly basis for the first ten years and semiannually for the remaining twenty years. This is for groundwater monitoring only. Cap maintenance will be conducted as needed.

21. Treatment and handling systems are not expected to produce emissions sufficient to require additional permitting. Air monitoring will be conducted via the existing Site monitoring system. Any additional air monitoring required for worker health and safety considerations will be conducted by the appropriate oversight organization.

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Schedule Assumptions

1. The use of laboratories in the State of Colorado which are certified by the State of Utah will not cause schedule impacts.

2. Assume 25% of the total waste (e.g., 25,000 cy) was shipped offsite in bulk via truck, using the 20 cy roll-off containers. This would become a lengthy process, (e.g., 8 years), based on shipping 500 cy every two months. This equates to 36 truckloads in a two-month period. This also assumes that there would not be delays in the waste characterization process.

Hypothetical Model for Waste Volume Cost Over Time Assumptions

1. The waste disposal and treatment options were based on an annual budget of $20M for ER activities, with the exception of a budget of $10M for FY96. This budget was used in planning for outyear activities as well.

2. The same costs for thermal desorption were used for both onsite and offsite options because it was a conservative estimate for both options.

3. The total volume does not include all of the high-risk removal actions because areas in the IA have not been totally characterized. However, it does represent the majority high-risk waste volumes outside of demolition activities.

4. No waste will be disposed of until FY97.

Attachment 2

Basis of Estimates for Onsite Waste Management and Offsite Disposal Cost

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WASTE CONTAINERS

ASSUMPTIONS:

1) No waste will be packaged in drums due the higher cost per unit volume of waste.

2) Due to the small quantities of some of the waste streams and the fact that RFETS is currently packaging off-site waste in half crates, it was assumed that 2% (2,000 cy) of the projected waste volume will be packaged and transported in half-crates. Half crates are not re-usable.

3) The remainder of the remediation waste will be packaged in re-usable roll-off containers (98,000 cy) for offsite disposal.

4) Roll-offs will be cleaned/decontaminated and returned for re-use after waste disposal.
The cycle time for a rolloff is two months.
5) Rate of disposal. The cost estimate rate for off-site disposal at Envirocare is 3 years. This number averages to 5,444 cy per two months. Therefore the amount of roll-offs that need to be procured is 372. See detailed BOE below).

6)It was assumed that only 20 C.Y. roll-offs or containers would be used.

7) All waste (98,000 C.Y.) will be generated and disposed within a three year period.

COST CALCULATIONS AND BASIS OF ESTIMATE:

HALFCRATES	QTY	UNIT	BASIS OF ESTIMATE
External volume of a half crate	56	c.f.	(standard volume)
Cubic yards of waste per half crate - loss due to packaging	38	c.f.	Internal volume calculation based on Specification Drawing dimensions.
Volume of waste to be disposed in half crates (cubic yards)	2,000	c.y.	Assumption #2 above.
Volume of waste to be disposed in half crates (cubic feet)	54,000	c.f.	Assumption #2 above. 2,000 c.y. X 27 c.f./c.y.
Number of crates required	1,421	crates	(54,000 c.f.)/(38 c. f./Hcrate)
Cost per crate	$500	dollars each	Recent procurement
Total cost of Halfcrates, Offsite Options.	$ 710,500		1,421 crates X $500/crate

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ROLL-OFFS, by Rail to Offsite Disposal	QTY	UNIT	BASIS OF ESTIMATE
Capacity in Cubic yards per roll-off	20	c.y.	Basic Assumption
Usable Capacity in Tons per Rolloff	24	tons, net	Capacity of RailCar = 75 TONS. 1 Rolloff @ 0.75 Tons empty + 24 tons of waste = 25 Tons .. 3 Rolloffs at 25 tons gross wt. each = 75 Ton Capacity of railcar.
Density of soils at RFETS	1.62	tons/c.y.	Merrick Conceptual Design Document for the New Sanitary Landfill
Volume of waste allowed on each railcar	44.4	C.Y.	3 X 24 tons / 1.62 T/CY = 44.4 C.Y.
Number of Rolloffs per railcar - Maximum/not full	3.0	Rolloffs/car	44.4 C.Y. /20 C.Y. = 2.22 Rolloffs
Usable volume capacity per rolloff	14.8	C.Y.	44.4 C.Y./ 3 Rolloffs=14.8 C.Y. Rolloff
Number of roll-offs needed to achieve 5444 c.y. shipments every 2 months	372	roll-offs	(98000CY /36 months X 2 months /Roundtrip X 1 Car/44CY X 3 Rolloffs/Car = 372 rolloffs/ Roundtrip.)
Cost to procure one roll-off	$10,570	each	Actuals from Trench T-3 and T-4 Removal Project
Total cost for roll-offs, offsite disposal option.	$3,932,040		$10570 X 372 roll-offs

Containers, Rolloffs onsite storage. (Metal Buildings, Slab on Grade).			
Rolloffs/ Containers, onsite storage options,	QTY	UNIT	BASIS OF ESTIMATE
Volume of Waste to be stored	100,000	C.Y.	Basic assumption
Usable capacity of container	20	C.Y.	Basic assumption
Number of containers required	5000		100,000/20 = 5,000
Cost to procure one rolloff/container	$10,570	each	Actuals from Trench T-3 and T-4 Removal Project
Total Cost to procure 5,000 container/rolloffs, onsite storage options. (100,000 C.Y.)	$52,850,000		5,000 X $10,570 each.

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CONTAINER COST SUMMARY:

Total half-crate cost (2% of Waste Volume)	$710,500
Total roll-off cost (offsite transport & Disposal)	$3,932,040
TOTAL CONTAINER COST (Offsite disposal options)	$4,642,540

TOTAL CONTAINER COST (Onsite storage options)	$52,850,000

Note 1.
End dump trucks operating and acquisition costs were placed into the Transportation BOE
Note 2.
Note these costs are UNescalated.

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PACKAGING

CRATE PACKAGING AND PREPARATION

1) For the purposes of this estimate it was assumed that the waste would not be packaged in drums because of the higher costs.

2) Due to their small quantities, the following wastes likely will be packaged in half-crates see Table 5-1):

OU-2 Trench T-2	0 cu. yd.
OU-4 Debris	700 cu. yd.
OU-9 Tank 40	130 cu. yd.
OU-6 B-1 Dam	8 cu. yd.
Hot Spot Removal	50 cu. yd.
IDM	180 cu. yd.
TOTAL	1,068 cu. yd.

3) Approximately 1421 Halfcrates will be required to contain 2,000 C.Y.Waste.

4) Packaging refers only to the cost of labor and labor supplies necessary to prepare, fill, label, and certify containers of waste for transportation. Packaging costs here exclude cost of containers , transportation, and characterization.

CRATE PACKAGING	QTY	UNITS	BASIS OF ESTIMATE
Crates packaged per hour, including documentation	0.2	crates/hr	Experience on 750 Pad.
Number of crates	1,421	crates	(From "Waste Containers" BOE)
Total hours to fill, seal, glue and nail lids, provide and attach documentation on Loaded Crates	7,105	hours	(1421 crates)/(0.2 crates/hr)
Cost per labor hour	$85	/hr	Assumed base rate including labor burden. From FY 96 Budget Call Book.
Total cost to Package Halfcrates	$603,925		$85/hr X 7,105 hours

ROLL-OFF PACKAGING AND PREPARATION

6) Assume that all waste stored or disposed of on-site <u>not</u> "in bulk" will be packaged in roll-offs.
   6a) Assume that all waste destined for "immediate" offsite disposal will be packaged in rolloffs.
   6b) Assume that all waste stored or disposed on site, "in bulk" will be packaged and transported in End Dump Trucks.

7) Assume that the packaging <u>time</u> for end dump trucks and rolloffs are equal, regardless of destination.

8) Personal Protective Equipment (PPE) is assumed to be no greater than level D (gray coveralls) for estimating purposes. Costs of Level D PPE is considered minimal. Actual PPE will be prescribed by site HS &R personnel.

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ROLL-OFF PACKAGING	QTY	UNIT	BASIS OF ESTIMATE
Person-hours to package one container	4	hours	Actuals from Trench T-3 and T-4 Removal Project
Cost per labor hour	$85	/hour	Approximate average labor rate
Labor cost per container	$ 340		4 Hours X $85
Amount of waste in roll offs (off-site)	98,000	c.y.	100,000 cy - 2,000 cy (in crates)
Amount of waste in roll-offs (on-site)	100,000	c.y.	Ground Rule from Section 7.0 of this document
Volume of waste allowed in one rolloff. (offsite)	14.8	c.y.	From "Waste Container" BOE
Volume of waste allowed in one rolloff. (onsite)	20.0	c.y.	From "Waste Container" BOE
Number of times the roll-offs need to be packaged (off-site rail transportation)	6,622	times	98,000CY / 14.8 CY/Rolloff = 6622
Number of times the roll-offs need to be packaged (on-site storage options)	5,000	times	100,000Cy / 20 CY = 5000
Total cost for roll-off packaging (off-site)	$2,251,480		6622 X $340
Total cost for roll-off packaging (on-site)	$1,700,000		5,000 X $340

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DUMP TRUCK PACKAGING	QTY	UNIT	BASIS OF ESTIMATE
Person-hours to package/load one dump truck, including loading, documentation, placarding, and smear testing. (excludes excavation, crushing, grinding or treatment time and costs.) (Assumes clock time = 2 hours)	4	hours	Assumed based on actuals from Trench T-3 and T-4 Removal Project
Amount of waste in dump trucks (on-site)	100,000	c.y.	From 'Waste Container' BOE
Volume of waste allowed in one dump truck	16.0	c.y.	From 'Transportation' BOE
Number of times the dump trucks need to be packaged (on-site)	6,250	times	(100,000C.Y.) / (16 C.Y. per truck)
Total hours to place waste in dump trucks. Includes documentation, placarding, smear testing.	25,000	hours	4 Hours to package one dump truck X 6250 times
Cost per labor hour	$85	/hour	Base labor rate from FY96 Budget Call
Cost to package dump trucks w/o contingency	$2,125,000		Total hours X labor rate
Total cost for dump truck packaging	$2,125,000		Total cost w/o contingency

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PACKAGING COST SUMMARY:

OFFSITE PACKAGING COSTS	
(2,000 CY) Total half-crate packaging cost	$603,925
(98,000 CY) Total roll-off packaging cost	$2,251,480
TOTAL **OFFSITE** PACKAGING COST W/O CONTINGENCY (100,000CY)	$2,855,405

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ONSITE PACKAGING COSTS , Bulk storage	
Total half-crate packaging cost	$0
(100,000CY) Total dump truck packaging costs	$2,125,000

ONSITE PACKAGING COSTS, Container storage	
Total half-crate packaging cost	$0
(100,000 C.Y.) Total roll-off packaging costs	$1,700,000

Note: All costs on packaging BOE are UNescalated

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TRANSPORTATION

ASSUMPTIONS:

1) No Drum Transportation is included in this estimate

2) Approximately 1421 Halfcrates are included in this transportation estimate for offsite disposal. All Halfcrates will be transported by truck to offsite disposal.

3) Approximately 4900 roll-off containers of waste will be transported off-site (98,000 C.Y. / 20 CY each).

4) For onsite disposal /placement in bulk calculations all waste will be transported in 16 C.Y end-dump trucks. The trucks will be weight rated to transport full loads.

5) For onsite storage and transportation in containers the volume per container is 20 C.Y., only one container per truckload.

6) All rolloffs for offsite disposal will be transported by rail.

7) Rail Transportation of rolloffs, maximum of 4 Roll-offs per railcar, (80 C.Y. volume capacity / railcar), for return transportation of used, clean, empty, rolloffs to site for reuse.

8) Rail Transportation, Maximum number of rolloffs per loaded car is 3 due to weight limit of 75 tons. (See Weight & Volume Calculation in this BOE).

9) The existing rail siding at RFETS is currently active, certified and considered adequate to support

10) Railcar loading equipment must be provided and included in this estimate.

11) Contingency will not be added to individual BOE's.

COST CALCULATIONS AND BASIS OF ESTIMATES:

Half-Crate transportation - OFFSITE DISPOSAL	QUANTITY	UNIT	BASIS OF ESTIMATE
Waste to be transported	1,421	Halfcrate	"Waste Containers" BOE
Weight Capacity of truckload	22.5	Tons	State/DOT Regs, Est. Vehicle net load
Weight per Halfcrate	2.45	Tons	38 Cu.Ft / 27 Cu Ft/YD X 1.62 Ton / Yd = 2.279 Tons soil/Hcrate +0.175 ton tare/crate = 2.45 tons /HCrate
Max Halfcrates per truckload	9	Halfcrate:	22.5 Tons/Truck / 2.45 Tons / Halfcrate = 9.18 Halfcrates / Truck
Truckloads required.	158	Trucks	1421 HCrates/ 9 halfcrates / truck = 157.89
Cost per truckload	4,800	Dollars	Existing contract.
Direct Cost of Transportation	758,000	Dollars	4800 X 158 =$758,400
Total Cost of halfcrate transportation offsite	$758,000		

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Note: Two offsite transportation BOE's were prepared, one to determine the weight limit and one to determine the volume limit. The weight is the governing factor. The volume calculation is included here for reference only.

ROLL-OFF TRANSPORTATION - OFFSITE DISPOSAL	QTY	UNIT	BASIS OF ESTIMATE
Rail car transportation only, based on **weight**			
Amount of waste in roll offs (off-site)	98,000	c.y.	From 'Waste Container' BOE
Volume of waste allowed in one roll-off (max) (due to Weight limit)	14.8	c.y.	From 'Waste Container' BOE
Number of Rolloffs to be transported (recycled)	6,667		98,000 C.Y. / 14.8 C.Y. Rolloff
Number of loaded Rolloffs per railcar	3	Rolloffs	Assumption #8 (Above).
Number of Railcar trips required, loaded	2,223	Railcars	6667 rolloffs / 3 per car = 2223 railcar trips, loaded
Number of Railcar trips required, return empty	1,667		6667 Rolloffs / 4 per car =1667 railcar return "empties" trips.
Total Railcar trips required	3890		2223 + 1667 = 3890
Cost per railcar trip	$4,150	Dollars	RMRS Transportation Mgr. Pers Comm.
Total cost for rail transportation of rolloffs (98,000 C.Y.))	$16,143,500		$4150 X 3890 trips = $16,143,500

ROLL-OFF TRANSPORTATION - OFFSITE DISPOSAL	QTY	UNIT	BASIS OF ESTIMATE
Rail car transportation only, based on **volume**			
Amount of waste in roll offs (off-site)	98,000	c.y.	From 'Waste Container' BOE
Volume of waste allowed in one roll-off (max)	20.0	c.y.	From 'Waste Container' BOE
Number of Rolloffs to be transported (recycled)	4,900		98,000 C.Y. / 20 C.Y. Rolloff
Number of loaded Rolloffs per railcar	4	Rolloffs	Assumption #7 (Above).
Number of Railcar trips required, loaded	1,225	Railcars	4900 rolloffs /4 per car = 1225 railcar trips, loaded. *NOTE* : Four fully loaded Rolloffs exceed weight capacity of railcar by 25 Tons, per "Waste Container" BOE.
Number of Railcar trips required, return empty	1,225		4900 Rolloffs / 4 per car =1225 railcar return trips
Total Railcar trips required	2,450		1225 + 1225 = 2450
Cost per railcar trip	$4,150	Dollars	RMRS Transportation Mgr. Comm.
Total cost for rail transportation of fully loaded rolloffs, (4 rolloffs per railcar)	Not Achievable, **weight** restriction		$4150 X 2450 trips = $10,167,500

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Waste Transportation to onsite storage or onsite disposal in bulk

TRANSPORTATION -ONSITE DISPOSAL/STORAGE		QTY	UNIT	BASIS OF ESTIMATE
Amount of waste in dump trucks		100,000	c.y.	Basic assumption
Volume of waste allowed in one truck		16.0	c.y.	Assumption #4 (above)
Number of Truckloads Required		6,250	Rtrips	100,000 C.Y. / 16 C.Y. Truck
Roundtrip Distance per Truckload		3	Miles	Base assumption
Miles traveled by Trucks		18,750	Miles	6250 Rtrips X 3 Miles/Trip
Roundtrip Truckloads/day		8.3	Round-trips	6250 Rtrips/3 years X 1 year/50 weeks X 1 week/5 days X 1 day / 6 hrs working = 8.3 RTrips/day
Loads per truck per day (6 Hours operating)		2	trips	Base assumption 3 hours/RoundTrip, load 1 hour, travel 1 hour, unload 1 hour. (See Packaging BOE)
Trucks required each day		5	Trucks	8.3 RTrips/day X 1 day / 2 Rtrips/ truck = 4.15 Trucks, use 5 trucks, incl spares.
Labor, Drivers required to drive trucks		5	Drivers	Base assumption, 1 driver per truck per day
Labor Cost to drive trucks (Pay at 8 hrs/day, work at 6 hours/day)	$	2,550,000	Dollars	$85/hr X 8 hr/day X 5 drivers/day X 5 days/week X 50 weeks/yr X 3 years. Cost Basis - FY 96 Work Package Guidance)
Fuel Cost for trucks	$	9,375	dollars	18750 miles X 50 cents/mile Assumption
Procurement cost of 5 16 yd end-dump trucks	$	1,250,000	dollars	5 Trucks X $250K each, Rough Estimate, based on prior purchases
Maintenance of Trucks	$	500,000	Dollars	Rough Estimate
Total cost for onsite "Bulk" transportation	$	4,309,375		SUM of Labor, Fuel, Procurement, Maintenance

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Onsite Transportation of Rolloffs/Sealand Containers

TRANSPORTATION -ONSITE DISPOSAL/STORAGE IN CONTAINERS		QTY	UNIT	BASIS OF ESTIMATE
Amount of waste in containers		100,000	c.y.	Basic assumption
Volume of waste allowed in one truck/container		20.0	c.y.	Assumption #5 (above)
Number of Truckloads Required		5,000	Rtrips	100,000 C.Y. / 20 C.Y. Truck
Roundtrip Distance per Truckload		3	Miles	Base assumption
Miles traveled by Trucks		15,000	Miles	5000 Rtrips X 3 Miles/Trip
Roundtrip Truckloads/day		7.0	Round-trips	5000 Rtrips/3 years X 1 year/50 weeks X 1 week/5 days X 1 day / 6 hrs working =7 RTrips/day
Loads per truck per day (6 Hours operating)		2	trips	Base assumption 3 hours/RoundTrip, load 1 hour, travel 1 hour, unload 1 hour. (See Packaging BOE)
Trucks required each day		4	Trucks	7 RTrips/day X 1 day / 2 Rtrips/ truck = 3.5 Trucks, use 4 trucks, incl spares.
Labor, Drivers required to drive trucks		4	Drivers	Base assumption, 1 driver per truck per day
Labor Cost to drive trucks (Pay at 8 hrs/day, work at 6 hours/day)	$	2,040,000	Dollars	$85/hr X 8 hr/day X 4 drivers/day X 5 days/week X 50 weeks/yr X 3 years. Cost Basis - FY 96 Work Package Guidance)
Fuel Cost for trucks	$	7,500	dollars	15000 miles X 50 cents/mile Assumption
Procurement cost of 4 container-hauling trucks	$	1,000,000	dollars	4 Trucks X $250K each, Rough Estimate, based on prior purchases
Maintenance of Trucks	$	500,000	Dollars	Rough Estimate
Total cost for onsite "container" transportation	$	3,547,500		SUM of Labor, Fuel, Procurement, Maintenance

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Railcar Loading Equipment for Rolloffs.

Forklift 25 ton Capacity 20 foot lift	$250,000		Cap Cost. Quote FOB RFETS
Forklift operating cost @ $50/hr =	$225,000		3 years X 50 Weeks/year X 5 days/week X 6 hours/day =
Forklift operator and spotter- labor	$1,020,000	Dollars	3 years X 50 weeks year X 40 hrs week X $85 Hour X 2 people
Site-prep and maintenance of loading area	$250,000	Dollars	Rough Estimate
Upgrade of rails (not required)	-0-		Assumptions #8 and 9 Above.
Total of rail car loading facility equipment and maintenance of site.	$1,745,000	dollars	Sum of above costs

SUMMARY OF TRANSPORTATION COSTS

Onsite Transportation, bulk storage, via dump trucks	$	4,309,375

Onsite Transportation of Containers to Storage Facility	$	3,547,500

Off site transportation.		
Rail loading facility equipment and operation	$	1,745,000
Rolloff Transportation with recycling	$	16,143,500
Trucking of halfcrates	$	758,000
TOTAL	$	18,646,500

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Characterization Costs For Onsite Management and Offsite Disposal

Assumptions

1) Although there is a wide variation in potential sampling costs for various facilities, by making the costs identical, the playing field was leveled in terms of sampling and analysis. This allows the cost analysis to focus on other factors. Most of the variation between facilities can be attributed to the number of different analyses required and analytical methods used. In reality, the sampling and analysis costs would be expected to be higher for offsite facilities and lower for an onsite facility. This is generally true for any offsite facility and is driven by various permit requirements, waste acceptance criteria, RCRA, and other factors.

2) Laboratory analysis were estimated based on past laboratory costs. The costs are estimates and as such differ from any proprietary information that might be in current analytical contracts. For required sample methods that currently was not available through the Rocky Flats Sample Management Office, it was assumed that the required sampling methods (8000 series) would be available and the cost would be similar to similar existing methods currently in use.

3) It was assumed that all of the samples would be analyzed at laboratories. For onsite management, it might be possible to use field methods which could further reduce the costs.

4) Assume that on the average, one sample would be taken for every 75 cubic yards to meet the waste acceptance criteria. This sampling amount was increased by 100% to cover the following:

1) Quality Assurance Samples - 25%
2) Post-treatment Sampling - 75%

Assume that for a baseline each sample would be analyzed using the paint filter test, gamma spectroscopy, and TCLP for metals and volatiles. Additional miscellaneous analysis could include additional samples for Hydrogen Cyanide, Hydrogen Sulfide, Uranium Isotopic Analysis, Thorium Isotopic Analysis, Plutonium 239/240, Gross Alpha/Beta, Proctor Testing, and others.

5) Assume that the cost for sample containers were included in the analytical costs.

6) Assume that sampling would be performed on-site by plant personnel. A burdened cost of $85/hour was assumed for both monitoring and sampling personnel. Assume that sampling crews would consist of two individuals with full-time radiation monitoring support.

7 Assume that most of the sampling would be done in Level D personal protective

equipment and that on occasion this would be upgraded to Level C.

8) Assume that samples would be tracked through the Rocky Flats Environmental Database System.

9) Assume that transportation costs would be minimal since most of the samples would be analyzed on plant site. Assume that some samples would go off-site due to capacity or analytical method.

Cost Calculations

Laboratory Analysis:

Paint Filter Test (estimate)	$100.00
TCLP (metals)	$550.00
TCLP (organics)	$550.00
Gamma Spectroscopy	$200.00
Total Cost	$1,400

$1,400

Possible Additional Sample Costs

Any of the analytes below could be included depending on the waste acceptance
All sample costs are estimates and have not been escalated.

Analysis	Cost
pH	$ 15.00
Hydrogen Cyanide	$ 65.00
Hydrogen Sulfide	$ 50.00
Heavy Metal Analysis* (CLP and Non-CLP)	$600.00
Hexavalent Chromium	$ 60.00
Volatiles (Method - CLP)*	$340.00
Semivolatiles (Polynuclear Aromatics)**	$310.00
TCLP (Metals)	$550.00
TCLP (Organic Volatiles)	$550.00
TCLP (Semivolatiles)	$800.00
Gamma Spectroscopy	$200.00
Uranium Isotopic Analysis	$280.00
Thorium Isotopic Analysis	$240.00
Plutonium 239/240	$280.00
Gross Alpha/Beta	$180.00
Proctor Test	$260.00
Total Organic Halides (TOX)	$150.00

Pesticides and PCBs	$260.00
Herbicides	$310.00
Petroleum Hydrocarbons	$180.00

* Substituted other methods to estimate cost
** Substituted EPA Method 610 for 8100

Labor (Cost per Sample):

Presampling Preparation and Sampling Forms	-	**0.75 Hours**	
Donning Personal Protective Equipment	-	**0.5 Hours**	
Sampling	-	**1.25 Hours**	
Safety Monitoring	-	**2 Hours**	
Data Entry and Sample Tracking	-	**0.75 Hours**	
Sample Packaging and Shipping	-	**0.75 Hours**	
Management Oversight	-	**0.25 Hours**	
Total	-	**6.25 hours**	
Labor Rate		**$85/hour**	
Labor Cost		**$530**	**$ 530**

Materials & Equipment (Not Including Sample Bottles)

Coolers and Sampling Supplies	**$ 40**	
Protective Equipment (Level C &D)	**$ 70**	
Monitoring Equipment and Supplies	**$ 70**	
Equipment Total	**$180**	**$ 180**
Transportation (on-site/off-site)	**$ 40**	**$ 40**
Total Cost Per Sample		**$2,150**

Number of samples:

(100,000/75) x 2 = 2680 samples

Total Characterization Cost

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2680 samples x $2150/sample = (without contingency)	**$5,762,000**
Total Characterization Cost (Contingency not included)	**$5,762,000**

Treatment Costs for Off-Site Disposal

Assumptions:

1) Assume that only the waste that needs to be treated to meet Land Disposal Restrictions will be treated and that treatment will consist of either solidification or thermal desorption. Assume that none of the waste needs volume reduction. Assume that soils that do not need to be treated to meet Land Disposal Restrictions (LDRs), do not need any additional treatment including dewatering or drying.

2) Cost for solidification of Solar Ponds sludge was based on Solar Ponds' estimates in the "Operable Unit 4 IM/IRA Decision Document". The estimate was for Pondcrete and Sludge combined. Volumetrically, the sludge represented roughly half of the total volume so the cost estimate was approximated by taking half of the total cost or $21 million. This cost is fully burdened but does not include escalation. The volume of sludge at the Solar Ponds is 6,000 cubic yards.

3) Cost of solidification of soils was modified from on pondcrete treatment costs in the from "Pondcrete Processing Conceptual Design", Haliburton NUS Corporation, January 6, 1995. Capital Costs are based on facility designed to treat approximately 12,000 cubic yards of pondcrete. Soil solidification costs could be reduced by approximately $11.6 million if the equipment fro pondcrete processing can be utilized for soil solidification.

Capital Cost	$11,600,000
Unit Operating Cost	$5,500,000/5,600 yd^3 = $980/$yd^3$

The total volume of remediation requiring solidification is approximately 41,100 yd^3 of which 6,000 yd^3 is sludge (see attached Table B-8) so

42,300 yd^3 - 6,000 yd^3 = 36,300 yd^3 of soils

4) A cost of $1300 per cubic yard for thermal desorption was based on the estimate for the remediation of the East Trenches (Trenches T-3/T-4). The volume requiring thermal desorption treatment is approximately 3400 yd^3 (see Table B-8).

5) Unit costs were assumed to be all inclusive. This included all transportation, health and safety, documentation, oversight, etc.

6) Costs for treatment of the liners was not included in the estimate. It was assumed that contamination on the liners would be less difficult to remove and that the costs would not be high. This assumption would need to be revised if the contamination has been absorbed into the asphalt as opposed to removable surficial contamination.

Cost Calculations

Thermal Desorption:

3400 cubic yards x $1300/cubic yard	= $4,420,000	≈	**$ 4,420,000**
Solidification of Sludge:	= $21,000,000		**$ 21,000,000**

Solidification of Soils:

Capital Cost	= $11,600,000	
Operating Cost:		
36,300 cubic yards x $980/cubic yard	= $35,570,000	
	$47,170,000	**$ 47,170,000**

Total Treatment Cost **$ 72,590,000**
(Contingency not included)

Treatment Costs for Onsite Management

Assumptions:

1) Assume that all of the soils removed from the trenches, IHSS 119.1, some soils from 903 Pad and some soils removed from Original Process Waste Line Tanks T-2, T-3, T-9, T-10, T-14, T-16 and T-40 will require treatment by thermal desorption.

	Cubic Yards
Trench T-1	1000
Trench T-3	300
Trench T-4	300
Trenches T-5 through T-11	1000
Mound Area	1500
903 Pad (IHSS 112 and 140)	1400
Tanks T2 and T-3	500
Tanks 9 & 10	500
Tanks T-14 and T-16	3,340
Tank T-40	130
Total	9,970

2) Assume a unit cost of $1300 per cubic yard for thermal desorption was based on the Operable Unit 2 estimate for the remediation of the East Trenches.

Cost Calculations:

$1300 x 9,970 = **$12,960,000**

Total Treatment Cost (Contingency not included) **$12,960,000**

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Attachment 3

Description of Hypothetical Cost Model for Accelerated Actions at the Rocky Flats Environmental Technology Site

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The purpose of the hypothetical cost model for accelerated actions was to compare the cost and schedule impacts of the onsite waste management option versus the offsite option, given a fixed budget. Unit costs were developed based on actuals and the estimates described in Attachment 2 as follows:

Unit Cost for Onsite Waste Management (includes Excavation)	$2,128/cy
Unit Cost for Offsite Disposal (includes Excavation)	$3,482/cy
Unit Cost for Thermal Desorption	$2,970/cy

Based on the above unit costs, the cost of thermal desorption used for onsite management and offsite disposal were calculated for each accelerated action. Ten million dollars were allocated for the first year, based on the actual FY96 budget. It was assumed that the budget for each following year would increase to $25M. All of the accelerated actions were prioritized based on risk. The cost model was set up as follows:

1. Starting with Year 1, the cost of both thermal desorption and disposition for the highest priority accelerated action was allocated to that year, followed by the next highest priority accelerated action and so on until the $10M budget was consumed.

2. This was repeated again for Year 2 for a $25M budget and again for the next year until there were no more accelerated actions to allocate. Both the onsite and offsite options were allocated in this manner.

3. Based on the costs allocated for each accelerated action in each fiscal year, the volume of soils treated with thermal desorption and the volume of soil dispositioned were determined.

4. These volumes were then plotted versus fiscal year as shown in Figures B-5 and B-6.

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Appendix C

Onsite Remediation Waste Storage Facility Siting Study

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ABBREVIATIONS AND ACRONYMS

Am	americium
ARAR	applicable or relevant and appropriate requirements
CAMU	Corrective Action Management Unit
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and Environment
CHWA	Colorado Hazardous Waste Act
cm/sec	centimeters per second
cy	cubic yards
D&D	deactivation and decontamination
DOE	United States Department of Energy
ESF	East Spray Fields (IHSS 216.2 and 216.3)
FY	fiscal year
HW	hazardous waste
IA	Industrial Area
IA-East	Industrial Area-East
IA-West	Industrial Area-West
IDM	Investigation-Derived Material
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
ITS	Interceptor Trench System
NEPA	National Environmental Policy Act
NSL	New Sanitary Landfill
PA	Protected Area
PAC	potential areas of concern
PCB	polychlorinated biphenyls
Pu	plutonium
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RWSF	Remediation Waste Storage Facility
SME	Subject Matter Expert
SE Quad	Southeast Quadrant
Site	Rocky Flats Environmental Technology Site
Site Vision	Rocky Flats Conceptual Vision
SW Quad	Southwest Quadrant
TSCA	Toxic Substance Control Act
WMF	waste management facility

EXECUTIVE SUMMARY

A Remediation Waste Storage facility (RWSF) has been envisioned to store remediation waste at the Rocky Flats Environmental Technology Site (Site). The objectives of this siting study are to identify and rank criteria to be used to select a location, develop a methodology for comparative analysis of different locations, and select location(s) that would be suitable for a RWSF within the boundaries of the Site, using the identified criteria and methodology for comparative analysis.

The location would be for a RWSF that accepts remediation wastes with low-level radioactive and/or hazardous constituents, but not preclude the shipment of remediation waste that can be more effectively and economically managed offsite. The facility would be designed and constructed to meet all of the applicable federal, state, and local regulatory requirements.

Seven onsite locations were identified and carried through the location selection process. The three locations in the Industrial Area (IA) are the IA-West, IA-East, and the area adjacent and to the east of the Solar Ponds. The four locations in the buffer zone are the New Sanitary Landfill (NSL), East Spray Fields (ESF), the Southeast Quadrant (SE Quad), and the Southwest Quadrant (SW Quad).

Six categories were considered in developing the comparative analysis. These criteria include regulatory requirements and guidelines that have been discussed during various stakeholder meetings regarding a RWSF at the Site. These criteria have been placed into six general categories, and further divided into 35 specific subdivisions.

The following general criteria categories, were assigned a weighting factor (%) totaling 100%:

Category 1, Corrective Action Management Unit (CAMU) Criteria - 20%

Category 2, Public Protection (Geotechnical and Hydrological Criteria) - 20%

Category 3, Site Special Issues - 15%

Category 4, Cost Criteria - 15%

Category 5, Regulatory Support - 15%

Category 6, Other Stakeholder Concerns - 15%

The following locations were evaluated against the criteria and given an overall ranking between 0 and 100%, with 100% being the most favorable location for the siting of a RWSF.

Solar Ponds location, IA	68.3%
IA-West location, IA	67.6%
New Sanitary Landfill, buffer zone	67.4%
SE Quad location, buffer zone	66.4%
ESF location, buffer zone	66.1%
SW Quad location, buffer zone	63.4%
IA-East location, IA	62.5%

Overall, the Solar Ponds location was ranked slightly higher than the IA-West location and the NSL as a place to locate a RWSF at the Site. The results of this study are detailed and summarized herein.

Category 1, CAMU, favored the IA locations, with the designation of the location as a CAMU. The ability to reduce the areal extent of contamination without contaminating clean areas weighed heavily in favor of the IA locations.

Category 2, Public Protection, ranked three of the buffer zone locations the highest. The primary concern with the locations in the IA is the elevated groundwater table, however, this concern is somewhat mitigated by the fact that all viable design alternatives envisioned are above-grade facilities.

Category 3, Site Special Issues, ranked the SE Quad location the highest, followed by the Solar Ponds, and ESF location. The three locations in the IA all received high ranking for the ability to support the Rocky Flats Conceptual Vision (Site Vision) in terms of future land use. However, the impacts of having to address issues related to existing infrastructures lowered the overall scores in this category. Extensive underground and overhead utilities are encountered within most of the IA, along with other building and waste storage facilities that would have to be removed or rerouted.

Category 4, Cost Criteria, favored the buffer zone locations. The major factor of the locations within the IA is the cost associated with removing, rerouting, or replacing building and underground and overhead utilities in the IA. The Solar Pond location has the additional burden of having to construct a portal through the Protected Area (PA) security fence, constructing a fence surrounding the location, and having a security staff available during construction and operation of the facility.

Category 5, Regulatory Support, showed support clearly in favor of a location in the IA. The Solar Ponds location was ranked highest followed by IA-East and IA-West.

Category 6, Other Stakeholder Concerns, ranked the IA locations the highest. The general public would more likely be receptive to placing environmental waste in areas that already contain some contamination rather than siting a RWSF in an area that has no history of contamination. Also, the

Jefferson County, Colorado Board of Commissioners are on record (Resolution No. CC94-654) for desiring to maintain the buffer zone around the IA as undeveloped open space.

C.1 OBJECTIVES

For this project, the reduction of environmental risk is dependent on the ability to disposition and manage remediation waste. As part of risk reduction at the Rocky Flats Environmental Technology Site (the Site), it is currently projected that there is 123,000 cubic yards [cy] (95,000 cubic meters [m^3]) of remediation waste to be excavated and appropriately managed. Approximately 9,000 cubic yds can be treated by thermal desorption treatment and returned to where it came from, leaving 114,000 cy that will need to be stored and managed See Table 3-1 Waste Identification and Volumes for a Remediation Waste Storage Facility, in the IM/IRA Decision Document for the RWSF for a break down of volumes by source and waste type. This waste will come from soils excavated from Individual Hazardous Substance Sites (IHSSs), accelerated actions, D&D waste and investigative derived waste (IDM). This waste consists of media with hazardous constituents or with mixed hazardous/low-level radioactive constituents. The waste streams will include, but are not limited to (approximate percentage of waste is in parentheses):

- Debris from decontamination and decommissioning activities (57%)
- Contaminated soil and debris collected from accelerated actions and hot spots removals - (30%)
- Pond sludge - (9%)
- Asphaltic materials and pondcrete - (less than 1%)
- Investigation-Derived Material (IDM) from characterization (not suitable for disposal in the sanitary landfill) from intrusive investigation activities - (less than 1%)
- Toxic Substance Control Act (TSCA) waste such as asbestos and polychlorinated biphenyls (PCBs) - (less than 1%)
- Treatment by-products from groundwater, surface water, and/or soil remediation actions - (less than 1%).

To store this remediation waste, a RWSF has been proposed to be located within the boundaries of the Site. This task was undertaken to identify the optimal location for the facility. The three objectives of this task are to:

1. Identify and rank criteria to be used for location selection.
2. Develop a methodology for comparative analysis of different locations.
3. Select a location large enough for construction of a facility that would have the capacity to accommodate 114,000 cy of environmental waste, using the identified criteria and methodology for comparative analysis.

C.2 COMPARATIVE ANALYSIS OF SITE LOCATIONS (ALTERNATIVES)

C.2.1 SCREENING CRITERIA DEFINED

The location must accommodate a facility that would accept for storage, remediation waste with low-level radioactive and/or hazardous constituents. The facility would be designed and constructed to substantively comply with all applicable federal, state, and local regulatory requirements.

A number of categories were considered in developing the location criteria matrix. The criteria included requirements and guidelines that have been discussed during various stakeholder meetings regarding RWSF at the Site. These criteria can be placed into six major categories: (1) Corrective Action Management Unit (CAMU) Criteria, adherence to the key points of this category is fundamental if the RWSF is to designated a CAMU, (2) Public Protection, this geological and geotechnical criteria is being considered and would be relevant and appropriate if at some later date, the decision is made to close the RWSF in-place, (3) Site Special Issues, these are issues that are unique to RFETS that require consideration in the selection of a location for a RWSF, (4) Cost Criteria, (5) Regulatory Support, and (6) Other Stakeholder Concerns which generally deals with community acceptance. Each of these categories is further divided into specific issues. These categories and specific issues are discussed in the following subsections.

C.2.1.1 Category 1: Corrective Action Management Unit (CAMU) Criteria

Category 1, CAMU, focuses on the designation of the RWSF as a CAMU, per 6 CCR 1007-3, 264.522 (c), and is a critical factor in locating the facility at the Site, with the following key points:

1. The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies.

2. Waste management activities associated with the CAMU shall not create unacceptable risks to humans or the environment resulting from exposures to hazardous waste or hazardous constituents.

3. The CAMU shall include uncontaminated areas of the facility only if the inclusion of such areas for the purpose of managing remediation waste is more protective than management of wastes at contaminated areas of the facility.

4. The following key point of the CAMU regulation is not applicable to this siting study because there will be no waste left in place. Areas within the CAMU where remediation wastes remain in place after closure of the CAMU shall be managed and contained to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment.

5. The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 6 CCR 1007-3, 264.552(c)(1) or (c)(2).

6. The following key point of the CAMU regulation is not applicable to this siting study because there will be no waste left in place. The CAMU shall minimize the land area of the facility upon which remediation wastes will remain in place after closure of the CAMU, unless to do so

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would be inconsistent with 6 CCR 1007-3, 264.522 (c)(1) or (c)(2).

7. The CAMU shall enable the use, when appropriate, treatment technologies, including innovative technologies, to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of remedial waste.

C.2.1.2 Category 2: Public Protection (Geotechnical and Hydrological Criteria)

Category 2, Public Protection, consists of geological, geotechnical and hydrological considerations to ensure the protection of the public, should the decision be made in the future to close the RWSF in-place. These considerations are summarized below:

1. The geological and hydrogeologic conditions of a location in which hazardous waste is to be stored should be such that reasonable assurance is provided that the wastes are isolated within the storage area away from pathways to the public.

2. Geomorphic conditions either will not vary significantly from the present state or will occur to a predictable degree, which can be accommodated in the facility design.

3. Structural related issues include slope and geotechnical stability.

4. The immediate area of the location should be in strata of minimal groundwater flow.

5. Geological strata combined with engineering barriers shall provide minimum permeability.

6. Siting consideration should include bedrock and surface integration including the nature and extent of bedrock material.

7. Siting consideration should include minimal relative presence of fractures or faults.

8. Consideration should be given to the relative depth to bedrock and groundwater, including seasonal fluctuations for groundwater.

9. The Site will not impact nor be impacted by surface water.

10. Relative distance to nearest discharge area shall include consideration of groundwater flow direction and travel time.

11. The terrain is such that good drainage exists for movement of precipitation away from the storage area, and such that water and wind erosion will be minimal.

C.2.1.3 Category 3: Site Special Issues

Category 3, Site Special Issues, supports the timely construction of a facility and integration with other Site programs, including the Site Vision to occur, and includes:

1. Support from the proposed CAMU of the Site Vision objectives.
2. Impacts from existing utility, sewer, process waste, or communications lines.
3. Impacts from security.
4. Impacts from plutonium (Pu) consolidation or residue stabilization activities.
5. Impacts from decommissioning activities.
6. Impacts from current RCRA units.
7. Impacts from mineral rights issues or other easements.
8. Ability to collocate additional RWSFs in the same vicinity

C.2.1.4 Category 4: Cost Criteria

Category 4, Cost Criteria, presents cost considerations assigned as two separate criteria:

1. Cost of engineering and construction of protective measures.

2. Cost of location preparation including building demolition, subsurface utility line removal and rerouting, access requirements, and power/facility requirements above the basic RWSF.

C.2.1.5 Category 5: Regulatory Support

Category 5, Regulatory Support, focuses on using the State principles for onsite waste management of contaminated materials, per the February 27, 1995 letter from Tom Looby (CDPHE) to Jack McGraw (EPA) and Mark Silverman (DOE). The following principles have been evaluated in this study to ensure consistency with EPA and CDHPE desires, but because the RWSF being proposed is for storage, not disposal, some of these criteria may not be appropriate for siting a storage facility.

1. The number of disposal locations must be minimized. "We (CDPHE) suggest one centralized location be chosen for consolidation of contaminated materials."

2. "Every effort should be made to locate a centralized disposal facility in an area of optimal geologic parameters preferably within or close to the Industrial Area (IA)."

3. "Any disposal facility must be designed and built as a state-of-the-art disposal facility that meets or exceeds all permitting and regulatory requirements. This includes (but not limited to) siting, design, long-term protection, and performance requirements."

4. "A permitted facility would provide DOE the greatest degree of future applicability and utility. The facility should be designated with the intent to permit under RCRA/CHWA."

5. "Any disposal location at RFETS should be located in areas that have limited future land use potential and will be controlled by DOE until the interred waste no longer presents a risk to human health or the environment."

C.2.1.6 Category 6: Other Stakeholder Concerns

Category 6, Other Stakeholder Concerns, lists the following stakeholder concerns that have been factored into the analysis, and include:

1. General public perception and acceptance

2. Municipal or County acceptance

3. Department of Energy (DOE) Orders

4. National Environmental Policy Act (NEPA)

C.2.2 METHODOLOGY

A weighting system (modified from Dawson, G. W. and Mercer, B.W., Hazardous Waste Management, 1986) was used to develop the ranking system.

First, a subjective weighting factor (%) was assigned to each of the six general categories of criteria, totaling 100%, as shown in Table C-1, Criteria Comparison.

Table C-1 Criteria Comparison

Category	Criteria	Weighting Factor (%)
1	Corrective Action Management Unit (CAMU) Criteria	20
2	Public Protection (Geotechnical and Hydrological Criteria)	20
3	Site Special Issues	15
4	Cost Criteria	15
5	Regulatory Support	15
6	Other Stakeholder Concerns	15
	Total	**100**

Second, each of the six general categories was divided into specific issues as shown in Table C-2, RWSF Location Criteria Detail, and each specific issue was subjectively assigned a value between 1 and 3, with 3 being more important, and 1 being less important criteria.

Third, each of the locations (e.g., Industrial Area-West [IA-West] and Industrial Area-East [IA-East]) was compared to the specific issue, as well as the relativity to one another, and a calculated value between 0 and 1 was determined; 1 would be very favorable, and a value of 0 would indicate a fatal flaw resulting in removing that location from further consideration for a RWSF, as shown in Table C-2.

This matrix form was developed showing location versus specific issues, as shown in Table C-2. This form was distributed to Subject Matter Experts (SMEs) for scoring. The scores were averaged, and average values were used to complete the ranking. If there was a major difference between SMEs, discussions were held to resolve those differences.

	SITING CRITERIA			Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1
	Category 1, CAMU Criteria - Ability to designate as CAMU. Per 6 CCR 1007-3 264.552 (c)	20															
1	The CAMU shall facilitate the implementation of reliable, effective, protective, and cost effective remedies.		3	1.8	0.6	1.5	0.5	2.1	0.7	3.0	1	2.7	0.9	2.7	0.9	2.7	0.9
2	Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposures to HW or HW constituents.		3	2.4	0.8	2.4	0.8	2.4	0.8	2.1	0.7	2.1	0.7	2.1	0.7	2.1	0.7
3	The CAMU shall include uncontaminated areas of the facility, only if including such areas for the purposes of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.		2	1.4	0.7	1.4	0.7	1.6	0.8	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6
4	The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2).		3	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8
5	The CAMU shall enable the use when appropriate of treatment technologies to enhance long term effectiveness of remedial actions by reducing the toxicity, mobility or volume of remedial waste.		2	1.8	0.9	1.8	0.9	1.8	0.9	1.8	0.9	1.8	0.9	1.8	0.9	1.8	0.9
	CAMU Criteria		13.0	9.8		9.5		10.3		10.5		10.2		10.2		10.2	

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	SITING CRITERIA			Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1
	Category 2, Public Protection - Geological, Geotechnical and Hydrological Criteria	20															
1	The geological and hydrological conditions of a site in which HW are to be stored should be such that there is reasonable assurance that the wastes are isolated within the storage area away from pathways to the public.		3	0.6	0.2	0.6	0.2	0.9	0.3	1.2	0.4	1.5	0.5	2.1	0.7	0.3	0.1
2	Geomorphic conditions either will not vary significantly from the present state or will occur to a predictable degree which can be accommodated in the facility design.		2	1.6	0.8	1.6	0.8	1.6	0.8	1.8	0.9	1.8	0.9	1.4	0.7	1.8	0.9
3	Structure related issues to include: Slope and geotechnical stability		3	2.7	0.9	2.7	0.9	2.7	0.9	2.7	0.9	2.7	0.9	2.4	0.8	2.7	0.9
4	The immediate area of the site is in strata of minimal groundwater flow.		3	0.9	0.3	0.9	0.3	0.9	0.3	0.9	0.3	0.6	0.2	1.5	0.5	0.9	0.3
5	Geological strata combined with engineering barriers shall provide a minimum permeability for aquifer protection.		3	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8
6	Bedrock/surface integration including the nature and extent of bedrock material.		2	1.6	0.8	1.2	0.6	1.2	0.6	1.8	0.9	1.4	0.7	2.0	1	1.8	0.9
7	Minimal relative presence of fractures or faults.		2	1.2	0.6	1.2	0.6	1.2	0.6	1.6	0.8	1.6	0.8	1.6	0.8	1.6	0.8
8	Relative depth to bedrock/groundwater including seasonal fluctuations for groundwater.		3	0.9	0.3	0.6	0.2	0.3	0.1	1.5	0.5	1.5	0.5	0.3	0.1	0.6	0.2
9	The site will not impact nor be impacted by surface water.		2	2.0	1	2.0	1	2.0	1	1.8	0.9	1.8	0.9	1.8	0.9	1.8	0.9
10	Relative distance to nearest discharge area to include consideration of groundwater flow direction and travel time.		3	0.6	0.2	0.6	0.2	0.6	0.2	0.9	0.3	0.6	0.2	1.5	0.5	0.6	0.2
11	The terrain is such that good drainage exists for movement of precipitation away from the storage area.		1	1.0	1	1.0	1	1.0	1	1.0	1	1.0	1	0.9	0.9	1.0	1
	Public Protection		27.0	15.5		14.8		14.8		17.6		16.9		17.9		15.5	

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	SITING CRITERIA			Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1
	Category 3, Site Special Issues - Ability of the candidate site to provide a "footprint" that allows timely construction of a facility to occur. (schedule criteria)	15															
1	Ability of the site to support the Rocky Flats Conceptual Vision (Vision) objectives.		3	2.1	0.7	2.4	0.8	3.0	1	0.3	0.1	0.3	0.1	0.3	0.1	0.3	0.1
2	Impacts from existing utility, sewer, process waste, or communications lines.		2	1.2	0.6	0.4	0.2	0.8	0.4	1.8	0.9	1.6	0.8	2.0	1	2.0	1
3	Impacts from security.		1	0.9	0.9	0.9	0.9	0.4	0.4	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
4	Impacts from Pu consolidation or residue stabilization activities.		1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
5	Impacts from D&D activities.		2	1.2	0.6	1.0	0.5	1.4	0.7	1.6	0.8	1.8	0.9	1.8	0.9	1.8	0.9
6	Impacts from current RCRA units.		2	1.8	0.9	0.4	0.2	1.4	0.7	2.0	1	2.0	1	2.0	1	2.0	1
7	Impacts from mineral rights issues or other easements.		2	1.2	0.6	1.8	0.9	1.8	0.9	0.8	0.4	1.8	0.9	2.0	1	1.2	0.6
8	Ability to co-locate additional waste management cells in the same vicinity.		2	1.6	0.8	1.2	0.6	1.6	0.8	2.0	1	2.0	1	2.0	1	1.6	0.8
	Site Special Issues		15.0	10.8		8.9		11.2		10.2		11.2		11.8		10.6	
	Category 4, Cost Criteria	15															
1	Cost of engineering and construction of protective measures.		3	2.1	0.7	1.5	0.5	1.5	0.5	2.4	0.8	2.1	0.7	2.1	0.7	2.1	0.7
2	Cost of site preparation including building demolition, subsurface line removal and re-routing, access requirements, and power/facility requirements		3	2.1	0.7	1.5	0.5	1.8	0.6	2.4	0.8	2.4	0.8	2.4	0.8	2.4	0.8
	Cost Criteria		6	4.2		3.0		3.3		4.8		4.5		4.5		4.5	

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SITING CRITERIA				Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1
	Category 5, Regulatory Support State Principles for On-Site Disposal of Contaminated Materials (27-February-95 letter from Tom Looby to Jack McGraw and Mark Silverman)	15															
1	"The number of disposal sites must be minimized. We (CDPHE) suggest one centralized site be chosen for consolidation of contaminated materials."		2	1.6	0.8	1.4	0.7	1.8	0.9	1.4	0.7	1.2	0.6	1.2	0.6	1.2	0.6
2	"Every effort should be made to site a centralized disposal facility in an area of optimal geologic parameters preferably within, or close to the IA."		3	2.1	0.7	2.1	0.7	2.1	0.7	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6
3	"Any disposal facility must be designed and built as a state of the art disposal facility that meets or exceeds all permitting and regulatory requirements. This includes siting, design, long term protection, and performance requirements."		3	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6
4	'A permitted facility would provide DOE the greatest degree of future applicability and utility. ....the facility should be designed with the intent to permit under RCRA/CHWA"		2	1.6	0.8	1.6	0.8	1.6	0.8	1.6	0.8	1.6	0.8	1.6	0.8	1.6	0.8
5	"Any disposal site at RFETS should be located in areas that have limited future land use potential and will be controlled by DOE until the interred waste no longer presents a risk to human health or the environment."		3	1.5	0.5	2.1	0.7	2.7	0.9	1.2	0.4	1.2	0.4	0.9	0.3	0.9	0.3
Regulatory Support			13.0	8.6		9.0		10.0		7.8		7.6		7.3		7.3	

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SITING CRITERIA				Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1	Points Scored	multi factor 0-1
	Category 6, Other Stakeholder Concerns	15															
1	General public perception/acceptance		2	1.4	0.7	1.4	0.7	1.6	0.8	0.8	0.4	0.6	0.3	0.4	0.2	0.4	0.2
2	Municipal or County acceptance.		2	1.2	0.6	1.4	0.7	1.4	0.7	0.4	0.2	0.4	0.2	0.2	0.1	0.2	0.1
3	DOE Orders		2	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6	1.2	0.6
4	NEPA		3	2.1	0.7	2.1	0.7	2.1	0.7	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6
	Other Stakeholder Concerns		9.0	5.9		6.1		6.3		4.2		4.0		3.6		3.6	

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Evaluate the seven locations (e.g., IA-East, IA-West) against the specific issues (for location, see Figure 1). The evaluation of the seven locations against Category 2 was accomplished with a series of maps displaying geologic, geomorphology, and hydrogeologic conditions (see Figures 2 through 7).

1. Evaluate and assign a number between 0-1 for each location on the matrix (e.g., IA-West, IA-East) against each specific issue with 0 being a fatal flaw that would preclude the location from being selected to 1 being the most favorable circumstance for that criteria (see Table C-2 for assigned numbers).

2. Multiply the score assigned to the specific issue in step 1 above (0 to 1) by the value assigned to the specific issue (between 1 and 3).

3. Sum the above products within each of the specific issues, as shown in Table C-2. There is a total of 35 specific issues illustrated in Table C-3, Criteria Issues:

Table C-3 Criteria Issues

Category	Criteria	Issues
1	Corrective Action Management Unit (CAMU) Criteria	5
2	Public Protection (Geotechnical and Hydrological Criteria)	11
3	Site Special Issues	8
4	Cost Criteria	2
5	Regulatory Support	5
6	Other Stakeholder Concerns	4
	Total	**35**

4. Divide the above sums by the total points and multiply by the weighting factor of that category, which in all cases is either 15 or 20%. The total available points assigned are 83, and are distributed as illustrated in Table C-4, Criteria Points.

Table C-4 Criteria Points

Category	Name	Points
1	Corrective Action Unit (CAMU) Criteria	13
2	Public Protection (Geotechnical and Hydrological Criteria)	27
3	Site Special Issues	15
4	Cost Criteria	6
5	Regulatory Support	13
6	Other Stakeholder Concerns	9
	Total	**83**

5. Sum the weighting factor of the six categories for the final ranking of the location. The overall ranking is summarized in Table C-5, RWSF Location Criteria Summary.

Each location was thus given an overall ranking between 0 and a 100%, with 100% being the most favorable location for the siting of a RWSF.

C.2.3 SCREENING PROCESS

A basic assumption made was that the entire Site as shown in Figure 1 would be included in the siting study. Category 2 includes the geologic, hydrogeologic, and geomorphologic aspects of the siting study. A series of maps were produced to assist in this evaluation. Additionally a map addressing ecology issues was included because these issues are best illustrated on a map. The seven maps produced were:

- Figure 1, Site Location Map, shows the location of building, roads, and the seven locations carried through in this evaluation.
- Figure 2, Hydrogeological Conditions, includes the depth to the water table and the area encompassed by 100-year flood plain.

Table C-5 RWSF Siting Criteria Summary

SITING CRITERIA				Alternative Sites													
				Industrial Area						Buffer Zone							
				IA - West		IA - East		Solar Ponds		NSL		ESF		SE Quad		SW Quad	
		Weight %	Total Available Points	Partial %	Points Scored	Partial %	Points Scored	Partial %	Points Scored	Partial %	Points Scored	Partial %	Points Scored	Partial %	Points Scored	Partial %	Points Scored
1	CAMU CRITERIA	20	13.0	15.1	9.8	14.6	*9.5*	15.8	*10.3*	16.2	*10.5*	15.7	*10.2*	15.7	*10.2*	15.7	*10.2*
2	PUBLIC PROTECTION	20	*27.0*	11.5	*15.5*	11.0	*14.8*	11.0	*14.8*	13.0	*17.6*	12.5	*16.9*	13.3	*17.9*	11.5	*15.5*
3	SITE SPECIAL ISSUES	15	*15.0*	10.8	*10.8*	8.9	*8.9*	11.2	*11.2*	10.2	*10.2*	11.2	*11.2*	11.8	*11.8*	10.6	*10.6*
4	COST CRITERIA	15	*6.0*	10.5	*4.2*	7.5	*3.0*	8.3	*3.3*	12.0	*4.8*	11.3	*4.5*	11.3	*4.5*	11.3	*4.5*
5	REGULATORY SUPPORT	15	*13.0*	9.9	*8.6*	10.4	*9.0*	11.5	*10.0*	9.0	*7.8*	8.8	*7.6*	8.4	*7.3*	8.4	*7.3*
6	OTHER STAKEHOLDER CONCERNS	15	*9.0*	9.8	*5.9*	10.2	*6.1*	10.5	*6.3*	7.0	*4.2*	6.7	*4.0*	6.0	*3.6*	6.0	*3.6*
	TOTALS	**100%**	***83.0***	67.6%	***54.8***	62.5%	***51.3***	68.3%	***55.9***	67.4%	***55.1***	66.1%	***54.4***	66.4%	***55.3***	63.4%	***51.7***

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- Figure 3, Geological and Geotechnical Conditions, includes steep, color-coded slope areas for slopes 15-20%, 20-30%, and greater than 30% and inferred faults traces.

- Figure 4, Structure Base of Alluvium, drawn on the base of the alluvium (top of bedrock).

- Figure 5, Thickness of Alluvium, show the thickness of the Rocky Flats Alluvium.

- Figure 6, Ecology and NEPA, shows the location of seeps, wetlands, and Preble's Meadow Jumping Mouse probable habitat, a wildlife species that is being considered for listing as a species of concern, or a threatened and endangered species.

- Figures 2, 3, and 6 were combined into Figure 7, Adverse (for a RWSF location) Conditions, which delineates three of the major potentially limiting criteria, the 100-year floodplain, steep slopes and the location of wetlands, seeps, and the Preble's Meadow Jumping Mouse habitat. Areas highlighted on this map have been removed from future consideration in this siting study because the presence of one or more of these aspects presents a major obstacle for locating a RWSF.

This initial screening of the Site reduced the number of locations being addressed. Seven locations are being carried forward in this study, four in the buffer zone and three located within the IA of the Site, as shown in Figure 1.

The four areas in the buffer zone are:

- The New Sanitary Landfill (NSL)

- An area near the East Spray Fields (ESF)

- An area in the Southwest Quadrant (SW Quad) of the buffer zone

- An area in the Southeast Quadrant (SE Quad) of the buffer zone

The three areas in the IA are:

- An area on the west side of the Industrial Area - (IA-West)

- An area on the southeast side of the Industrial Area - (IA-East)

- An area including the Solar Ponds 207B (North, Central, and South) and the land immediately adjacent and to the east (IHSS 165 and IHSS 176)

These seven locations are then carried on through the study and evaluated against the six general criteria categories. The scored matrix of location versus criteria and the values associated with the different combinations are shown in Table C-2.

C.2.4 ANALYSIS

The summary of the criteria evaluation is presented in Table C-5.

C.2.4.1 Corrective Action Management Unit (CAMU) Criteria

"The CAMU will facilitate the implementation of a reliable, effective, protective, and cost-effective remedy."

- A reliable, effective, and protective facility can be engineered at any of the locations being considered. The cost-effective component of this criteria ranges significantly from location to location, and is partially dependent on the RWSF design alternative selected. Locating any of the design alternatives within the IA is less cost-effective because of the infrastructure currently in place that would have to be removed, rebuilt at another location, or rerouted, such as with buried and overhead utilities.

- IA-West, IA-East, and Solar Ponds, all located within the IA, would be the less cost-effective options.

- NSL, ESF, SE Quad, and SW Quad locations located in the buffer zone would be the more cost-effective options.

"Remediation waste management activities associated with CAMU cannot create unacceptable risks to human health or the environment from exposure to hazardous waste or hazardous constituents."

- A slight advantage would be to the locations within the IA in terms of transporting waste. Most of the waste that is being targeted for the RWSF is originating in the IA, and haul distances would be less to a facility in the IA then outside the IA.

The CAMU will include uncontaminated areas of the facility, only if including such areas for the purpose of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.

- NSL, SW Quad, and SE Quad locations are not in IHSSs or potential areas of concern (PAC). The designation of a CAMU to any of these locations would not be more protective than construction of the same facility within the IA on an IHSS.

- IA-West and IA-East locations are not within IHSSs or PACs, however, they are located in the IA, adjacent to either known contamination; adjacent or within areas of the location that have been subject to significant industrial uses, such as office buildings, waste storage buildings, production buildings, parking lots, paved roads, and buried and overhead utilities.

- The Solar Ponds and ESF are located within areas that have, in part, been designated IHSSs. The Solar Ponds location overlaps the Triangle Area, IHSS 165; the Contractor Storage Yard, IHSS 176; and the Solar Ponds, IHSS 207B. Managing remediation waste in this area has the advantage of managing waste in a secure area and reducing the size of the overall footprint of contamination at the Site.

- The ESF location overlaps IHSSs 216.2 and 216.3; however, these IHSSs have been identified as having no risk associated with them and have been recommended to go to no further action (NFA).

The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 6 CCR 1007-3, 264.552(c)(1) or (c)(2).

- The timing of remedial activity implementation is more dependent on the RWSF design alternative selected and the permitting process than on the location selected. This criteria is approximately the same for all locations being considered.

The CAMU shall enable the use, "as appropriate, treatment technologies (including innovative technologies) to enhance long-term effectiveness of remedial actions at the facility by reducing the toxicity, mobility, or volume of wastes that will remain in place after closure."

- The ability of the CAMU to use these treatment technologies, when appropriate, is more or less independent on the location selected, and is approximately the same for all locations in the study.

C.2.4.2 Public Protection (Geotechnical and Hydrological Criteria)

The geological and hydrogeologic conditions of a location in which hazardous waste is stored should provide reasonable assurance that the wastes are isolated within the storage area away from pathways to the public.

- Hydraulic conductivities of foundation soil materials (Rocky Flats Alluvium) typically occur in the 10^{-3} to 10^{-5} cm/sec range. Lower hydraulic conductivity values in the range of 10^{-6} to 10^{-7} cm/sec have been measured for the underlying weathered claystone bedrock. All of the locations are located in recharge areas associated with the Rocky Flats Alluvium and colluvial deposits, and many are located near discharge areas. The depth to the Fox Hills aquifer is greater than 500 feet over most of the Site and this interval consists mainly of low permeability claystones with hydraulic conductivities in the range of 10^{-6} to 10^{-7} cm/sec.

- The estimates of lateral groundwater flow travel times in the underlying surficial materials from the proposed waste locations to their nearest discharge points are well below a 1,000 years for all of the locations under consideration. The calculated travel times typically range from several years to several decades. The presence of significant groundwater discharge points (springs and seeps) in hydraulically downgradient areas of the SW Quad (Antelope Springs), NSL (Lindsey Ranch Springs), and potentially the ESF location, tend to reduce the suitability of these locations because of the potential ecological impacts associated with sensitive habitats issues. The location least affected by short groundwater travel times is the SW Quad location because groundwater is assumed to flow through bedrock materials (hydraulic conductivities 10^{-6}-10^{-7} cm/sec) rather than the more permeable alluvium.

- Water losses from location operations via leaking pipes and general housekeeping practices are currently believed to contribute an unknown but potentially significant amount of recharge to the groundwater in the Site IA. It is expected that the elimination of anthropogenic recharge sources related to cessation of location operations and building closures under the Site Vision will result in a lowering of water levels in the IA similar to that observed in many IA well hydrographs following the termination of plant production operations in 1990.

Geomorphic conditions either will not vary significantly from the present state or will occur to a predictable degree which can be accommodated in the facility design.

- This is not a major factor in the overall siting study; all locations have approximately the same geomorphic conditions with the degree of erosion occurring at a predictable rate and can be accommodated in the facility design. The SE Quad location is rated lower in this category because the protective cover of the Rocky Flats Alluvium has been removed by erosion and escarpment retreat.

Structural related issues include slope and geotechnical stability, as shown in Figures 3 and 7.

- Areas with steep slopes (slopes greater than 15%) have been eliminated from the siting study. There is a steep slope to the north of the Solar Ponds location; however, the footprint to the facility would be positioned as far south of the slope as the design would allow and is not considered to be a limiting siting factor. Geotechnical stability of foundation soils is not expected to be a problem at any of the locations. This consideration will be addressed by a field geotechnical investigation performed at the selected location during the feasibility assessment phase of the program.

The immediate area of the location should be in strata of minimal groundwater flow.

- All of the locations have minimal groundwater flow, however, the SE Quad location is situated in an area considered more suitable compared to the other locations. At the SE Quad location, the RWSF would be built on weathered bedrock materials that have a significantly lower permeability than either the surrounding thin, colluvial soil veneer or Rocky Flats Alluvium.

Geological strata combined with engineering barriers shall provide a minimum permeability.

- The design of the facility at any of the candidate locations would incorporate an engineered barrier that would provide a minimum permeability of 10^{-7} cm/sec for protection of domestic or agriculture aquifers. Additional protection of the regionally important Laramie/Fox Hills aquifer is provided by several hundred feet of intervening, low permeability claystone aquitard materials comprising the upper Laramie and Arapahoe formations. Downward migration from the unconfined aquifer is thought to be nonexistent based on existing data (EG&G, 1995a).

Siting consideration should include bedrock and surface integration including the nature and extent of bedrock material.

- The upper Laramie Formation is an extensive (maximum thickness beneath the Site is greater than 500 feet) aquitard beneath all locations under consideration and forms an effective and continuous low-permeability barrier to downward vertical groundwater flow. Local variations in shallow bedrock lithology caused by the presence of small discontinuous bodies of subcropping Arapahoe formation sandstones are observed in the IA, notably at the Solar Ponds and IA-East locations. These sandstones are capable of both vertical and lateral groundwater transport, but vertical flow to deeper sandstones and the Laramie/Fox Hills aquifer is thought to be nonexistent. Sites with thinly saturated alluvium and subcropping sandstones, such as are found at the Solar Ponds and IA-East areas, have the greatest potential for groundwater interchange between alluvial and bedrock units. However, the sandstones from the Arapahoe and Laramie formations are discontinuous and isolated, with fewer sandstone lens present in the lower part of the formation.

Siting consideration should include minimal relative presence of fractures or faults.

- Bedrock fracturing is potentially important in areas of thinly saturated alluvium (Solar Ponds, ESF, and IA-East locations), where a significant portion of alluvial groundwater may recharge the bedrock, or at the SE Quad location, where liner materials would be in direct contact with bedrock. Groundwater flow in fractured claystone bedrock is thought to be minimal because of limited fracture densities and small fracture apertures observed in core samples across the location. Fracture densities are observed to decrease with depth.

- The inferred bedrock faults at the Site, as shown in Figures 3 and 4, are not considered to pose a seismic risk (EG&G, 1995b), according to the Nuclear Regulatory Commission (10 CFR Part 100, Appendix A) definition (NRC, 1990 and 1991), because the Rocky Flats Alluvium is not deformed over the intensely fractured areas of the Laramie Formation at the Site.

  - Solar Ponds and IA-East. There is an inferred north-to-south orientated bedrock fault through the Solar Ponds that continues south through the IA-East location (EG&G 1995a). The inferred fault appears to be located hydraulically upgradient from the Solar Ponds location which would remove it as a potential groundwater pathway. The trace of this inferred fault also bisects the IA-East location from north to south.

  - IA-West. There is an inferred northeast-to-southwest trending bedrock fault through the IA-West location. This fault is located hydraulically downgradient from the IA-West location and represents a potential groundwater pathway to deeper sections of the Laramie Formation.

- ESF. There is an inferred northeast-to-southwest bedrock fault trending fault through the ESF location. The fault is located hydraulically upgradient from the location and removes it as a potential groundwater pathway.

- NSL, SE Quad, and SW Quad. There are no mapped or inferred faults in these areas.

- A preliminary evaluation of potential vertical groundwater movement along fault zones at the Site using environmental isotopes as hydrologic tracers has indicated that fault zones probably transmit little, if any, groundwater preferentially downward relative to flow in undisturbed, unweathered bedrock zones (memorandum to A. Primrose from R. Smith dated November 22, 1995).

Consideration should be given to the relative depth to bedrock/groundwater, including seasonal fluctuations for groundwater.

- Bedrock depths range from less than an estimated 5 feet at the SE Quad location to over 40 feet at the NSL, ESF, and SW Quad locations. Saturated alluvial thicknesses at the candidate locations vary as a function of distance from drainages, configuration of bedrock topography, and seasonal recharge. Generally, saturated thicknesses are greatest in the spring (April, May, and June) and may fluctuate anywhere from a few feet to as much as 20 feet depending on local hydrologic and seasonal recharge conditions.

- Precipitation for the spring of 1995 has been estimated to be the greatest in a 102-year period based on precipitation records from Boulder, Colorado. Seasonally high water tables, in some cases within a foot of ground level, were measured or estimated at many of the locations in 1995. The locations with the deepest water tables (seasonal peaks greater than 10 feet below ground level) include ESF and the NSL.

- IA-West, IA-East, and Solar Ponds. As shown in Figure 2, the average water table in the IA is +/- 10 feet from the surface (Ref.: EG&G, Hydrogeologic Characterization Report for the Rocky Flats Environmental Technology Site, April 1995). At the IA-West location, the minimum depth to groundwater (historical highs) was recorded or estimated during 1995 and ranged from 0.0 to 8.7 feet below ground level in the six monitoring wells in and around the location. In this same timeframe at the Solar Ponds location, the depth to groundwater ranged from 1.0 to 4.8 feet. Well coverage at the IA-East location is less extensive compared to the other IA locations, and it is assumed that water-level conditions were similarly shallow based on historical water-level records and location-specific hydrologic conditions.

  - NSL. The concerns related to water table depth at the NSL are less than those associated with the IA. The minimum depth to groundwater at the NSL location was measured at 26 feet (well 0190) in 1995, which makes this the most favorable location in terms of the seasonal fluctuation criteria. The water table typically occurs in the 30- to 50-foot below grade range under normal (nonpeak) hydrologic conditions.

  - ESF. Water level records of four wells at the ESF location indicate that the minimum depth to water expected in this area is about 20 feet with an average depth of between 25 to 30 feet. The alluvium at this location generally has a saturated thickness of less than 5 feet, with

significant unsaturated areas occurring during seasonal watertable lows.

- SE Quad. There is a paucity of water-level data in this area because of the lack of monitoring well coverage. The majority of the surficial deposits in this area most likely exist in a largely unsaturated condition. A shallow water table in the underlying weathered bedrock material, however, may exist and cannot be ruled out without more information.

- SW Quad. Depth to groundwater at the SW Quad location is 0 to 20 feet with a saturated thickness of between 30 and 40 feet. Groundwater in this area becomes more shallow in an eastward direction toward Antelope Springs, as indicated by monitoring well data. The minimum water-table depth in areas west of Antelope Springs is estimated to be less than 5 feet.

The site will not impact nor be impacted by surface water

- None of the locations are located in areas that will be impacted by surface water. The locations are not expected to have a significant impact on surface water, although slight reductions in flow at nearby springs and seeps may be experienced because of a loss of recharge area. This situation might exist at the SW Quad, NSL, and ESF locations where free-flowing springs contribute directly to stream flow.

Relative distance to the nearest discharge area should include consideration of groundwater flow direction and travel time.

- The relative distance to the nearest discharge areas is relatively short for most of the locations being considered.

  - IA-West and IA-East. These locations lie astride the subsurface drainage divide between the ephemeral Woman and Walnut Creeks. The nearest point of discharge are the seeps that are expressed near the base of the alluvium on the south-facing slopes of the Woman Creek Drainage. These wetlands areas are approximately 250 feet south of the IA-West location. Groundwater flow from the IA-East location south of the drainage divide would flow toward Woman Creek but is captured by the French Drain along the 881 Hillside.

  - Solar Ponds. This location lies astride the subsurface drainage divide between the North and South Walnut Creeks. The Interceptor Trench System (ITS) adjacent to, and north of, the Solar Ponds captures part of the groundwater flow to the north. The flow to the north not captured by ITS moves toward South Walnut Creek and eventually enters the groundwater system associated with this drainage. The nearest point of discharge to South Walnut Creek is approximately 250 feet south of the Solar Ponds location.

  - NSL. This location lies astride the subsurface drainage divide between the ephemeral Rock Creek to the north and North Walnut Creek to the south. Surface expressions of groundwater in the forms of seeps are evident along the base of the alluvium in the Rock Creek Drainage about 1500 feet to the northeast. On the south side of the drainage divide the nearest discharge to surface water would be about 500 feet south to the upper reaches of North Walnut Creek.

- ESF. This location lies on the subsurface drainage divide between Woman and Walnut Creeks. The part of this candidate area that lies on the Woman Creek side of the watershed is unsaturated, which would indicate that groundwater from this location in all likelihood does not flow into Woman Creek. The part of the location on the Walnut Creek side of the location discharges into a series of seeps located 200 to 1000 feet north of the location (depending on the location of the facility) at the base of the alluvium that discharges through surface flow into Walnut Creek.

- SW Quad. The direction of flow of the groundwater from this location is to the northeast and discharges into Antelope Springs, which is adjacent to the location. The location is within the Woman Creek drainage basin.

- SE Quad. This candidate location is located on the north side of the Woman Creek drainage. Subsurface data are sparse in this area but the area is not located on the Rocky Flats Alluvium. The surficial geology of this location is weathered claystones, siltstones, and sandstones of the Arapahoe and the underlying Laramie Formations (EG&G, 1995a). The location potentially has no saturated unconsolidated surficial deposits.

The terrain is such that good drainage exists for movement of precipitation away from the storage area, and such that water and wind erosion will be minimal.

- This criteria is essentially the same for all locations, either good drainage already exists or a drainage system can be engineered to accommodate the needs of this requirement. The SW Quad has a slightly poorer drainage system developed than the other locations.

C.2.4.3 Site Special Issues

The ability of the location to support the Site Vision objectives: Under the Site Vision, all nuclear materials will be removed from the Site and the DOE will remediate the Site in a manner consistent with future projected land (see Figure 8, Conceptual Site Land Uses) and water uses.

- The future land use of the buffer zone varies from unrestricted to restricted open space, whereas the IA is projected as either an industrial use area or as a capped area.

  - Solar Ponds would be an ideal candidate to support the Site Vision, because of the future land use of the IA and its location within the footprint of the capped area.

  - IA-East and IA-West could, with extensive modification to the footprint of the capped area, could support the RFCA. The IA-West location is in a noncontaminated area in the IA. The design of the capped area would have to be extensively altered.

  - The candidate locations, NSL, ESF, SW Quad, and SE Quad, do not support the Site Vision because utilization of these locations would involve placing contamination in previously uncontaminated areas.

- Impacts from existing utility, sewer, process waste, or communications line:

  - IA-West, IA-East, and Solar Ponds. The three locations within the IA all have significant amounts of utility lines, sewer lines, and other infrastructure as listed in Table C-6, In-place Infrastructure, either buried or above ground that would require removal or replacement. Impacts would also include demolition of buildings within the footprint, provide the storage of RCRA waste currently located in buildings at these locations (IA-East and the Solar Ponds), and construction of a portal and security fence for the Solar Ponds location. The order-of-magnitude costs generated for the preparation of a location are in Table C-7.

Table C-6 In-place Infrastructure

Location	Area	Infrastructure
New Sanitary Landfill	Underground	Telephone main Electrical - 208V Water Line - 3@ (abandoned)
	Overhead	Electrical Utilities - 208V
	Miscellaneous	Live Firing Range - Range Fan Area
	Buildings	None
Solar Ponds	Underground	Process Waste Lines - 3" and 8" Raw Water Lines - 4," 6" and 8" Domestic Cold Water - 4" Sewer Lines - 4", 8" and 12" Process Drains - 3", 6" and 8" Water Valves Culverts Telephone Lines
	Overhead	Electrical Utilities - 110V, 440V, 480V and Helicopter Deterrent Power Poles
	Buildings[1]	228A, 228B, 910, 928, 964, 965, 967, and 990
IA-East	Underground	Electrical Utilities - 480V and 13.8kV Water Pipelines - 3", 6", and 10" Steam - 6" and 8" Gas Lines - 3" Sewer Lines - 4" and 12" Telephone Lines Foundation Drains Tunnel Culverts Alarms and Data Systems Storm Drains Vaults
	Overhead	Electrical - 2400V and 13.8kV Alarms Steam and Condensate Natural Gas
	Buildings	T886B, T886C, T893B, 902 Tent, 906, and ER Contractor Yard
IA-West	Underground	Electrical Utilities - 15V, 110V, 120V, 120/240V, 277V, 2400V, and 13.8kV Domestic Cold Water Pipelines - 4", 6", and Raw Water Pipelines - 2", 4", and 12" Water Valves Culverts - 12", 18", and 20" Alarms - 1", 2" and 4" Sewer Lines - 4" and 8" Catch Basins Storm Drains - 15" Scanner
	Overhead	Electrical - 480V, 2400V, 13.8kV and Parking
	Buildings	T124A

(1) Only Building 964 will need to be removed if any design alternative other than the Abovegrade Landfill is the preferred alternative.

Table C-7 Order-of-Magnitude Costs for Site Preparation

Location	Construction Cost
IA-East	$14,800,000
Solar Pond	$11,900,000
IA-West	$2,200,000
NSL	$100,000

- Costs were not generated for the ESF, SW Quad, or the SE Quad locations. The preparation for these areas would fall between the costs of the IA-West and NSL.

- Impacts from security:

  - Security impacts would be approximately the same for all locations, except for the Solar Ponds where an access portal would be needed to allow for construction materials and workers to enter the PA, a perimeter fence to isolate the discharge to surface water would be about 500 feet south to the upper reaches of RWSF during both construction and postconstruction activities, and a security staff during construction activities. The cost of the portal, fence, and security staff has been calculated as part of the preparation cost.

- Impacts from Pu consolidation or residue stabilization activities:

  - Impacts from Pu consolidation or residue stabilization activities are not a factor for the siting of a RWSF.

- Impacts from deactivation and decontamination (D&D) activities:

  - IA-West. Building T124A, is located within the footprint and staging area (22 acres) of the abovegrade RWSF landfill, and would require demolition if this design option was selected. This building is currently scheduled for removal in fiscal year (FY) 2000, but that could easily be accelerated if the location were selected. The other design alternatives for this location all have smaller footprint and staging areas (approximately 10 to 12 acres) and would not require demolition of this building.

  - IA-East. There are several building and the contractor yard that would be impacted from siting the RWSF at IA-East. Building 906, the centralized waste storage facility, is the newest building at the Site and was specifically built for waste storage. The decommissioning of this facility has not been scheduled and the current working assumption is that it will remain at least for the near term. The 902 Pad facility is a tent and the possibility exists to move it to another location without losing storage capacity. The contractor yard has a number of trailers and government- and contractor-owned stored equipment. The decommissioning of this area has not yet been scheduled and the working assumption is that it would remain open beyond 2003.

- Solar Ponds. Building 964 is located within the footprint of all of the RWSF alternatives. It is a sheet metal building used as a RCRA storage facility. Demolition of the structure is straight forward and could be completed in 90 days assuming additional waste storage capacity becomes available. If the above-grade landfill alternative is selected the footprint would be larger and also require the demolition of Buildings 228A, 228B, 928, 965, 910, and 990.

- NSL, ESF, SW Quad, and SE Quad. There are no buildings associated with these candidates locations.

- Impacts from current RCRA units:

  - IA-East. Building 906, the centralized waste storage facility, is a RCRA storage facility. The decommissioning of this facility has not been scheduled and the current working assumption is that it will remain until no longer required.

  - Solar Ponds. Building 964 is a RCRA storage facility located within the footprint of the RWSF. Alternative storage capacity would have to be created before demolition of this structure.

  - IA-West, NSL, ESF, SW Quad, and SE Quad. There are no RCRA storage units located at these candidate locations.

- Impacts from mineral rights issues or other easements:

  - All mineral rights at the Site are either privately held or as with the NSL location, it is both privately and governmentally held (see Figure 9, Mineral Ownership). Alluvial thicknesses greater than 40 feet are potentially economic for the gravel resources.

  - NSL and SW Quad. Both locations have alluvial thicknesses greater than 40 feet.

  - IA-West. Alluvial thicknesses are 25 to 40 feet thick and do not constitute an economic resource.

  - ESF. Alluvial thicknesses are 10-30 feet thick and do not constitute an economic resource.

  - IA-East and Solar Ponds. Alluvial thicknesses are +/-10 feet thick and do not constitute an economic resource.

  - SE Quad. Located off the Rocky Flats Alluvium, there are no gravel deposits at this location.

- Ability to collocate additional RWSFs in the same vicinity:

  - IA-West, NSL, ESF, SW Quad, and SE Quad. All have adequate space to location

additional RWSF cells if needed.

- Solar Ponds. The footprint shown can accommodate approximately 300,000 cy.

- The area around IA-East is restricted, with the 800 complex to the west, steep slopes to the south, and the security fence surrounding the PA to the north. Room for expansion would potentially be available to the east.

C.2.4.4 Cost Criteria

- The cost of engineering and construction of protective measures:

  - The cost of engineering and construction varies with the RWSF alternative selected. The cost of construction at the Solar Ponds would be greater than at other locations, because of the additional requirements imposed by having to construct a materials and worker portal through the security fence into the PA, and the additional security that would be required.

- Cost of preparation of the location including building demolition, subsurface line removal and rerouting, access requirements and power/facility requirements above the basic RWSF:

  - The cost of preparation varies by location. The cost of preparation at the NSL location is in the area of $100,000. The preparation for the NSL location already under construction has mitigated the costs that would otherwise be associated with a RWSF at this location.

  - ESF, SW Quad, and SE Quad would require construction or upgrades to the roads leading to the locations; costs are estimated to be more than the NSL location ($100,000) but less than the costs of the IA-West location ($2.2 to $2.8 million).
  - The locations within the IA, IA-West, IA-East, and Solar Ponds have considerable costs associated with preparation including building demolitions, subsurface line removal and rerouting access requirement. Costs associated for preparation range in order of magnitude from approximately $2.2 to $2.8 million for IA-West, $6.1 to $14.5 million for the Solar Ponds, and $15.2 to $18.1 million for IA-East.

C.2.4.5 Regulatory Support

"The number of disposal sites must be minimized. We (CDPHE) suggest one centralized site be chosen for consolidation of contaminated materials." The following concepts have been evaluated in this study to ensure consistency with EPA and CDHPE desires, but because the RWSF being proposed is for storage, not disposal, some of these criteria may not be appropriate for siting a storage facility.

- Locating the RWSF at the Solar Ponds location minimizes the number of locations by locating the facility in an area that coincides with, and would ultimately be incorporated into, the larger cap, and is a component of the Site Vision. The IA-West and the IA-East locations could, with

major revisions, support the Site Vision.

- The NSL, ESF, SE Quad, and the SW Quad locations would increase the overall areal extent of contamination by their location that is further away from the IA. The IA is where the bulk of the environmental waste at the Site is located.

"Every effort should be made to site a centralized disposal facility in an area of optimal geologic parameters preferably within or close to the Industrial Area (IA)."

- Optimal geological parameters at the Site reside in the locations outside of the IA. The NSL, ESF, and the SE Quad are preferred locations from an optimal geologic standpoint relative to the IA. However, all three locations are at a distance from the IA; the NSL is 2,000 feet northwest; ESF is 4,000 feet to the east; and the SE Quad is approximately 6,000 feet to the southeast of the PA.

- Optimal geological parameters do not exist within the IA, as discussed in Section 2.4.1, IA-West, IA-East, and the Solar Ponds are all within the IA.

"Any disposal facility must be designed and built as a state-of-the-art disposal facility that meets or exceeds all permitting and regulatory requirements. This includes (but not limited to) siting, design, long-term protection, and performance requirements."

- The alternatives considered will be built as a state-of-the-art storage facility and will meet or exceed all permitting and regulatory requirements. This criteria is the same for all locations being considered.

"A permitted facility would provide DOE the greatest degree of future applicability and utility. The facility should be designated with the intent to permit under RCRA/CHWA."

- This criteria is the same for all locations being considered.

C.2.4.6 Other Stakeholder Concerns

- General public perception and acceptance:

  - For onsite management of remediation waste, the locations within the IA, IA-West, IA-East and the Solar Ponds would in all likelihood be more readily acceptable to the general public than storage in the buffer zone. The locations in the IA reduce the footprint of contamination at the Site, and other than offsite disposal, storage of the environmental waste in the IA may well be the most acceptable alternative to the general public. Also, the Interim Measure/Interim Remedial Action (IM/IRA) for closure in place of Solar Ponds has already been accepted by the public.

- Municipal or County acceptance:

  - The Jefferson County, Colorado Board of Commissioners Resolution No. CC94-654 states, "maintaining, in perpetuity, the undeveloped buffer zone of open space around

Rocky Flats is a critically important environmental, safety, and health constraint which must be required as part of any and all alternatives actions proposed by the Department of Energy." The three locations within the IA, IA-West, IA-East and the Solar Ponds would support this resolution.

- NSL, ESF, SW Quad, and SE Quad locations are located within the buffer zone and as such, constructing a RWSF at any of these locations would be counter to the desires of Jefferson County.

- DOE Orders:
  - The same DOE orders would apply equally to all locations.
- NEPA:
  - NEPA issues would be addressed equally for all locations.

C.2.5 RESULTS FOR SELECTED LOCATIONS

The results of the above analysis are summarized in Table C-5. Overall, the Solar Ponds (68.3%) was ranked slightly higher then the IA-West (67.6%) location, and the NSL (67.4%) as a location for a RWSF at the Site.

In Category 1, CAMU, the ability to designate the location as a CAMU was in favor of the IA locations, in order: Solar Ponds; IA-East; and IA-West. The capacity to reduce the areal extent of contamination and not contaminate clean areas weighed heavily in favor of the IA locations. No fatal flaws were associated with this category at any of the seven locations carried through the evaluation.

In Category 2, Public Protection (Geotechnical and Hydrological Criteria), three of the buffer zone locations were ranked highest, in order: SE Quad; NSL; and ESF. The primary concern with the locations in the IA, (Solar Ponds, IA-West, and IA-East) is the elevated groundwater table; however, the concerns are somewhat mitigated through the use of an above-grade design. No fatal flaws were associated with this category at any of the seven locations carried through the evaluation.

In Category 3, Site Special Issues, the SE Quad was evaluated as the highest, followed by Solar Ponds, and ESF locations. The three locations in the IA, IA-West, IA-East, and the Solar Ponds all received high ranking for the ability to support the Site Vision. However, the impacts of having to address issues with the existing infrastructure lowered the overall scores for the IA locations in this category. No fatal flaws were associated with this category at any of the seven locations carried through the evaluation.

In Category 4, Cost Criteria, the locations in the buffer zone are favored. All four buffer zone locations received higher ranking than those locations in the IA. The major factors were the costs associated with removing, rerouting, or replacing buildings and underground and overhead utilities in the IA. The Solar Ponds has the additional burden of having to construct a portal through the PA security fence, constructing a fence surrounding the location, and having a security staff available

during construction and operation of the facility.

In Category 5, Regulatory Support, the support is clearly in favor of a location in the IA. The Solar Ponds location was ranked highest followed by IA-East and IA-West.

In Category 6, Other Stakeholder Concerns, the three locations within the IA, Solar Ponds, IA-East, and IA-West respectively, ranked the highest. The general public would likely be more receptive to placing remediation waste in areas that already contain some contamination rather than siting a RWSF at a location that has no history of contamination. The Jefferson County, Colorado Board of Commissioners, state their position in Resolution No. CC94-654 as "Maintaining in Perpetuity, the undeveloped buffer zone of "Open Space" around Rocky Flats is a critically important environmental safety and health constrain which must be required as part on any and all alternative action proposed by the Department of Energy."

C.2.6 REFERENCES

Dawson, G.W. and Mercer, B.W., 1986, Hazardous Waste Management, Wiley-Interscience Chapter 5 Facility Siting.

EG&G, 1995a, *Geological Characterization Report for the Rocky Flats Environmental Site*, March 1995.

EG&G, 1995b, *Evaluation of the Capability of Inferred Faults in the Vicinity of Building 371, Rocky Flats Environmental Technology Site, Colorado: Prepared by Geomatrix Consultants, Inc., for EG&G Rocky Flats, Inc.*, Draft Report, January 1995.

Environmental Guidance Regulatory Bulletin, Office of Environmental Guidance RCRA/CERCLA Division (EH-231)CAMU/TU Final Rule Issued May 12, 1993.

EPA, 1993, Federal Register, Part II, 40CFR Part 260, et. al. Corrective Action Management Units and Temporary Units; Corrective Action Provisions; Final Rule February 16.

Jefferson County Colorado Board of Commissioners, Resolution No. CC94-654.

Looby, Tom (CDPHE), 1995 to Jack McGraw (EPA), and Mark Silverman (DOE), subject matter: State principles for onsite waste management of contaminated materials, February 27.

Smith, R., 1995, Memorandum to Annette Primrose, November 22.

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Appendix D

Selection Criteria Descriptions

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D.2 COMPARISON OF ALTERNATIVES CRITERIA D-5

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D-1 Screening Criteria for IM/IRA Waste Management Facility D-1

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D.1 SCREENING CRITERIA

The criteria used in the Onsite Remediation Waste Storage Facility Siting Study and the Draft Evaluation of Onsite Versus Offsite Remediation Waste Management Options is presented in Table D-1.

Table D-1 Screening Criteria for IM/IRA Remediation Waste Storage Facility

IM/IRA Selection Criteria	Siting Criteria	Design Criteria
1. CAMU CRITERIA - Ability to designate as CAMU per 6 CCR 1007-3 264.552 (c)		
(1.1) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost effective remedies.	X	X
(1.2) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposures to hazardous waste or hazardous waste constituents.	X	X
(1.3) The CAMU shall include uncontaminated areas of the facility, only if including such areas for the purposes of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.	X	
(1.4) Areas within that CAMU, where remediation wastes remain in place after closure of the CAMU, shall be managed and contained so as to control, minimize, or eliminate future releases to the extent necessary to protect human health and the environment.	X	X
(1.5) The CAMU shall expedite the timing of remedial activity implementation, unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2).	X	X
(1.6) The CAMU shall enable the use, when appr., of trtmt. technologies (including innovative techs.) to enhance long term effectiveness of remedial actions by reducing the tox, mob., or vol. of remediation waste that will remain in place after closure.		X
(1.7) The CAMU shall minimize the land area of the facility upon which remediation wastes will remain in place after closure of the CAMU unless to do so would be inconsistent with 264.552 (c)(1) or (c)(2).	X	
2. PUBLIC PROTECTION (GEOTECHNICAL AND HYDROLOGICAL CRITERIA) - Ability to protect public per 6 CCR 1007-2 Part 2		
(2.1) The geol. and hydro. conditions of a site in which HW are to be disposed shall be such that reasonable assurance is provided that such wastes are isolated within the designated disposal area... away from ...pathways (to public) for 1000 yrs.	X	X
(2.2) Geomorphic conditions either will not vary significantly from the present state or will occur to a predictable degree which can be accommodated in the facility design.	X	
(2.3) Structure related issues to include: Slope and geotechnical stability	X	X
(2.4) The immediate area of the site is in strata of minimal groundwater flow.	X	
(2.5) ...geological strata combined with engineering barriers shall provide a minimum permeability of 10-7 cm/sec or equivalent...domestic or agr. aquifer protection.	X	X
(2.6) Bedrock/surface integration including the nature and extent of bedrock material.	X	

Table D-1 (continued)

IM/IRA Selection Criteria	Siting Criteria	Design Criteria
(2.7) Minimal relative presence of fractures or faults.	X	
(2.8) Relative depth to bedrock/groundwater including seasonal fluctuations for groundwater.	X	
(2.9) The juxtaposition of the site and any free flowing or standing natural surface waters shall be such that disposal location will not impact nor be impacted by surface water.	X	
(2.10) Relative distance to nearest discharge area to include consideration of groundwater flow direction and travel time.	X	X
(2.11) The terrain is such that good drainage exists for movement of precipitation away from the disposal area, and such that water and wind erosion will be minimal.	X	X
(2.12) The geochemical characteristics of the geological strata are compatible with the waste categories proposed to be disposed...provide high adsorption, absorption...fixation of any wastes that may migrate...	X	X
3. SITE SPECIAL ISSUES - Ability of the candidate site to provide a "footprint" that allows timely construction of a facility to occur. (schedule criteria)		
(3.1) Ability of the site to support the Site Vision and RFCA objectives.	X	X
(3.2) Impacts from existing utility, sewer, process waste, or communications lines.	X	X
(3.3) Impacts from security.	X	X
(3.4) Impacts from Pu consolidation or residue stabilization activities.	X	
(3.5) Impacts from building deactivation activities.	X	
(3.6) Impacts from D4 activities.	X	
(3.7) Impacts from current RCRA storage or other active RCRA units.	X	X
(3.8) Impacts from mineral rights issues or other easements.	X	
(3.9) Ability to co-locate additional waste management cells in the same vicinity.	X	X
4. COST CRITERIA		
(4.1) Cost of construction, includes Construction, Preconstruction, and Design Costs	X	X
(4.2) Cost of site preparation including building demolition, subsurface line removal and re-routing, access requirements, and power/facility requirements above basic cell F&OR.	X	X
(4.3) Cost of interim closure and monitoring after interim closure		X
(4.4) Total Life Cycle Cost		X
5. REGULATORY SUPPORT - State Principles for On-Site Disposal of Contaminated Materials (27-February-95 letter from Tom Looby to Jack McGraw and Mark Silverman)		
(5.1) The number of disposal sites must be minimized. We (Colorado Department of Public Health and the Environment) suggest one centralized site be chosen for consolidation of contaminated materials.	X	

Table D-1 (continued)

(5.2) Every effort should be made to site a centralized disposal facility in an area of optimal geologic parameters preferably within, or close to the IA.	X	
(5.3) Any disposal facility must be designed and built as a state of the art disposal facility that meets or exceeds all permitting and regulatory reqmts. This includes (but not limited to) siting, design, long term protection, and performance reqmts.	X	X
(5.4) A permitted facility would provide DOE the greatest degree of future applicability and utility. ....the facility should be designed with the intent to permit under RCRA/CHWA...	X	X
(5.5) Levels of radioactive contamination in any materials disposed on-site will be limited....levels as yet undetermined...		X
(5.6) Any disposal site at the Site should be located in areas that have limited future land use potential and will be controlled by DOE until the interred waste no longer presents a risk to human health or the environment.	X	
6. OTHER STAKEHOLDER CONCERNS		
(6.1) General public perception/acceptance	X	X
(6.2) Municipal or County acceptance.	X	X
(6.3) DOE Orders	X	X
(6.4) NEPA	X	
(6.5) Air Impacts	X	X
(6.6) Compliance to ARARS	X	X
(6.7) Long Term Liability/Effectiveness		X
(6.8) Ability to Accept Waste		X
(6.9) Demo. performance/Useful Life		X
(6.10) Construction and Operation		X
(6.11) Schedule Requirements		X
(6.12) Availability of Technology		X
(6.13) Availability of Service and Materials		X

The stakeholder concerns criteria addresses impacts to parties affected by decisions at the Site and to the Site and the surrounding community, as follows:

6.1) General Public Perception/Acceptance - The public sentiment including the general public and concerned local communities is evaluated as an alternative.

6.2) Municipal and County Acceptance - The viewpoints of local government including Jefferson County and local municipal governments are reflected in this criteria.

6.3) DOE Orders - This criteria has the ability to meet the requirements of DOE orders, particularly orders that protect the safety of workers, the public, and the environment.

6.4) NEPA - This criteria contains NEPA compliance requirements including environmental impacts, socioeconomic impacts, and impacts to archeological, cultural, and historical locations.

6.5) Air Impacts - This criteria includes impacts to air quality—onsite, offsite and regionally, as well as air pollution prevention or mitigative measures.

6.6) Compliance to Performance Regulations - This criterion was used to evaluate the ability of any given alternative to meet existing and potential state and Federal performance requirements. This did not include any performance requirements specific to the cleanup of Individual Hazardous Substance Sites that are independent of any given alternative.

6.7) Long-Term Liability and Effectiveness - This criterion was employed to evaluate the ability to safely isolate, contain, and manage remediation waste with the passage of time. It also addressed the issues of long-term liability, particularly for alternatives whose ability to safely manage materials could be subject to change in the future.

6.8) Ability to Accept Waste - This criterion was utilized to evaluate the ability of an alternative to accept waste volumes and different types of waste that will result from environmental restoration activities. This included, at a minimum, the ability of various options to accept remediation waste at the same rate that it is generated and to have the overall capacity to be a viable solution for at least near-term activities.

6.9) Demonstrated Performance/Useful Life - This criterion was used to address the permanence of a selected alternative as well as whether the alternative is known through experience to be viable.

6.10) Construction and Operation - This criterion was used to evaluate a number of factors such as whether monitoring is feasible during operations and after closure, whether environmental and geological features would circumvent construction or the overall constructability, and whether transportation of remediation waste is feasible.

6.11) Schedule Requirements - This criterion was used to directly support one of the main objectives of this IM/IRA—can the alternative be ready to accept remediation waste and be fully operational when needed in the future.

6.12) Availability of Technology - This criterion was employed to evaluate whether the technologies exist and have been developed to the point where they would be available. This was primarily directed at design considerations; however, the availability of monitoring, transportation, handling, and safety technologies was also part of this consideration.

6.13) Availability of Services and Materials - This was an evaluation of the availability of construction materials, equipment, analytical support, construction labor, and support personnel over the entire life of any given alternative.

D.2 COMPARISON OF ALTERNATIVES CRITERIA

The final comparison of alternatives used the seven criteria (plus two additional criteria) that are summarized, as follows:

1) Protection of Public Health and the Environment - This criterion was used to evaluate the alternative's impacts to ground water, surface water, drainage pattern impact, soil, air, plants and animals for the life cycle of the IM/IRA. Emphasis is placed on the ability of the alternative to control migration and leachability of contaminants and impact of any construction.

Impacts on erosion rate and loss of top soil were also examined including their offsite effects of erosion and wind blown soil. Alternatives were evaluated as to whether there were temporary or short-term changes to the soil and the erosion rate or whether these changes had lasting long-term impacts. The ability of an alternative to minimize and/or mitigate these erosional effects through erosion control or replacement of the topsoil was evaluated.

Each alternative was analyzed for biological impacts, direct and indirect impacts on critical habitat, wetlands, and vegetation. Analyzing biological effects included the cumulative effects of regionally important species, endangered species, and biodiversity. It also included the irreversible effects of permanent loss of habitat and permanent loss of species. The ability to restore biological habitat and wetlands or reduce the impact by the timing of the action was also evaluated.

Impact to air quality onsite, offsite, and regionally; and pollution prevention or mitigative measures were also considered.

The impact of the alternative on the safety of the surrounding community is evaluated. This includes not only disposal and storage of remediation waste but also the impact of transportation of remediation waste. Direct effects on water quality and water consumption are an important part of this criteria as well as airborne materials that could potentially impact public health.

2) Worker Safety - The health and safety of workers is evaluated. This includes all phases of the alternative from construction to all handling and operation to closure and surveillance.

3) Transportation - This includes all forms of transport associated with an alternative from any shipment of waste to the impacts that an alternative might have on existing traffic systems. Transportation had to be examined out of state also since the all of alternatives involve offsite shipment at some time..

4) Facility Design, Containment and Monitoring - This criterion was used to evaluate the design of each alternative in terms of implementability, efficiency safety, availability, and protectiveness. The ability of each alternative to effectively contain contaminants and the ability verify that containment through monitoring was also evaluated.

5) Institutional Controls - This criterion was used to evaluate institutional controls which limit human activities at or near the facility, protect health and environment, and assure continued effectiveness of the alternative.

6) Cost - The total cost of each alternative was evaluated, as were individual costs for design, site

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preparation, construction, operations, interim closure, and interim closure monitoring.

7) Community Acceptance - This criterion was used to evaluate the public sentiment concerning an alternative. It includes the general public as well as concerned local communities. This is a modifying criterion that will address public comments as part of the review

8) Short-Term Effectiveness - This is a gauge of the alternative's capability to support upcoming risk reduction efforts at the Site. These efforts are primarily early actions which could include hot-spot removal, tank removals, additional solar pond remediation, and PCB location remediation.

9) Long-Term Effectiveness and Permanence - This criterion was used to evaluate the ability to safely isolate, contain, and manage remediation waste with the passage of time. It also addressed the issues of long-term liability, particularly for alternatives whose ability to safely manage materials could be subject to change in the future.

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Appendix E

Descriptions of Remediation Waste Storage Facility Design Alternatives

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REMEDIATION WASTE STORAGE FACILITY (RWSF) DESIGN ALTERNATIVES

The alternative facility designs were all based on the need to accommodate 100,000 cubic yards (cy) of Low Level Mixed Waste (LLMW), Low Level (LL), or Hazardous Wastes (HW) in a storage facility. None of the designs considered were tailored to a specific location on RFETS site. In general, bulk waste placement requires the smallest land area when compared to containerized waste placement.

Attributes common to alternative designs:

- 100,000 cy waste capacity in retrievable, monitored, storage.
- Each design considered would place the waste above the present grade.
- Each design was considered to be capable of waste retrieval, although the ease (and cost) of retrievability varied significantly among the designs.
- Conceptual design sketches (Figures) and cost estimates (Tables) follow the description of each design.
- Any leachate collected would be treated at another facility, and was not costed here.
- Groundwater Monitoring wells would be installed both up gradient and down gradient of the facility and operated from start of construction through the end of post closure monitoring.
- Costs were escalated to reflect estimated actuals at the time of expenditure , based on DOE guidance documented in RFETS 1996 Budget Call Manual.
- Construction periods were assumed to be of one year duration for all alternatives.
- Operations costs were defined as those activities directly related to placement of (prepared) waste into each alternative facility.
- Treatment and handling systems are not expected to produce emissions sufficient to require additional permitting. Air monitoring will be conducted vial the existing Site monitoring system. Any additional air monitoring required for worker Health and Safety consideration will be monitored by the appropriate oversight organizations.

962

Above Grade Waste Cell

This RWSF is designed such that clean dirt (fill) would be used to construct the sides of the cell so that the entire facility would be above the present grade. The design is similar to a standard Subtitle "C" landfill in use throughout the United States. The whole cell is placed at a higher elevation to allow greater vertical separation between the bottom of the cell and the water table. The conceptual design cost estimate assumed that the remediation waste would be placed in the cell without containers (in bulk, compacted in place), however, some existing containerized waste could be placed. In addition, the placement of individual waste streams would be mapped and gridded to allow retrieval (by excavation) when desired.

- This waste cell design includes a double liner with leachate collection system. These features were used to develop the cost estimate and may change during detailed design (see Figures E-1 and E-2). Compliance with 6 CCR 1007-3 Part 264 Subpart N requirements is accomplished by the following provisions:

  — Interim cover system

  — Leachate collection layer consisting of one foot of drainage gravel

  — Primary liner would be composed of an 80 mil high density polyethylene (HDPE) geomembrane

  — Leak detection system includes a geocomposite, (e.g., A geonet with a geotextile on each side)

  — Secondary liner would include three feet of compacted clay, overlain by a 80 mil HDPE geomembrane

This cell design cost estimate was based on cell dimensions of 440 feet long, 360 feet wide, and 30 feet deep. Table E-1 presents the cost estimate summary. The cost estimate included a clean dirt cover installed over exposed waste at the close of daily placement operations to prevent wind dispersion of the waste.

The entire footprint including sideslopes cover approximately 9 acres.

Cell Support Facilities include a lay down area for cell construction materials.

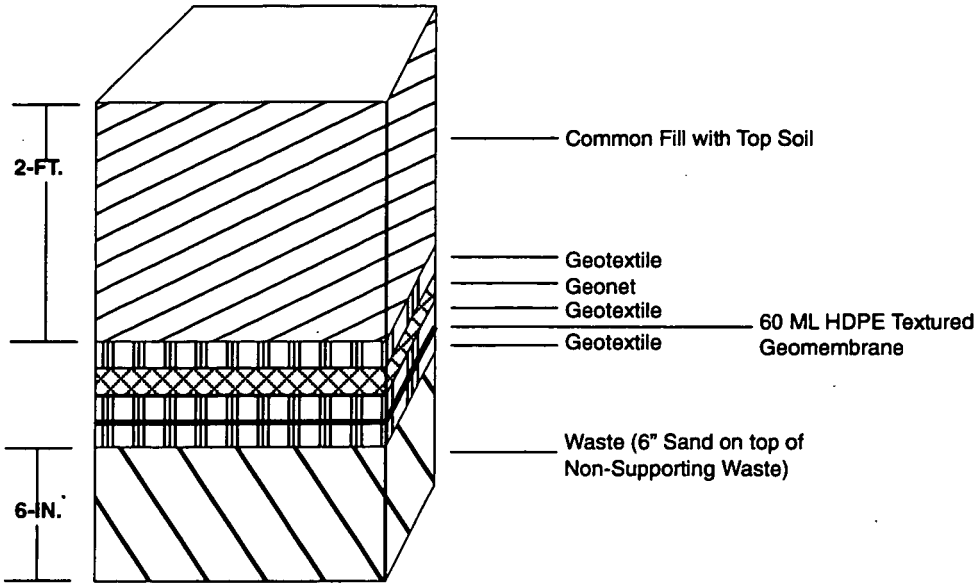
963

- Any leachate collected would be treated at another facility, and those costs were not included in this estimate.

- Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring.

964

INTERIM CELL COVER



CELL LINER

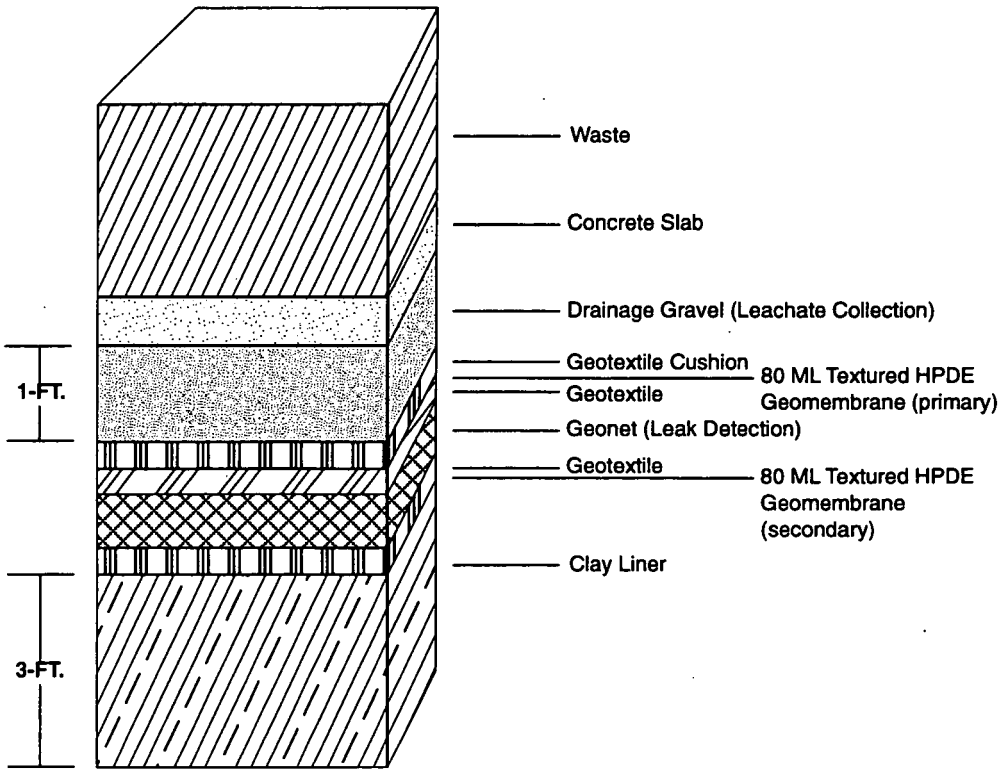


Figure E-1

ON-SITE FACILITY CROSS SECTION

965

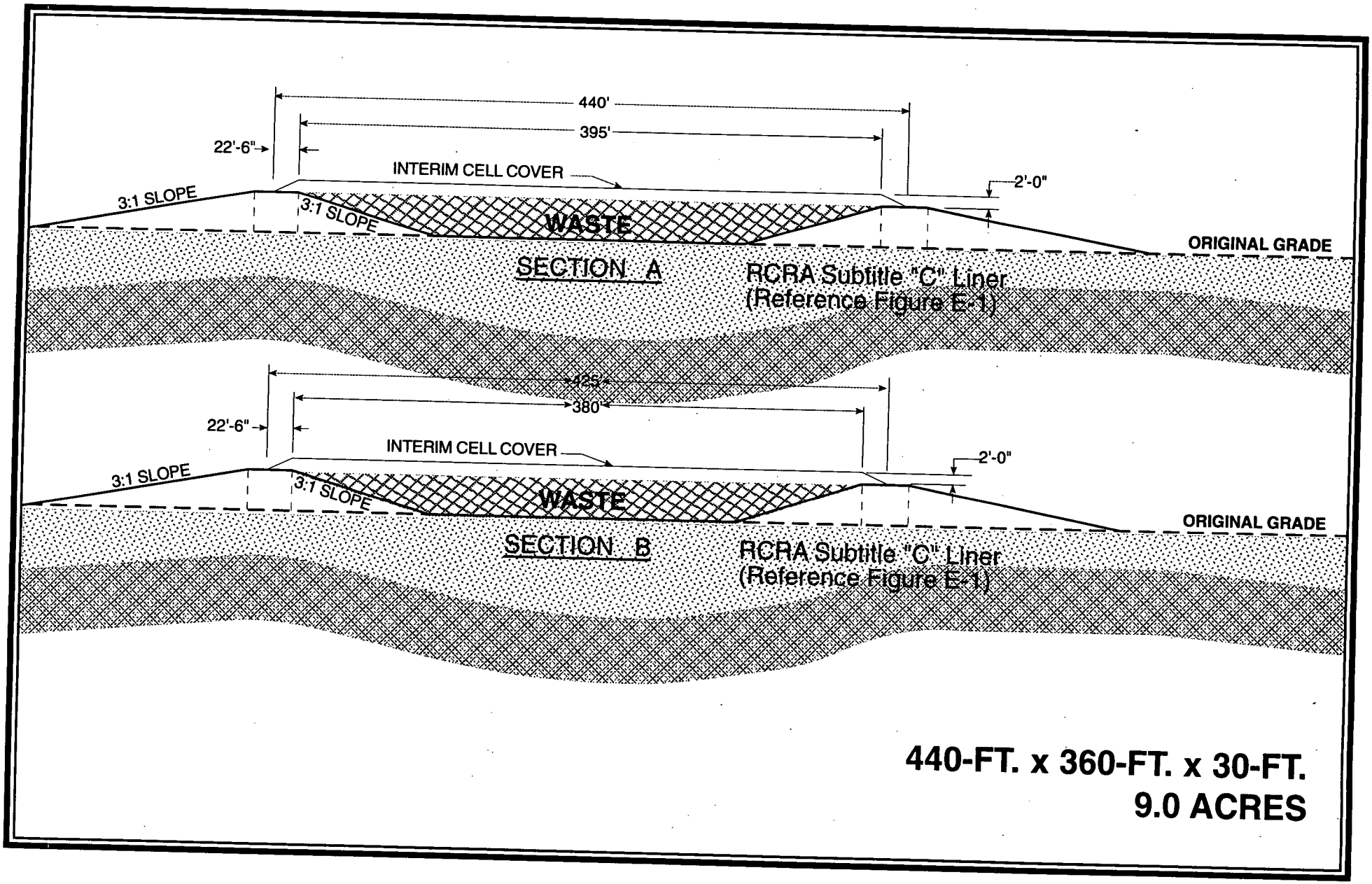


Figure E-2

CROSS-SECTION OF ABOVE-GRADE STORAGE CELL

966

TABLE E-1

Above-Grade Landfill

Task Description	Estimated Cost
Containers	$0
Packaging	$2,100,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$2,200,000
Permitting	$300,000
Pre-Construction	$400,000
Site Preparation	$8,800,000
Construction	$41,700,000
Operations	$9,000,000
Interim Cap Installation	$5,300,000
Interim Closure Care and Monitoring	$13,900,000
Off-Site Disposal	N/A
Contingency	$27,000,000
Total Life Cycle Costs	*$118,800,000*

Note: Costs escalated to expected year incurred.

967

Concrete Lined Cell, with Bulk Placement

This alternative design consists of three adjacent open top concrete cell(s) placed over a (RCRA Subtitle 'C' landfill) double liner and leachate collection system (see Figure E-3A). When the cell(s) are filled with remediation waste an interim cover is placed over the facility. The conceptual design cost estimate assumed that the remediation waste would be placed in the cell without containers (in bulk, compacted in place), however, some of the waste could be placed in containers, in addition, the placement of individual waste streams would be mapped to allow retrieval (by excavation) when desired. The individual cells are modular and would be constructed as needed over the liner to allow flexibility in sizing the facility.

The concept for the design was modified from the BNFL Drigg Facility in the United Kingdom. The following features were used to develop the cost estimate and may change during detailed design.

- This waste cell design includes an interim cover (see Figure E-1). The surface slope of the finished cover would be approximately 4%.

- This waste cell design also includes a double liner with leachate collection system (see Figure E-1). Compliance with 6 CCR 1007-3 Part 264 Subpart N requirements is accomplished by the following provisions:

  — Interim cover system

  — Self supporting open top concrete shell with reinforced concrete walls and floor slab. The wall design incorporates integral water stops and the floor design incorporates cast-in-place drain channels and sumps

  — Leachate collection layer consisting of one foot of drainage gravel

  — Primary liner would be composed of an 80 mil HDPE geomembrane

  — Leak detection system includes a geocomposite, (e.g. A geonet with a geotextile on each side)

  — Secondary liner would include three feet of compacted clay, overlain by a 80 mil HDPE geomembrane

- The Concrete Lined Cell facility conceptual design includes the following features which were included in the cost estimate (see Table E-2 for the cost estimate summary).

968

- Facility size of 500 feet long by 360 feet wide by approximately 14 feet deep
- The temporary storage facility long term footprint would be approximately four acres
- The entire footprint during construction and placement operations would be approximately 10 acres (Cell area + Lay down areas + Operations areas = 10 acres)
- No aisles or corridors
- Three open top concrete modules
- A lay down area for cell construction materials
- Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring
- Any leachate collected would be treated at another facility, and those costs were not included in the estimate

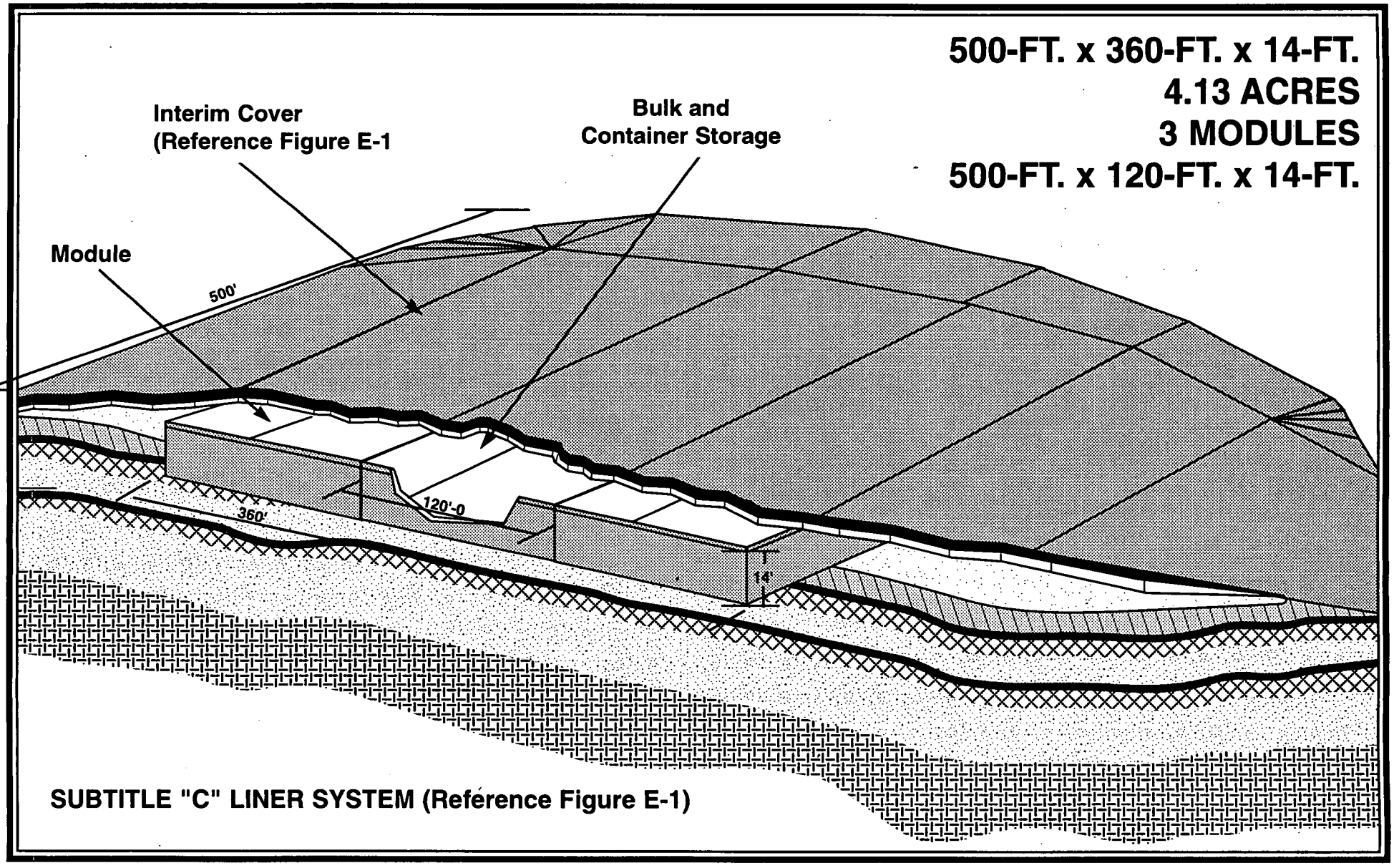


Figure E-3A

CONCRETE-LINED CELL WITH BULK WASTE PLACEMENT

970

TABLE E-2

Concrete Lined Cell with Bulk Waste Placement

Task Description	Estimated Cost
Containers	$0
Packaging	$2,100,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$1,600,000
Permitting	$300,000
Pre-Construction	$150,000
Site Preparation	$1,970,000
Construction	$18,600,000
Operations	$8,600,000
Interim Cap Installation	$5,300,000
Interim Closure Care and Monitoring	$13,000,000
Off-Site Disposal	N/A
Contingency	$17,600,000
Total Life Cycle Costs	*$77,320,000*

Note: Costs escalated to expected year incurred.

Concrete Lined Cell with Container Placement

This alternative design consists of three adjacent open top concrete cell(s) placed over a (RCRA Subtitle 'C' landfill) double liner and leachate collection system (see Figure E-3B). When the cell(s) are filled with remediation waste an interim cover is placed over the facility. All of the remediation waste would be placed in containers (Cargo containers) which would then be placed into the cells. This aspect is the only significant difference from the previously described option "Concrete Lined Cell with Bulk Placement". Individual waste streams would be recorded and mapped to allow retrieval (by excavation) when required. The individual cells are modular and would be constructed as needed over the liner providing flexibility in sizing the facility. The concept for the design was modified from the Drigg Facility in the United Kingdom.

The following features were used to develop the cost estimate and may change during detailed design.

- This waste cell design includes an interim cover (see Figure E-1). The surface slope of the finished cover would be approximately 4%.

- This waste cell design also includes a double liner with leachate collection system (see Figure E-1). Compliance with 6 CCR 1007-3 Part 264 Subpart N requirements is accomplished by the following provisions:

  — Interim cover system

  — Self supporting open top concrete shell with reinforced concrete walls and floor slab. The wall design incorporates integral water stops and the floor design incorporates cast-in-place drain channels and sumps.

  — Leachate collection layer consisting of one foot of drainage gravel

  — Primary liner would be composed of 80 mil HDPE geomembrane

  — Leak detection system includes a geocomposite (e.g,. A geonet with a geotextile on each side)

  — Secondary liner would include three feet of compacted clay, overlain by a 80 mil HDPE geomembrane

972

- The Concrete Lined Cell facility conceptual design includes the following features which were included in the cost estimate (see Table E-3 for the cost estimate summary).

  — Facility size of 405 feet wide by 500 feet long by approximately 14 feet deep

  — The waste cell facility long term footprint would be approximately 4.6 acres

  — The entire footprint during construction and placement operations would be approximately 10 acres (Cell area + Lay down areas + Operations areas = 10 acres)

  — No aisles or corridors

  — Three open top concrete modules

  — A lay down area for cell construction materials

  — Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring

  — Any leachate collected would be treated at another facility, and those costs were not included in the estimate

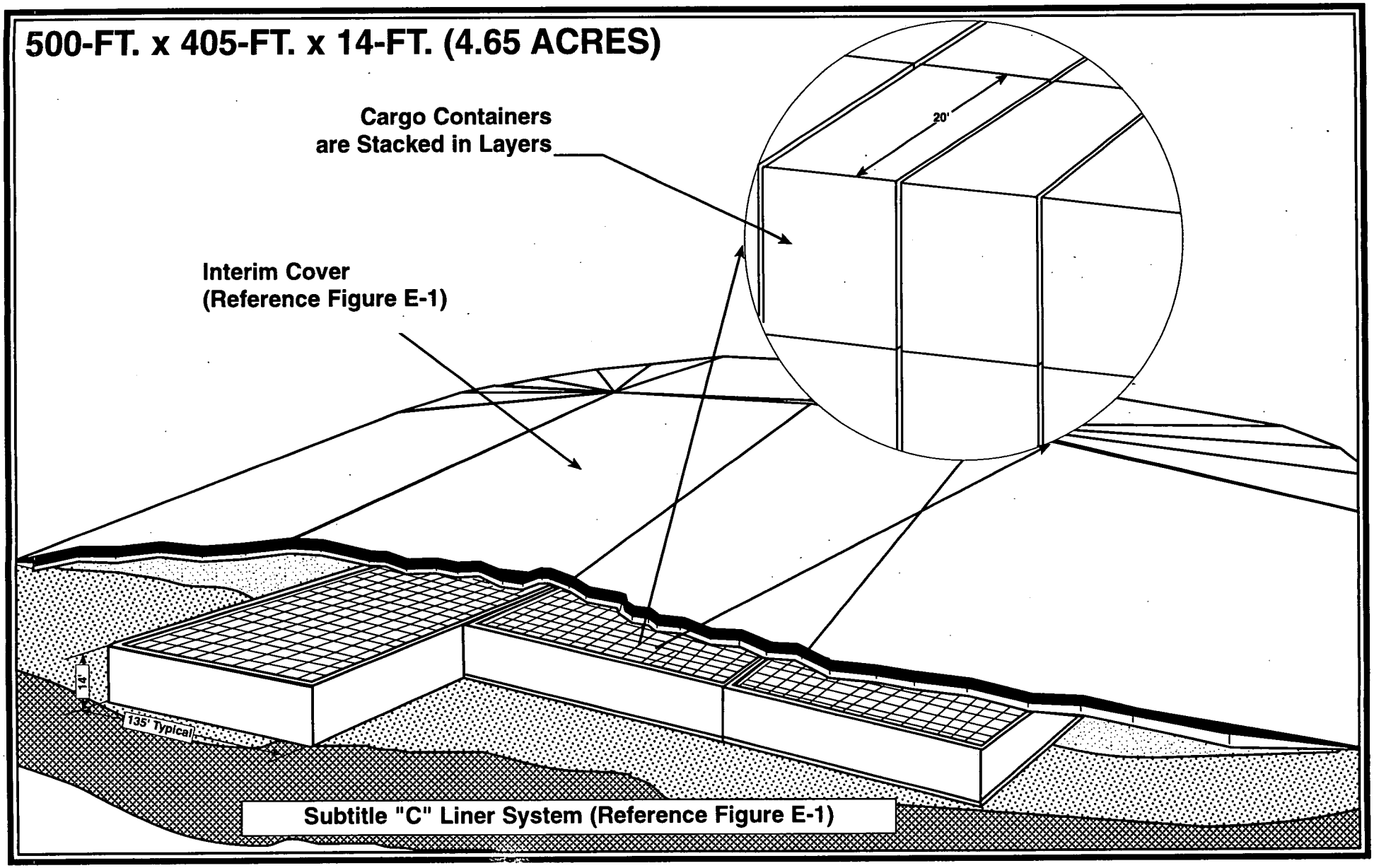


Figure E-3B

CONCRETE-LINED CELL IN CARGO CONTAINERS

974

TABLE E-3

Concrete Lined Cell with Cargo Containers

Task Description	Estimated Cost
Containers	$74,930,000
Packaging	$1,700,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$1,600,000
Permitting	$300,000
Pre-Construction	$150,000
Site Preparation	$1,970,000
Construction	$18,600,000
Operations	$4,900,000
Interim Cap Installation	$5,300,000
Interim Closure Care and Monitoring	$10,400,000
Off-Site Disposal	N/A
Contingency	$37,700,000
Total Life Cycle Costs	*$165,650,000*

Note:Costs escalated to expected year incurred.

975

HARDENED CONCRETE VAULT

This alternative design would place cargo containers, filled with remediation waste, within an above grade concrete structure (see Figure E-4). The structure would be designed as a self supporting, free standing, above grade, weatherproof structure. This structure would be constructed over a double liner and leachate collection system. The structure would consist of three modules (Vaults). Each module would contain a double row of cargo containers with an access aisle between the rows. The cargo containers would be stacked in the vault by forklifts from the access aisle. At the close of waste placement operations, each cell would be capped with a concrete roof, then the structures comprising the facility would be covered with an interim cover. This design enhances the monitoring capability during placement operations and retrievability after closure due to the open aisles and identified waste in individual containers. The concept for the design was modified from the "E"-Area Vaults from the DOE Savannah River Complex.

During the period of post closure monitoring (or later) access could be made into the vaults (by excavating through the interim cover) to inspect or retrieve the waste containers via the aisles which were left open , but isolated from the environment when the vaults were closed.

- The following features were used to develop the cost estimate (see Table E-4) and may change during detailed design.

  — Facility size would be approximately 560 feet long, 450 feet wide, and 14 feet high and consist of three modules

  — One module could be constructed each year, for three years, (subject to the rate of remediation waste generation)

  — Each module would consist of an 18 inch thick reinforced concrete slab floor, 12 inch thick reinforced concrete walls, and a 12 inch thick reinforced concrete roof

  — A 30 foot wide aisle or central corridor is planned in each module. These corridors would remain open during the life of the facility to allow routine monitoring and inspection

  — Waste would be placed into 20 cy cargo containers (5,000 containers, Total capacity 100,000 cy)

  — A double liner system and LCRS would be constructed similar to the CLC (see Figure E-1). This complies with requirements of 6 CCR 1007-3 Part 264 Subpart N.

976

- The waste cell facility long term footprint would be approximately six acres

- The entire footprint during construction and placement operations would be approximately 12 acres (Cell area + Lay down areas + Operations areas = 12 acres)

- Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring

- Any leachate collected would be treated at another facility, and those costs were not included in the estimate

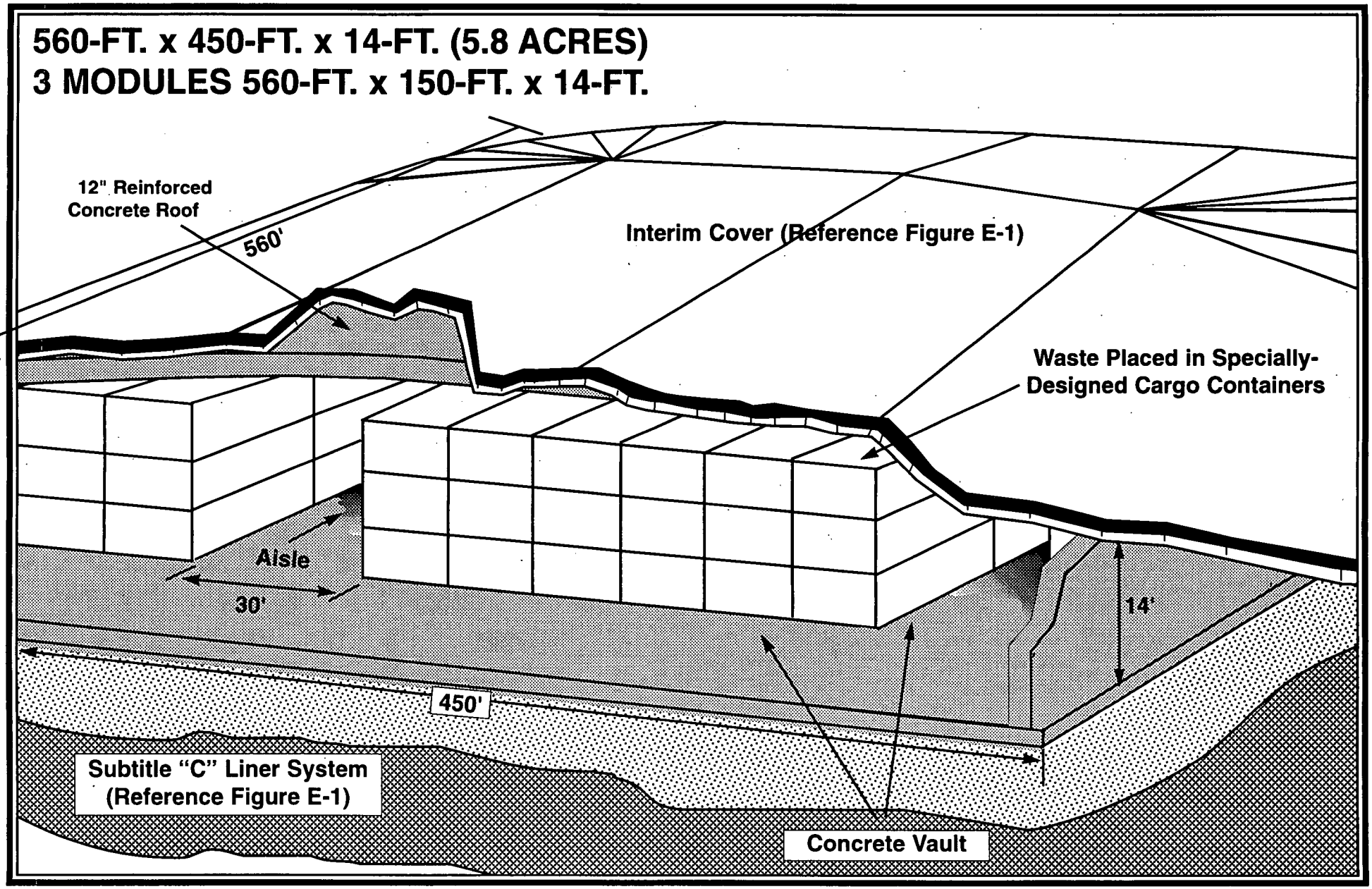


Figure E-4

HARDENED CONCRETE VAULT

978

TABLE E-4

Hardened Concrete Vault

Task Description	Estimated Cost
Containers	$74,930,000
Packaging	$1,700,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$2,200,000
Permitting	$300,000
Pre-Construction	$400,000
Site Preparation	$6,100,000
Construction	$26,000,000
Operations	$4,900,000
Interim Cap Installation	$5,300,000
Interim Closure Care and Monitoring	$10,400,000
Off-Site Disposal	N/A
Contingency	$41,300,000
Total Life Cycle Costs	*$181,630,000*

Note: Costs esalated to year incurred.

979

Silo Design

This alternative design consists of a series of 5,000 cy capacity open top concrete silos placed over a double liner and leachate collection system (see Figure E-5). When all of the silos are filled with remediation waste an interim cover is placed over the entire facility. Remediation waste would be placed in each silo in bulk (without containers) and compacted. When each silo is filled a structural concrete roof is constructed over the silo. Individual waste streams would be mapped and recorded to allow retrieval (by excavation) when desired. Individual silos would be constructed as needed to keep pace with remediation waste generation. This design alternative is based on a similar design described in EG&G- INEL *Interim Report: Waste Management Facilities Costs, Information for Mixed Low-Level Waste,* dated March 1994.

- The following features were used to develop the cost estimate (see Table E-5) and may change during the detailed design. This design complies with requirements of 6 CCR 1007-3 Part 264 Subpart N.

  — This waste cell design includes an interim cover (see Figure E-1)

  — The side slope of the finished cover would be approximately 12%

  — Leachate collection layer consisting of one foot of coarse sand

  — Primary liner would be composed of an 80 mil HDPE geomembrane

  — Leak detection system includes a geocomposite (e.g., A geonet with a geotextile on each side)

  — Secondary liner would include three feet of compacted clay, overlain by a 80 mil HDPE geomembrane

  — Facility size of 500 feet wide by 500 feet long by approximately 75 feet high

  — The waste cell facility long term footprint would be approximately six acres

— Self supporting open top reinforced concrete shell silos approximately 50 feet wide by 40 feet long by 70 feet high. Each silo to be constructed with 12 inch thick reinforced concrete walls and an 18 inch thick reinforced concrete slab floor. When filled with waste, a 12 inch thick structural concrete top would be constructed over each silo.

980

- Space between silos would be backfilled with clean sand or fill
- The entire footprint during construction and placement operations would be approximately 12 acres (Cell area + Lay down areas + Operations areas = 12 acres)
- Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring
- Any leachate collected would be treated at another facility, and those costs were not included in the estimate

981

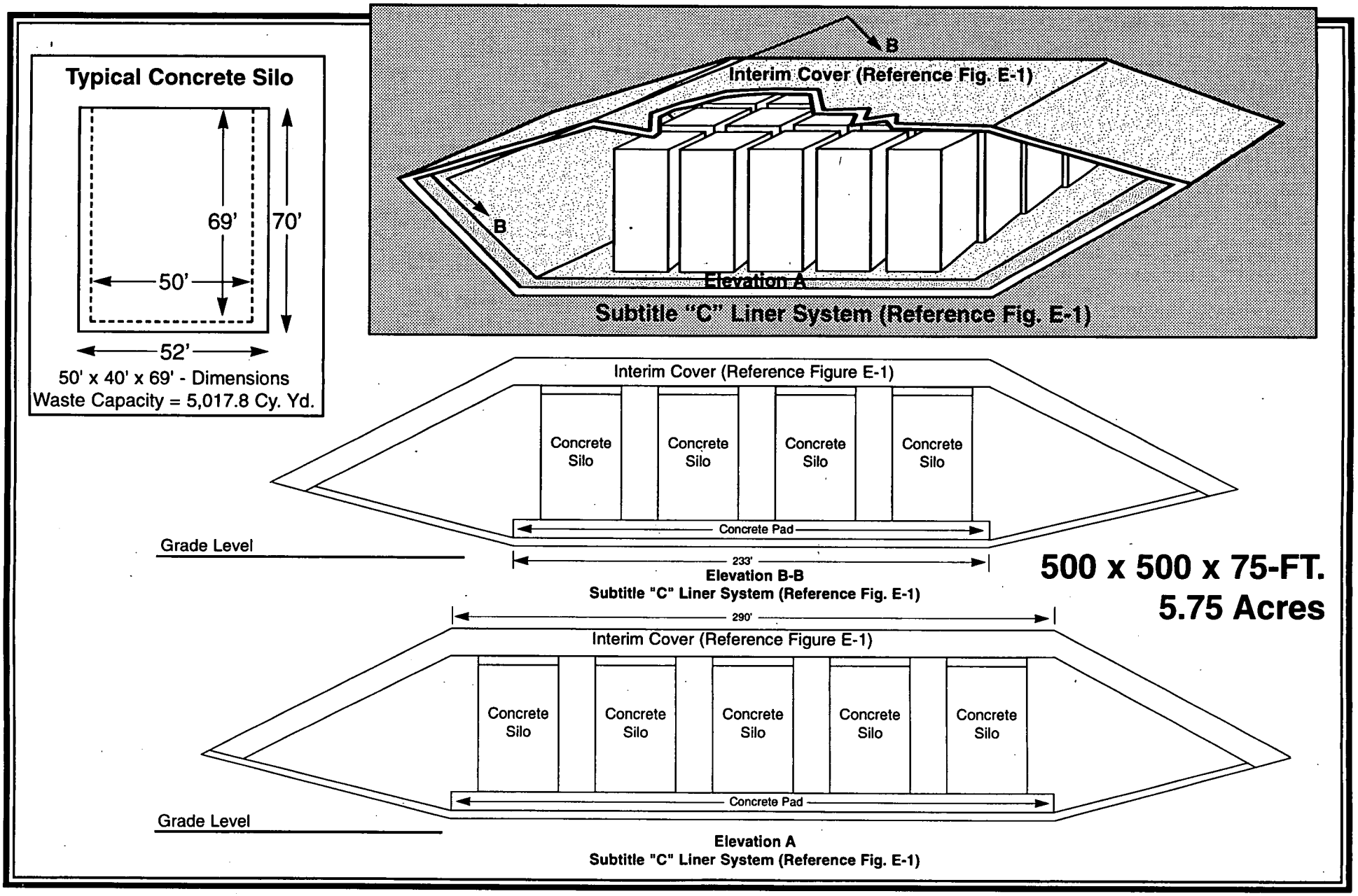


Figure E-5

SILO DESIGN

982

TABLE E-5

Silo Design

Task Description	Estimated Cost
Containers	$0
Packaging	$2,100,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$2,000,000
Permitting	$300,000
Pre-Construction	$400,000
Site Preparation	$6,100,000
Construction	$30,400,000
Operations	$14,300,000
Interim Cap Installation	$5,300,000
Interim Closure Care and Monitoring	$13,900,000
Off-Site Disposal	N/A
Contingency	$24,400,000
Total Life Cycle Costs	*$107,300,000*

Note: Costs escalated to year incurred.

SLAB on GRADE

This alternative design consists of 5,000, twenty cubic yard capacity, cargo containers filled with remediation waste placed outdoors on an above grade concrete slab (see Figure E-6). No liner or leachate collection system is incorporated into this design. A concrete berm around the perimeter of the slab and a sump to contain stormwater are integrated into the design. No roof or building enclosure would be placed over the cargo containers. The facility would have a design life of 30 years, at which time it was assumed that the waste would be transported to an off site facility for disposal. This concept is currently in use for storage of RCRA waste at RFETS.

- The following features were used to develop the cost estimate (see Table E-6) and could change during detailed design.
  - The waste would be placed in bulk into the 20 cy cargo containers
  - No double liner system of LCRS
  - Facility design life of 30 years
  - Requires 5,000 each 20 cy cargo containers, whose design life was assumed to be 30 years in outdoor storage
  - The footprint of the facility would be approximately 535 feet by 600 feet
  - The containers would be stacked three high and placed in double rows with a 5 foot aisle between the double rows
  - The slab with a perimeter stormwater curb would be constructed of reinforced concrete at the existing grade
  - The slab would be sloped to a central sump for storm water collection. For estimating purposes it was assumed that the storm water could be discharged without treatment.
  - Any costs associated with maintenance or replacement of the facility at the end of the design life were not included in this estimate
  - The site footprint during long term storage would be approximately 7 acres

— The entire footprint during construction and placement operations would be approximately 12 acres (Cell area + Lay down areas + Operations areas = 12 acres)

— Groundwater monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the life cycle (30 years).

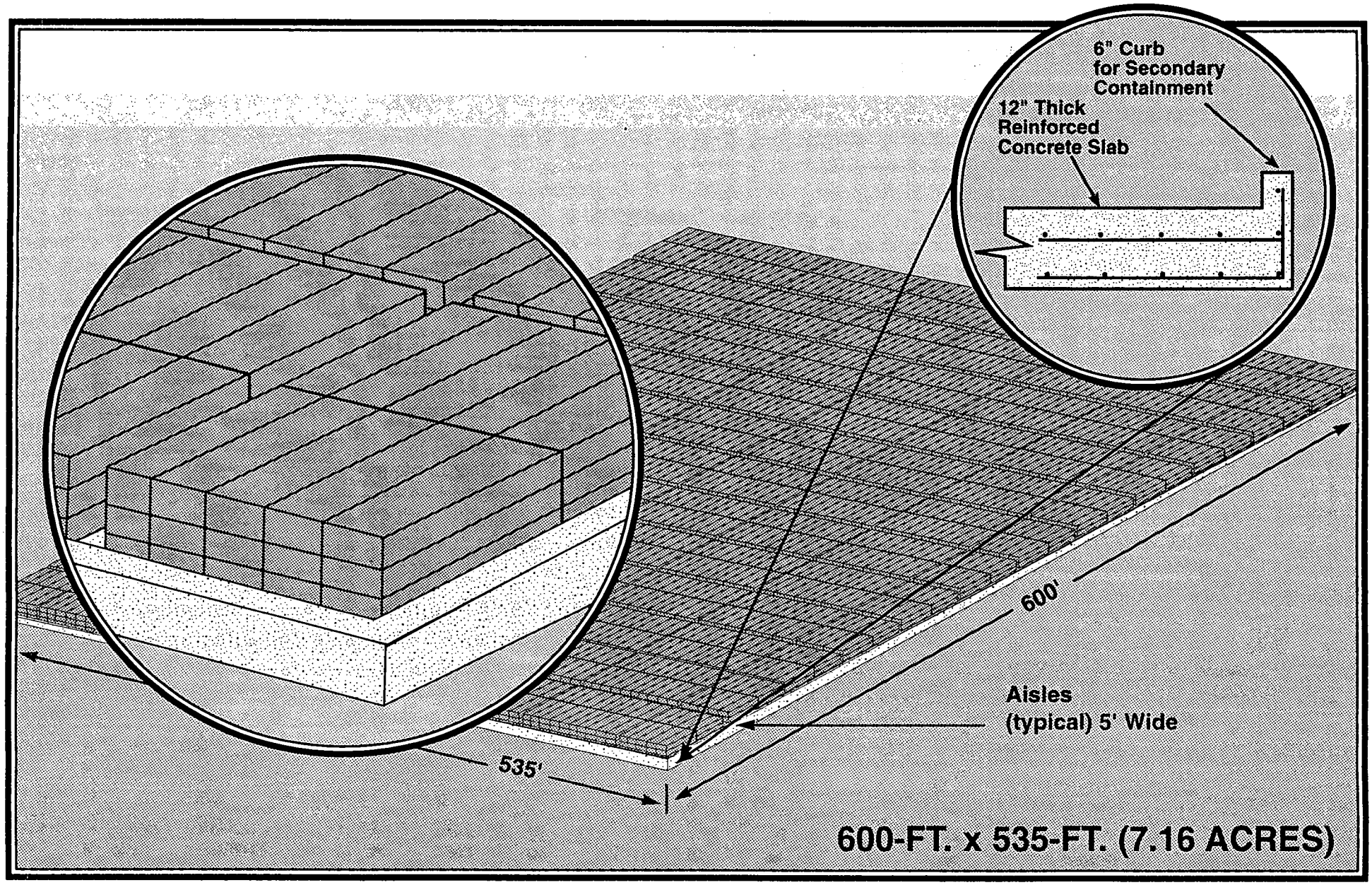


Figure E-6

SLAB ON GRADE

986

TABLE E-6

Slab on Grade

Task Description	Estimated Cost
Containers	$74,900,000
Packaging	$1,700,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$300,000
Permitting	$300,000
Pre-Construction	$200,000
Site Preparation	$6,100,000
Construction	$3,800,000
Operations	$5,500,000
Interim Cap Installation	N/A
Interim Closure Care and Monitoring	$8,500,000
Off-Site Disposal	N/A
Contingency	$32,200,000
Total Life Cycle Costs	*$141,600,000*

Note: Costs escalated to year incurred.

987

METAL BUILDINGS

This alternative design consists of 5,000, twenty cy capacity, cargo containers filled with remediation waste placed inside engineered metal buildings (see Figure E-7). This design alternative is very similar to the Slab-on-Grade design with the exception that in this design option, the cargo containers are sheltered from the weather, and that no storm water would be collected. The buildings would be constructed on a concrete slab. No liner or leachate collection system is incorporated into this design. The facility would have a design life of 30 years, at which time it was assumed that the waste would be transported to an off site facility for disposal. This concept is currently in use for storage of RCRA waste at RFETS.

- The following features were used to develop the cost estimate (see Table E-7) and could change during detailed design.
  - Four metal buildings, each 570 feet long by 130 feet wide by 20 feet high
  - One building would be constructed per year
  - Each building would be placed on a 12 inch thick concrete slab
  - 5,000 each 20 cy capacity cargo containers
  - The containers would be stacked three high in the buildings
  - Each building would retain one centralized corridor and access aisle for routine monitoring and inspection for the design life of the facility
  - 30 year design life of the facility
  - Large forklifts to move the cargo containers
  - Transportation of the waste to an off site disposal facility at the end of the design life
  - No double liner system for LCRS
  - Cost of maintaining or replacing this Remediation Waste Storage facility after the design life were not considered in this cost estimate

— Groundwater monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the life cycle (30 years).

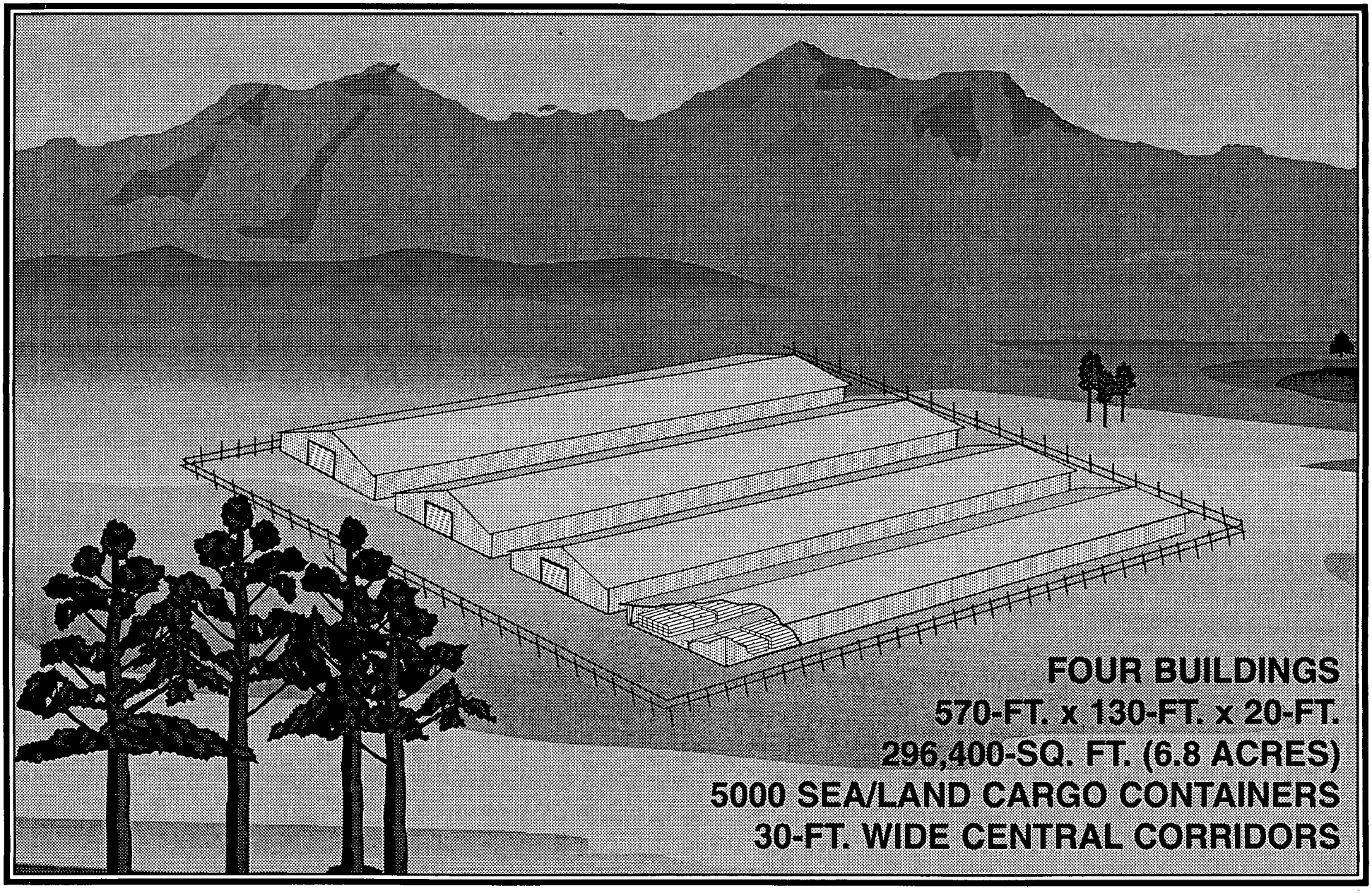


Figure E-7

METAL BUILDINGS

TABLE E-7

Metal Buildings

Task Description	Estimated Cost
Containers	$74,900,000
Packaging	$2,400,000
Characterization	$5,800,000
Transportation	$1,700,000
Design	$2,300,000
Permitting	$300,000
Pre-Construction	$1,300,000
Site Preparation	$2,800,000
Construction	$17,900,000
Operations	$4,900,000
Interim Cap Installation	N/A
Interim Closure Care and Monitoring	$10,400,000
Off-Site Disposal	N/A
Contingency	$36,700,000
Total Life Cycle Costs	*$161,400,000*

Note: Costs escalated to year incurred.

ENTOMBMENT

Essentially, in this alternative design concept, remediation waste is placed into 55 gallon steel drums. Eight steel drums are then placed into a large concrete canister (or concrete box) which is then filled with grout. The canisters are stored in a weatherproof hardened concrete vault. This design option is intended for long term retrievable storage (see Figure E-8). While meeting the definition of Monitorable Retrievable Storage , the actual waste, while highly retrievable would be less monitorable than several of the alternate designs. This design alternative is based on a similar design described in an EG&G-INEL *Interim Report: Waste Management Facilities Cost Information for Low Level Waste*, dated March 1994.

This design combines several concepts of some of the previous design alternatives, it is most similar to the hardened concrete vault design. The most significant difference is that each waste canister is entombed in concrete. The remediation waste is placed into 55 gallon steel drums. Eight drums are placed into a single larger canister (concrete box), which is then sealed by filling it with (cement) grout. The canisters are then placed into the storage facility which consists of a series of adjacent hardened concrete cells (vaults). The facility would be constructed over a double liner and leachate collection system. The facility itself would consist of rows of concrete cells having an access aisle between the rows. The canisters are placed into the open topped concrete cells, and stacked three high. When a cell is filled with canisters the void spaces in the cell (between the canisters and cell walls), are backfilled with sand and then a concrete cover is constructed on the top of the cell thereby closing the cell. When the cells have been covered with concrete, an interim cover is constructed over the entire facility.

- The following features were used to develop the cost estimate (see Table E-8) and could change during detailed design. This design option complies with 6 CCR 1007-3 Part 264 Subpart N Requirements.

  — This waste cell design includes an interim cover (see Figure E-1)

  — A leachate collection layer consisting of one foot of coarse sand

  — The primary liner would be composed of an 80 mil HDPE geomembrane

  — The leak detection system includes a geocomposite (e.g., A geonet with a geotextile on each side)

  — Secondary liner would include three feet of compacted clay, overlain by a 80 mil HDPE geomembrane

992

- Each cell floor would be reinforced concrete
- The canisters would be stacked three high in the cells with each canister holding 8 drums
- Each cell would have one adjacent aisle for routine monitoring and inspection
- 1,000 year design life of the facility
- Groundwater Monitoring wells (3 each) will be installed both up gradient and down gradient and will be operated from start of construction through the end of post closure monitoring
- Any leachate collected would be treated at another facility, and those costs were not included in the estimate

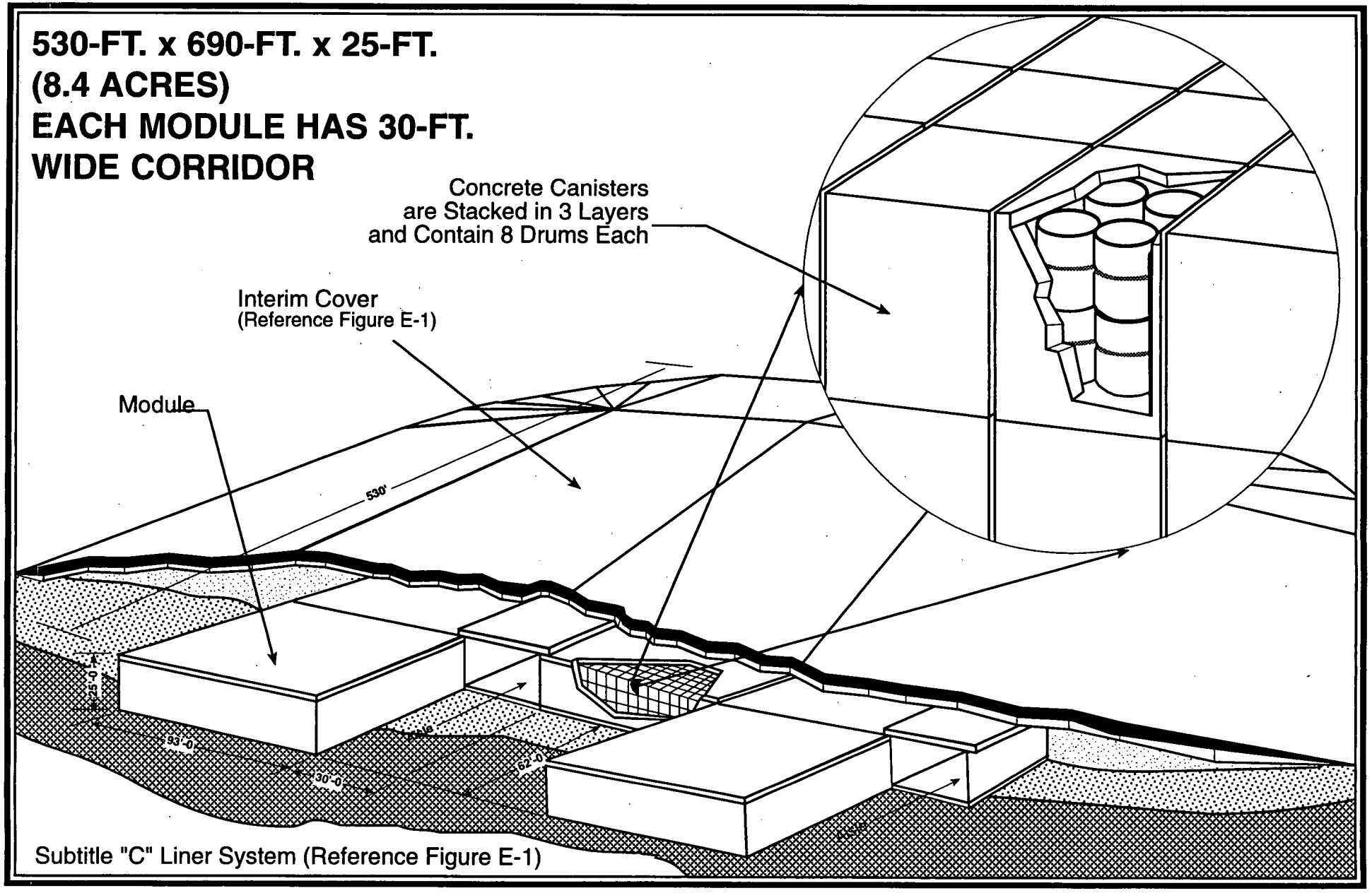


Figure E-8

ENTOMBMENT

994

TABLE E-8

Entombment

Task Description	Estimated Cost
Total Cost	$525,000,000
Total Life Cycle Costs	*$525,000,000*

Note: Based on Idaho National Engineering Laboratory report, "Waste Management Fa
Cost Information for Mixed Low Level Waste", dated March 1994.

995

PYRAMID DESIGN

This alternative design concept is to construct a pyramid around compacted remediation waste in bulk (see Figure E-9). The base/floor of the pyramid would have a rectangular footprint and constructed to be a structurally sound base of slab-on-grade reinforced concrete and quarried stone. The structure/facility would be built in a series of compacted lifts of remediation waste with a "ring" of quarried stone blocks forming the perimeter. The length of the perimeter would decrease as the height increased. It is believed that the quarried stone blocks would not exclude all stormwater over time. Sealant would be used between the quarried stone blocks to prevent stormwater from infiltrating the compacted waste. This design alternative was described and estimated as a result of input from the Citizens Advisory Board.

It was perceived that the ease of monitoring a selected remediation waste would be among the lowest of the options considered. In addition, the structural integrity of the facility would be provided by the compacted waste itself. The quarried stone blocks, due to their large size, would be extremely expensive to procure, transport, and install. Due to the limited mass of stone relative to the mass of compacted waste, the quarried stone blocks themselves would contribute little to the overall integrity of the facility. A sealant placed between the blocks would be expected to fail when differential settling of the waste occurred, allowing stormwater to enter the waste. Because the engineering properties of the remediation waste (if any) have yet to be defined, it is not clear if the compacted waste would support the quarried stone blocks. Imposing strict physical structural requirements upon the waste to be placed into the pyramid in order to achieve the necessary structural integrity for the intended purpose could exclude significant quantities of remediation waste from this facility or that the waste be treated to a defined strength requirement at additional cost.

For these reasons the pyramid design was discarded after initial cost estimates (see Table E-9) were prepared.

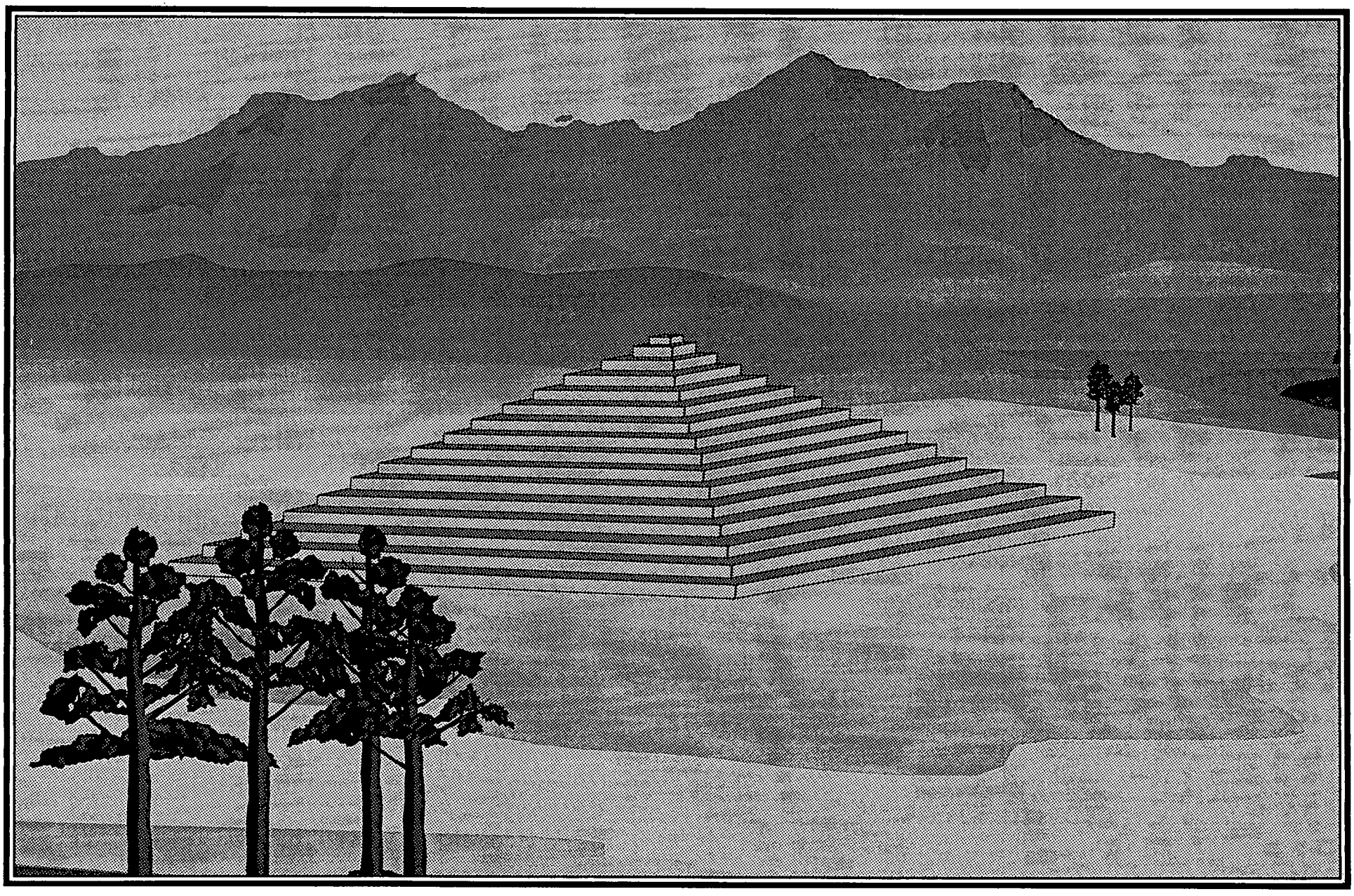


Figure E-9

PYRAMID

997

TABLE E-9

Pyramid Design

Task Description	Estimated Cost
Containers	$0
Packaging	$2,100,000
Characterization	$5,800,000
Transportation	$2,300,000
Design	$2,200,000
Permitting	$300,000
Pre-Construction	$400,000
Site Preparation	$14,500,000
Construction	$57,900,000
Operations	$9,000,000
Interim Cap Installation	N/A
Interim Closure Care and Monitoring	$13,900,000
Off-Site Disposal	N/A
Contingency	$31,900,000
Total Life Cycle Costs	*$140,300,000*

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Waste Pile

This alternative design concept was patterned after the Waste Pile constructed in 1988 at the Rocky Mountain Arsenal. The design was developed and implemented to isolate Basin F hazardous soils and sludges from the environment pending selection of a treatment method and a disposal site. In this concept wastes-in-bulk are compacted into a rectangular pile, covered with a geomembrane , (bottom, sides, and top) and dirt which is vegetated with native grasses (see Figure E-10). No special embankments, pits, buildings, or berms are employed. As the pile is constructed of compacted waste, the waste is covered (daily) with a plastic membrane to prevent the spread of contamination. When complete the pile is sealed within a geomembrane. The geomembrane would be covered with fill dirt and vegetated with native grasses. This alternative would provide 30 year monitored retrievable storage of remediation waste pending agreement by the public, the regulators, and the DOE as to disposition. See Table E-10 for a conceptual cost estimate.

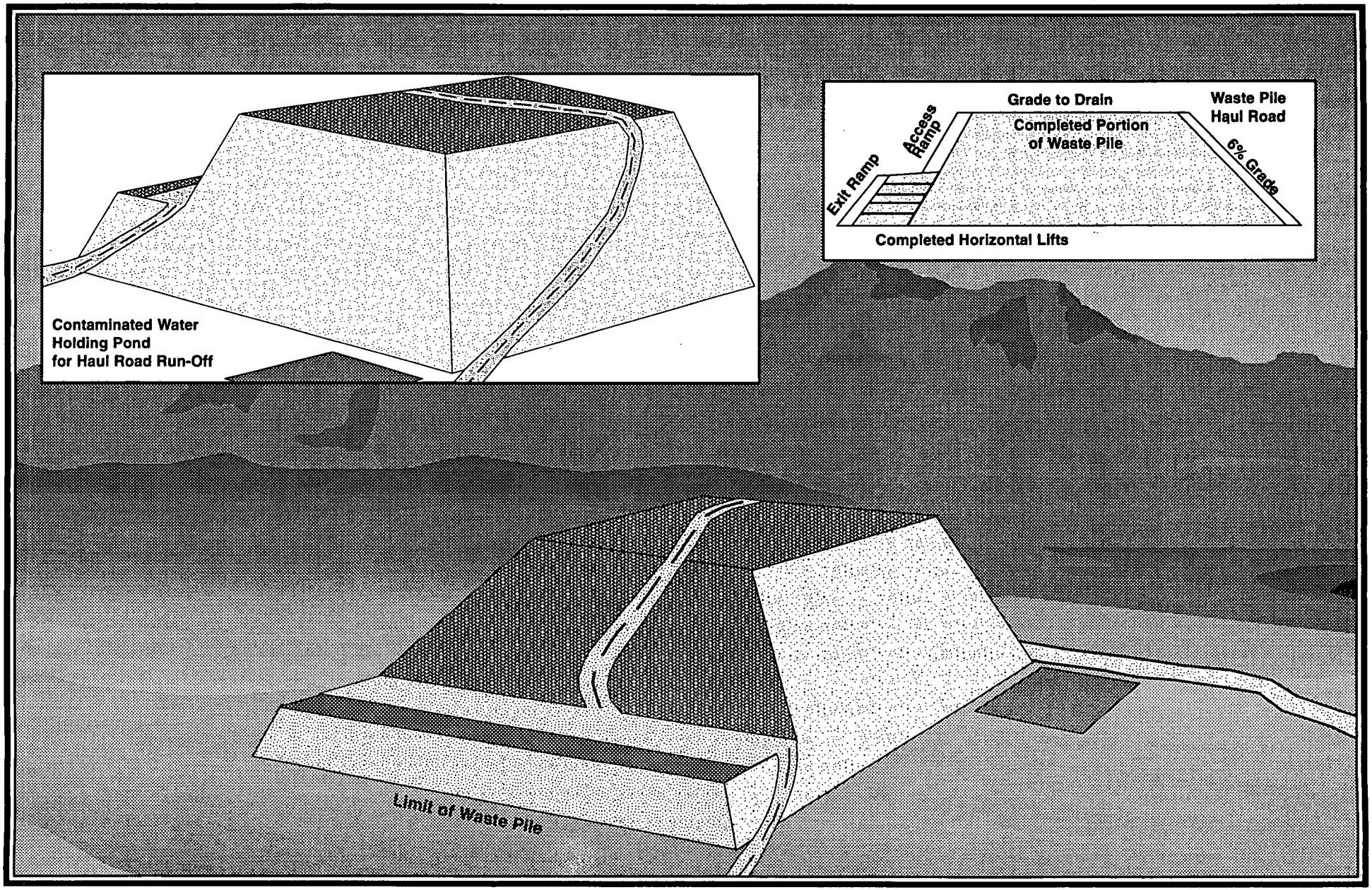

Figure E-10
WASTE PILE

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TABLE E-10

WASTE PILE

Task Description	Estimated Cost
Actual Costs (Escalated 1988 to 1996)	$36,669,000
Off-Site Disposal	N/A
Total Life Cycle Costs	*$36,669,000*

Note: Costs escalated to year incurred.

NO ACTION

The "No Action" alternative is included in this listing of design options to fulfill the requirements of both NEPA and CERCLA regulations. Both require that the "No Action" option continues to be considered through the end of the decision making process.

The Proposed Action is an onsite facility

The proposed action is to permit and construct an onsite storage facility to contain remediation waste(s) generated as part of the cleanup and closure activities at RFETS. This facility would be designed and permitted as a CAMU, a storage facility to isolate the wastes from the environment in a retrievable fashion. This facility would be designed to meet RCRA Subtitle "C" Landfill facility requirements. Permitted storage under a CAMU permit would allow the waste to remain non-Land Disposal Requirements (LDR) compliant for the period of storage. This storage would allow an indefinite period of time for the general public, the DOE and the CDPHE to determine and agree upon the ultimate fate (disposal) of the wastes via a Record of Decision (ROD). One of the disposal options which could be considered during this time period could be the permitting of the Remediation Waste Storage Facility as a permanent CAMU storage facility.

The No Action alternative is to ship remediation waste off site as soon as it is produced

The NO ACTION option is to package and ship all remediation waste generated as part of the cleanup and closure activities to an off site disposal facility, as a permitted onsite hazardous, LLW, or LLMW disposal facility does not exist. This option requires that all waste meet Department of Transportation regulations for Interstate shipment of hazardous, radioactive, and mixed waste before it leaves the Site. This option also requires that all remediation wastes generated meet LDR's prior to disposal. See Table E-11 for the conceptual cost estimate summary.

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TABLE E-11

NO ACTION

(Offsite disposal concurrent with generation)

Task Description	Estimated Cost
Containers	$4,600,000
Packaging	$2,900,000
Treatment/Characterization	$78,400,000
Transportation	$7,600,000
Design	N/A
Permitting	N/A
Pre-Construction	N/A
Site Preparation	N/A
Construction	N/A
Operations	N/A
Closure (Cap Installation)	N/A
Interim Closure Care and Monitoring	N/A
Off-Site Disposal (years 1997,8,9)	$73,300,000
*Contingency **	$49,100,000
Total Life Cycle Costs	*$215,900,000*

Note: (1) costs escalated to year incurred.

(*) Contingency not included in cost summary shown on Figure B-2 of Appendix B.

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Appendix F

Backup for Facility Design Screen

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Appendix F - Backup for Facility Design Screen

This appendix provides details of the facility design screen for each of the major criteria. This appendix backs up information provided in Table 6-1. Specific criteria have been referenced in parentheses (e.g., [C #.#]). Additional information on specific criteria can be found in Section 5 and Appendix D.

F.1 ABOVEGRADE STORAGE CELL

Description:

This facility is similar in construction to a typical waste management cell except that fill would be used to build up the sides of the cell so it could be placed abovegrade. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

Many of the features of the abovegrade storage cell support a CAMU designation. The facility would have a double liner, a leachate collection system, and an impermeable cap to ensure that releases do not occur (C 1.4). The facility could well support the timing of remedial activities since it is a simple and proficient design and remediation waste can be placed in the facility without as much additional processing (C 1.5). Because waste could be placed in bulk, remediation waste could go from treatment or excavation directly into the cell. This could both expedite accelerated actions as well as reduce the cost by eliminating the need for a remediation waste staging area. Construction and of the facility could be expedient because the design is simple and the technology is readily available and well known.

Public Protection (Geotechnical and Hydrological Criteria)

The abovegrade storage cell has many of the advantages of other designs including double liners and a shallow slope around the edge of the structure to protect against erosion (C 2.1, 2.3). The double liner system and abovegrade design would isolate the facility from the substrate and ground water (C 2.3, 2.10, 2.12). The impermeable cap could have an impact on surface water drainage and groundwater infiltration since water will be diverted to the edges of the cap (C 2.11).

Site Special Issues:

The abovegrade storage cell would require a larger footprint than many other designs because of the

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additional space required to construct the embankment around the facility. To ensure slope stability, the embankment would be at a five to one slope. This would impact the ability to collocate other waste facilities next to this facility (C 3.9) and could impact some additional utilities (C 3.2). Other than space considerations, it would support the Site Vision well because the storage cell cap could be tied into the cap planned for the Industrial Area of the Site (C 3.1).

Cost Criteria:

The Cost of Construction (C 4.1) was calculated as follows:

Design	$2,200,000
Pre-Construction	$400,000
Construction	$41,700,000
Total Cost of Construction	$44,300,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$8,800,000

The Cost of Interim Closure (C 4.3) was calculated as follows:

Interim Cover	$5,300,000
Interim Care And Monitoring	$13,900,000
Total Cost of Interim Closure	$19,200,000

The above costs were combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$118,800,000

The cost of construction would be high because of the cost of fill material that would be used to build up the embankments and because of all of the earthwork that would be required to place that fill (C 4.1). The low total life cycle cost (C 4.4) would be the result of onsite management in bulk form and potentially low interim closure costs (C 4.3).

Regulatory Support:

In terms of the regulatory support criteria, this facility would not have a lot of future applicability or utility outside of its use to manage bulk waste (C 5.4). For any use, only low level waste would be put in this type of facility (C 5.5). Also, this design is more the current standard than it is state of the art (C 5.3) although the liner and the cap have the potential to be a state of the art design.

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Other Stakeholder Concerns:

This would be one of the simpler facilities to design and construct (C 6.10). The needed materials, services and technologies would be readily available (C 6.12, 6.13). In terms of schedule requirements, this facility could be both expediently constructed and expediently operated (C 6.11) because:

- The design is simple
- The materials are easy to obtain
- The waste can be placed directly into the facility in bulk
- The technology is well known

F.2 CONCRETE LINED CELL WITH BULK PLACEMENT

Description:

Bulk waste would be placed in modular concrete cells. A double liner and a leachate collection system would be under the facility. Upon filling the cells an impermeable cap would placed above them. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

The concrete walls and floors provide an additional barrier of protection to prevent leakage (C 1.4). This design supports the timing of remedial activities in a number of ways (C 1.5). Waste would be placed in bulk, so remediation waste could go from treatment or excavation directly into the cell. This could both expedite accelerated action as well as reduce the cost by eliminating the need for a remediation waste staging area. Construction of the facility would be expedient because the design is simple and the technology is readily available and well known. The modular design allows use after filling of the cells while other are under construction so the facility could start accepting waste prior to the completion of construction.

Public Protection (Geotechnical and Hydrological Criteria) :

The combination of abovegrade design and a double liner barrier will provide reasonable assurances that groundwater and subsurface soils are protected (C 2.1, 2.5, 2.10). Structurally, the concrete walls could provide additional structural stability (C 2.3). Drainage and infiltration could be impacted by the impermeable cover (C 2.11). Geomorphic effects will be minimized by maintaining a gentle slope and by forcing the design to accommodate surface features and the existing drainage patterns (C 2.2, 2.11).

Site Special Issues:

This option has a smaller footprint than some designs although it is slightly larger than the hardened concrete vault. This design well supports Site Vision objectives (C 3.1) since the facility could be part of a continuous cap planned for the Industrial Area and the smaller size of the facility means less total space for managing waste. The modular design should facilitate the placement of similar structures near this facility since walls of the unit could be shared with new modules allowing additional units to be placed right beside existing ones (C 3.9). The use of modules in this design will also enhance the ability of the facility to accept a variety of remediation waste types including Decontamination and Decommissioning waste (C 3.6).

Cost Criteria:

The Cost of Construction (C 4.1) was calculated as follows:

Design	$1,600,000
Pre-Construction	$150,000
Construction	$18,600,000
Total Cost of Construction	$20,350,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$1,970,000

The Cost of Interim Closure (C 4.3) was calculated as follows:

Interim Cover	$5,300,000
Interim Care And Monitoring	$13,000,000
Total Cost of Interim Closure	$18,300,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$77,320,000

Low construction, site preparation, and closure costs (C 4.1, 4.2, 4.3) plus cost savings resulting from bulk storage of the waste would give the lowest total life cycle costs (C 4.4).

Regulatory Support:

This facility design would offer a greater degree of applicability and utility than many of the other designs and is permitable (C 5.3, 5.4). It is a state of the art design (C 5.3) used in Europe for similar applications. Only low-level waste is currently planned for this type of facility design (C 5.5).

Other Stakeholder Concerns:

The modular concrete lined cell allows for a variety of materials to be placed into the facility while still maintaining the ability to retrieve the waste (C 6.6). This facility would offer long-term effectiveness and permanence since it has additional barriers between the waste and the environment (C 6.7, 6.9). The demonstrated performance is better known since this design adds the additional protection of concrete to a storage cell type cap and liner system (C 6.9). Because of the concrete work, this design is expect to be more work intensive in terms of construction but less intensive in terms of operation since it will be a bulk facility (C 6.10). Because the waste could be placed in bulk, it could go directly into the facility after treatment or excavation. Materials, services, and the

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technology would be readily available (C 6.12, 6.13).

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F.3 CONCRETE LINED CELL IN CARGO CONTAINERS

Description:

Waste would be put into cargo containers and then placed in modular concrete cells. A double liner and a leachate collection system would be under the facility. Upon filling the cells an impermeable cap would placed above them. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

The concrete walls and floors provide an additional barrier of protection to prevent leakage (C 1.4). Construction and of the facility could be expedient because the design is simple and the technology is readily available and well known (C 1.5). The modular design allows use after filling of the cells while other are under construction so the facility could start accepting waste prior to the completion of construction.

Public Protection (Geotechnical and Hydrological Criteria):

The cargo containers themselves could provide some structural support ad well as providing an additional barrier to prevent leaking (C 2.3). Further protection of groundwater and the subsurface strata is provided by the concrete base (C 2.5, 2.11, 2.12). Drainage and erosion could be controlled by maintaining a shallow slope and by adjusting the design to account for existing drainage; however the impermeable cover would still have some impact (C 2.10).

Site Special Issues:

This option has a smaller footprint than some designs although it is slightly larger than the hardened concrete vault. This design well supports Site Vision objectives (C 3.1) since the facility could be part of a continuous cap planned for the Industrial Area and the smaller size of the facility would mean less total space for managing waste. The modular design would facilitate the placement of similar structures near the facility since walls of the unit could be shared with new modules allowing additional units to be placed right beside existing ones (C 3.9). The use of modules in this design will also enhance the ability of the facility to accept a variety of remediation waste types including Decontamination and Decommissioning waste (C 3.6).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	$1,600,000
Pre-Construction	$150,000
Construction	$18,600,000
Total Cost of Construction	$20,350,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$1,970,000

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	$5,300,000
Interim Care And Monitoring	$10,400,000
Total Cost of Interim Closure	$15,700,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$165,650,000

Low construction costs (C 4.1) would offset the cost for containers to yield a relative low total life-cycle cost (C 4.4).

Regulatory Support:

This facility design would offer a greater degree of applicability and utility than many of the other designs and is permitable (C 5.3, 5.4). It is a state of the art design (C 5.3) used in Europe for similar applications. Only low-level waste is currently planned for this type of facility design (C 5.5).

Other Stakeholder Concerns:

The use of containers better supports retrievability since the waste will be segregated, accessible and easier to inspect and remove (C 6.1, 6.2). As with the concrete lined call with bulk management, it compares favorably to the other designs in terms of useful life, effectiveness, demonstrated performance, and the availability of the technology, services and materials (C 6.7, 6.9, 6.12, 6.13). It will take additional time to construct than some of the other abovegrade designs due to all of the concrete work (C 6.10, 6.11). Operations will be slightly more intensive than the concrete lined bulk facility due to the use of containers (C 6.10, 6.11).

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F.4 HARDENED CONCRETE VAULT

Description:

Remediation waste inside cargo containers would be stored in a modular, abovegrade, self-supporting concrete structure placed over a double liner and leachate collection system. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

This design has additional features that enhance its protectiveness including additional barriers provided by concrete walls and floors and the containers (C 1.1). The waste would be very accessible since aisle ways would be present and containers could be removed and visually inspected for leaks. The modular design would allow use of one module prior to completion of the facility. This would allow use of the facility to be available sooner (C 1.5).

Public Protection (Geotechnical and Hydrological Criteria):

Concrete walls and floor could provide some additional structural support. Impermeable cap could impact drainage and infiltration patterns (C 2.11).

Site Special Issues:

The footprint for the hardened concrete vault would not be as large as many of the other designs considered. It would be easier to place additional facilities next to this facility because of its smaller foot print and concrete walls (C 3.9). One drawback would be that it could take a little longer to design and build and the filling of the facility is more work intensive and would take resources always from other Site closure activities (C 3.1). It would take longer to fill each vault which could also cause scheduling problems.

Cost Criteria:

The Cost of Construction (C 4.1) was calculated as follows:

Design	$2,200,000
Pre-Construction	$400,000
Construction	$26,000,000
Total Cost of Construction	$28,600,000

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The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$6,100,000

The Cost of Interim Closure (C 4.3) was calculated as follows:

Interim Cover	$5,300,000
Interim Care And Monitoring	$10,400,000
Total Cost of Interim Closure	$15,700,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$181,630,000

In spite of high site preparation costs (C 4.2), moderately high closure costs (C 4.3) and the cost for containers, the life-cycle cost would compare favorable with the other designs considered (C 4.4).

Regulatory Support:

This design could have utilized for other applications including management of other waste types because there would be access aisles and it would be designed to hold cargo containers which could be used for other materials as well (C 5.4), although this design is only being considered for low-level waste (C 5.5). It is a state of the art design C 5.3).

Other Stakeholder Concerns:

This facility offers a high degree of monitorability and retrievability (C 6.1, 6.2) because there would be aisles for access, the waste would be in containers, and the modular design would enhance the ability to segregate and track the waste. In terms of construction and operation, this design would be more intensive (C 6.10) since additional effort would be required to construct the concrete vaults walls. During operations additional effort would be needed in containerizing the waste. The materials, services, or the technology needed to construct and operate this facility would be readily available (C 6.12, 6.13).

F.5 SILO DESIGN

Description:

Concrete silos would be placed over a double composite liner system and leachate collection system. Remediation waste would be placed in the silos in bulk Upon completion of filling operations, the entire facility would be covered with an interim cap. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

The concrete silos, double liner and leachate collection system enhance the protectiveness of this design (C 1.1). Bulk placement in the silos would be easy to place but inspection would be limited.

Public Protection (Geotechnical and Hydrological Criteria):

Interim cap could impact drainage and infiltration patterns (C 2.11)

Site Special Issues:

The interim cap and small footprint would tie in well into the planned cap for the Industrial Area Cap as part of the Site Vision (C 3.1).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	$2,000,000
Pre-Construction	$400,000
Construction	$30,400,000
Total Cost of Construction	$32,800,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$6,100,000

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	$5,300,000
Interim Care And Monitoring	$13,900,000
Total Cost of Interim Closure	$19,200,000

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The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$107,300,000

Middle of the range construction costs (C 4.1) and low closure costs (C 4.3) combined cost savings from with bulk storage yielded a low life-cycle cost of the facility design alternatives (C 4.4).

Regulatory Support:

This design meets some of the state principles. It is a state of the art design (C 5.3) and it is design to be permitted under RCRA; however its future use would be limited since the design is geared towards the bulk management of low-level soils (C 5.4, 5.5).

Other Stakeholder Concerns:

This design is not in wide use and so the performance and useful life is not as established (C 6.7, 6.9, 6.12). The intensive nature of this design would be very demanding in terms of design and construction and would probably take longer to get into operation (F10, F11). The main activities that would affect the schedule would be the additional time setting up forms and filling the silos and additional time preparing the detailed design (C 6.11).

F.6 SLAB ON GRADE

Description:

Waste would be put in cargo containers and placed on an abovegrade slab. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

The Slab on Grade would be quick and easy to install due to its simple design, known technology, and the materials would be easily available. Since the time to complete the design work would be less also due to simplicity and the construction would mostly consist of site preparation and pouring the slab, it is anticipated that this design could be implemented in a relatively short period of time (C 1.5). The use of containers would allow for visual inspection in order to detect leaks prior to contaminants escaping to the environment (C 1.1, 1.2). Waste containers would be exposed to the elements unless a covering such as tent was placed over the slab. Contaminants that did escape from the containers could be collected in the concrete berm. Any waste material not captured by the concrete berm could escape into the environment, but since the waste is containers the possibility would be remote.

Public Protection (Geotechnical and Hydrological Criteria):

The ability to meet CAMU criteria is dependent on maintenance of the slab (C 2.5, C 2.10). A slab on grade design would be a temporary facility and the remediation waste would have to be shipped at a later date to some other facility to provide reasonable assurance that it could protect the public for a thousand years (C 2.1). A slab on grade could be engineered to provide adequate drainage (C 2.11), and a permeability of less than 10^{-7} centimeter/second (C 2.5). Slab design would also have to account for settling, expansion and contraction to avoid cracks and structural damage.

Site Special Issues:

The Slab on Grade would have minimal impact on utilities since there is little excavation involved and some overhead utilities could still run over the facility (C 3.2). As with Metal Buildings, this facility could readily support short-term Site Vision goals since it could be designed and constructed in less time, but it is temporary and could remain as an unclosed facility long after other plant facilities have been shut down (C 3.1). The collocation of other waste facilities is a problem only because the slab will have such a large footprint that it could limit the space available for other facilities (C 3.9).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	$300,000
Pre-Construction	$200,000
Construction	$3,800,000
Total Cost of Construction	$4,300,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$6,100,000

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	$8,500,000
Total Cost of Interim Closure	$8,500,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$141,600,000

Site preparation costs (C 4.2) and construction costs (C 4.1) would be very low because little earth work would be involved and construction would consist mainly of pouring the pad. However, these costs would be insignificant in comparison to the costs for offsite disposal and container costs which would give a very high total life-cycle cost (C 4.4).

Regulatory Support:

Like the Metal Buildings design, this RWSF would be designed meet RCRA requirements for permitted storage including the ability to visually inspect the waste (C5.3). The lack of cover and continual exposure of the waste containers to the elements could be an issue in permitting this facility (5.3, 5.4). It would have a good degree of future applicability and utility since it is basically just a concrete pad (C 5.4). Future applications could include other storage uses, a lay down yard, a staging pad for other cleanup operations, or a tent could be constructed over it. This facility design is far from being state of the art (C 5.3) since it really offers nothing new or innovative in the way of waste management.

Other Stakeholder Concerns:

The containers would be exposed to the elements and there would a slight possibility that the run off

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could get into surface water systems (C 6.2, 6.7). Due to the simplicity of this design it should be easy to design and construct in less time than the other designs (C 6.10, 6.11, 6.12, 6.13). Monitoring and retrieval would be well supported by this facility since all sides of the facility are potentially accessible and the containers can be easily moved and inspected. It would have a very short useful life relative to the other designs (C 6.7, 6.9). The materials, services and technology for this facility would easy to obtain because it a well known technology utilizing common construction materials (C 6.12, 6.13).

F.7 METAL BUILDINGS

Description:

Waste would be put in cargo containers and placed in four engineered metal buildings constructed on a concrete slab. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

The use of cargo containers would allow visual leak detection; however, the cost for these containers is high (C 1.1). Like the slab on grade, contaminants that did escape from the containers could be collected in the concrete berm. The building roof would protect containers from precipitation and further minimize any possibility of leaching (C 1.1). The simple, proven design and less intensive construction would allow this facility to be available sooner which could quicken near term remedial activities and might avoid temporary storage of this waste at another facility or staging area (C 1.1).

Public Protection (Geotechnical and Hydrological Criteria):

The design life of this facility would be less than other alternatives considered (C 2.1). An advantage would be that most leaks could be contained prior to escaping to the environment. The metal building design would be engineered to provide adequate drainage (C 2.11). Because this design actually consists of different buildings precipitation could be allowed to infiltrate to the water table without compromising the waste with in the buildings.

Site Special Issues:

The Metal Building design would have a large footprint compared to the other designs because additional space would be needed for aisle ways and to provide spacing between the buildings (C 3.1). The facility could be used before completely constructed since only one building would need to be ready for remediation waste to be placed inside. This would better support the Site Vision objectives of accelerated site clean up; however, its large footprint would not incorporate the Site Vision objective of reducing the foot print of contaminated area (C 3.1). One advantage to the Metal Buildings design is that there would be a little more flexibility in configuring the buildings so that utilities and other features could be worked around (C 3.2). The colocation of other waste facilities would be a problem only because the Metal Buildings would have such a large footprint that it could limit the space available for other facilities (C 3.9).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	$2,300,000
Pre-Construction	$1,300,000
Construction	$17,900,000
Total Cost of Construction	$21,500,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$2,800,000

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	$10,400,000
Total Cost of Interim Closure	$10,400,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$161,400,000

Low construction costs (C 4.1) would be offset by the cost of containers to yield one of the higher total life-cycle costs (C 4.4).

Regulatory Support:

This facility design would be designed meet RCRA requirements for permitted storage including the ability to visual inspect the waste (C 5.3). The lack of cover and continual exposure of the waste containers to the elements could be an issue in permitting this facility (5.3, 5.4). It would have a good degree of future applicability and utility since it would be basically just a concrete pad (C 5.4). Future applications could include other storage uses or as a building for other closure activities. Like the Slab on Grade, this facility design is not state of the art (C 5.3) since it really offers nothing new or innovative in the way of waste management.

Other Stakeholder Concerns:

Monitoring and retrieval could be performed from the aisle ways in each buildings and the waste containers could be pulled out for even closer inspection. This is a well known technology (C 6.12) and its performance is well demonstrated (C 6.9); however, in comparison to other designs it would have a poor useful life since it is designed as a temporary facility. Even with maintenance, its

effectiveness would eventually degrade as the buildings degrade (F7, F9). This facility would be easy to construct in a timely manner and the services and materials would very easy to acquire (C 6.10, 6.11, 6.13).

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F.8 ENTOMBMENT

Description:

Remediation waste would be placed in 55 gallon drum containers and then placed in a concrete canister that are then sealed with grout. The canisters are then placed in a hardened concrete vault. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

This would have additional features that would add to the overall but protectiveness but would come at a high cost. These protective features would include an impermeable cap, a double liner, an impermeable cap, and hardened concrete walls. Inside the facility, the waste would be further contained by placement in 55 gallon drums which in turn would be entombed in concrete canisters (C 1.1). Entombment in canisters would be incorporating a treatment technology (similar to solidification) that enhances long-term effectiveness (C 1.6). Due to work intensive nature of this design compared to most facilities, additional time could be needed to design and construct this facility (C 1.5). Once in operation, this design would probably require more effort to get the waste from the field and into the facility and could require an additional staging area to seal the waste in concrete canisters.

Public Protection (Geotechnical and Hydrological Criteria)

Numerous barriers protect groundwater and surface water from any form of contaminant migration (C 2.5, 2.11, 2.12). Impermeable cap could have some impact on drainage patterns and infiltration (C 2.11).

Site Special Issues:

Entombment would require a very large footprint because the concrete box containment takes up more space than either bulk management or cargo containers. Like other designs with concrete walls, it would be easier to place additional facilities in the vicinity of an entombment facility (C 3.9). Additional staging areas would be required to grout and then place the waste containers. This could have an impact on Site activities including Site closure activities (C 3.1). Additional problems could result when the waste is to be disposed of. Because the waste would be grouted into the containers, other facilities might not be willing to accept this waste. It could require expensive and time consuming reprocessing which would also have an impact to Site closure activities (C 3.1).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	N/A
Pre-Construction	N/A
Construction	N/A
Total Cost of Construction	N/A

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	N/A

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	N/A
Total Cost of Interim Closure	N/A

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$525,000,000

* The cost for entombment was not calculated using a bottoms-up method and therefore a breakdown of costs is not available.

Entombment would be more expensive or as expensive as any of designs considered in terms of construction costs (C4.1), site preparation (C 4.2), closure (C 4.3), and total life-cycle cost (C 4.4). Factors that contribute to this high cost could include:

- Placement in concrete boxes would be labor and material intensive
- The facility itself would be very large which would increase construction costs
- The larger footprint would require more site preparation work

Regulatory Support:

This facility design could be considered state of the art (C 5.3) due its more advanced containment system. Although the materials would be sealed in place, the concrete boxes would be retrievable for inspection (C 5.3, 5.4).

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Other Stakeholder Concerns:

Retrieval of the concrete boxes themselves would be simple as long as the facility was in operation. After the placement of the cap retrieval would be more difficult. Retrieval of individual drums would be further compounded by the fact that the drums would be set in grout and would have to be chiseled out. This unit would have a long useful life and would be very effective (C 6.7, C 6.9) since it would be constructed from time tested materials and would offer multiple levels of containment. Ultimately problems could occur if the entombed waste were shipped offsite since other facilities might not accept the waste in the concrete boxes. Removing the waste from the concrete boxes would be very expensive since the waste would have to be chipped out of the grout. This facility would be much more labor, material and time intensive for both construction and operation (C 6.10, 6.11). Additional time and effort would be needed to:

- Design the facility
- Develop the technology
- Build packaging facilities
- Perform additional site preparation

The operation phase would also be more intensive due to the additional efforts required to prepare the waste in concrete canisters (C 6.10, 6.11). There could also be some problems encountered with the availability of the needed technology since this type of facility is not as common (C 6.12). No problems are expected in getting the needed raw materials and services (C 6.13). There could be some limitations in accepting some waste due to the size limitations of the 55 gallon drums (C 6.8).

F.9 PYRAMID DESIGN

Description:

Bulk remediation waste would be placed inside of a giant hollow pyramid constructed of quarried stone blocks. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

This design could require more maintenance to maintain its protectiveness since settling or shifting of the outside block could cause areas of exposure requiring repair (C 1.1). A more lengthy design and construction period could be required for development of this technology and because availability of materials could be limited (C 1.5).

Public Protection (Geotechnical and Hydrological Criteria)

The Pyramid design should provide good drainage based on its geometry but could alter area drainage and infiltration patterns (C 2.11). The pyramid design would have to account for weight of the facility as well as impacts to slope stability (C 2.3).

Site Special Issues:

This alternative could need additional design and construction time which would impact cleanup efforts under the Site Vision (C 3.1). This additional time would be utilized for technology development since this is a new application. Additional time would also be spent obtaining a supplier of stone blocks, having the blocks cut, and for geotechnical work. As an innovative design, some additional time could also be required to verify the soundness of the technology. Ultimately, this could potentially impact building deactivation, decontamination, and decommissioning activities (C 3.5, 3.6). The prolonged design and construction of the facility could cause additional remediation waste to be placed in RCRA storage units consuming space needed for other waste (C 3.7). There could be some problems with locating future waste facilities near the pyramid since changes in geometry of the facility are limited and the footprint is larger than other designs (C 3.9).

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Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	$2,200,000
Pre-Construction	$400,000
Construction	$57,900,000
Total Cost of Construction	$60,500,000

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	$14,500,000

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	$13,900,000
Total Cost of Interim Closure	$13,900,000

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$140,300,000

Although this design would be one of the more expensive designs to prepare the site for and construct (C 4.1, 4.2), it would be one of the least expensive to close (C 4.3) and the total life cycle cost would place this design in the lower part of the range of those considered (C 4.4). Because the design is untested, additional costs could be incurred due technology development and additional design. These costs were not incorporated into the estimate.

Regulatory Support:

Although it is an innovative design, it is not currently state of the art (C 5.3) since the technology has never been developed for this application. Nor would the facility offer "the greatest degree of future applicability and utility" since it would be designed specifically for one use, the containment of contaminated soils.

Other Stakeholder Concerns:

Due to its innovative nature, a lot of unknowns are associated with this design. Although there is demonstrated performance with pyramids by ancient man for observatories, temples, or tombs, in general, there is no demonstrated performance for this particular design nor with the application of this design to waste management (C 6.9). If the blocks were to remain intact, the life of the structure

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itself could be similar to ancient pyramids. It is not known whether differential settling would open up the seams between the blocks allowing precipitation into the interior. Depending on their size and type of stone used, the blocks for the pyramid could be difficult to acquire (C 6.11, 6.12, 6.13).

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F.10 WASTE PILE

Description:

Bulk waste would be compacted into a rectangular pile, sealed in a geomembrane and covered with dirt. The facility would be underlain with a liner and leachate collection system. A more detailed description of this design is given in Appendix E.

CAMU Criteria:

Because the necessary design and site preparation of this facility would be minimal, use of the facility could be available sooner which could expedite some near-term early actions (C 1.5).

Public Protection (Geotechnical and Hydrological Criteria)

The design life of this facility is to approximately 30 years. At the end of its useful life, the facility would have to modified, a new facility would have to be constructed or the waste would have to be sent to another facility (C 2.1).

Site Special Issues:

The impermeable cap could be tied into the cap planned for the Industrial Area as part of Site closures activities under the Site Vision (C 3.1).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	N/A
Pre-Construction	N/A
Construction	N/A
Total Cost of Construction	N/A

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	N/A

The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	N/A

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Total Cost of Interim Closure	N/A

The above costs are combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$36,670,000

* A breakdown of specific costs are not available. Life-cycle costs are based on actuals from a similar facility.

The construction costs and site preparations costs would be very low (C 4.1, 4.2), resulting in a a low life-cycle cost (C 4.4).

Regulatory Support:

This design is geared specifically towards soil and other remediation recovered during Site clean up and therefore this facility would not have many other uses (C 5.4).

Other Stakeholder Concerns:

The useful life of this facility would be limited since the intent is to provide safe, cost-effective storage until the waste can be moved to a more permanent facility (C 6.6, 6.9). The simplicity of this facility would allow for a reduced design and construction period (C 6.11). Because waste would be placed in an easily accessed pile, operations would also be facilitated by this design. Once the waste pile is covered over, retrieval and monitoring of individual waste streams would be hampered by access problems and a lack of separation. On the other hand, retrieval of all of the waste at once could be relatively simple since the cover could be breached and the waste could be removed with a front end loader.

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F.11 NO ACTION

Description:

The no action alternative is to shipped the waste to an offsite facility as it is generated. A more detailed description of this design is given in Appendix E and Appendix B.

CAMU Criteria:

CAMU criteria are not applicable to this action since an offsite facility would not be used as a CAMU.

Public Protection (Geotechnical and Hydrological Criteria)

Public protection would be dependent on the facility. Protection to the groundwater would likely be equivalent or better than RCRA Title C Landfill requirements. Offsite facilities could have less permeable geologic strata to meet minimum permeability of 10^{-7} centimeters/second, whereas onsite facility would likely meet the same minimum permeability with engineered barriers (C 2.5).

Site Special Issues:

This option would only require a staging area for packaging and transporting the waste. Since no space would be needed for a storage facility, this option would well address the Site Vision objective of reducing the footprint of contaminated areas (C 3.1). Delays in shipping could cause valuable RCRA storage space to be utilized (C 3.7).

Cost Criteria:

The Cost of Construction (C 4.1) is calculated as follows:

Design	N/A
Pre-Construction	N/A
Construction	N/A
Total Cost of Construction	N/A

The Cost of Site Preparation (C 4.2) is:

Cost of Site Preparation	N/A

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The Cost of Interim Closure (C 4.3) is calculated as follows:

Interim Cover	N/A
Interim Care And Monitoring	N/A
Total Cost of Interim Closure	N/A

The above costs were combined with the costs for containers, packaging, characterization, transportation, permitting, operations, and contingency to yield the Total Life-Cycle Cost (C 4.4):

Total Life-Cycle Cost	$215,900,000

Because a major facility would not have to be constructed, most of the cost would be tied up in offsite disposal (C 4.4).

Regulatory Support:

These criteria are not applicable to this option, because these criteria only apply to onsite facilities.

Other Stakeholder Concerns:

Because this option would utilize an existing facility, issues associated with construction and the availability of the technology, materials, and services do not exist (C 6.10, 6.12 6.13). Some offsite facilities might not be able to accept all of the waste types that would be generated due permit or license restrictions, differing waste acceptance criteria, or restrictions based on regulation (C 6.8). In terms of schedule requirements, there would be no delays due to construction of the facility, although additional handling, packaging, and transportation facilities at the Site could be needed (C 6.11). During the operation phase, there would be delays in putting waste in the facility due to characterization, documentation, packaging, and acceptance requirements. Remediation waste would be put in temporary storage at the Site while these requirements were being addressed.

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Appendix G

(This Appendix has been deleted)

Appendix H
Backup Information for Risk Evaluation

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FORWARD:

This document was developed in early spring of 1996. The intent was to define a typical waste stream based on actual analytical data in the site characterization database (Rocky Flats Environmental Data System). Since significant data gaps exist in the characterization of the Industrial Area, data from the solar ponds characterization was used to estimate a representative waste stream. No inferences should be made regarding actual waste streams which will be activity specific and subject to regulatory agency approval. The use of waste streams such as pondcrete and solar ponds vadose zone soils were for the sole purpose of estimating typical waste streams at RFETS.

Appendix H is composed of three reports. The first report "Estimation Of Contaminant Concentrations From Probable Leachate Compositions At Seep Pathways In The Vicinity Of The Waste Management Facility, Rocky Flats Environmental Technology Site, Colorado" contains the other two reports in it's Appendix A.

The body of the first report is nineteen pages long and continues from page H-5 through H-25 The body of the second report is three pages long and continues from page 26 through H-28. The third report contains tables and figures within the test and continues from page H-29 through H-53. The third report contains an appendix (Appendix A) which goes form page H-53 through H-61.

The first report has an Appendix B (Help Model Output) which goes from page H-62 through the end of Appendix H.

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ESTIMATION OF CONTAMINANT CONCENTRATIONS FROM PROBABLE LEACHATE COMPOSITIONS AT SEEP PATHWAYS IN THE VICINITY OF THE WASTE MANAGEMENT FACILITY, ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE, COLORADO

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1.0 INTRODUCTION

A Waste Management Facility (WMF) has been proposed to be constructed at the Rocky Flats Environmental Technology Site (RFETS). A conceptual level, semi-quantitative assessment of the maximum level of contamination that could migrate from the Waste Management Facility (WMF) to surface water was performed. This effort serves as part of the analysis of the facility design in terms of CAMU protectiveness requirements and Part 2 Siting criteria. This report presents an estimate of the concentrations that could result from groundwater exiting from seeps and/or entering surface water from the WMF, given the current design.

Based on preliminary design drawings from RMRS/Engineering, the WMF will consist of a concrete slab, 500 by 360 feet in plan (approximately 4.13 acres). The slab will be constructed as three modules (500 feet long by 120 feet wide), which will be separated from each other by vertical concrete walls (18 feet high). A 14 foot high perimeter wall will enclose the entire slab. Various waste materials will be placed in the bins, including bulk wastes (contaminated soils), pondcrete (low strength concrete in approximately one meter cubes), and structural steel.

In concept, the bottom of the slab will be poured at existing grade. However, the slab will be underlain by a composite liner system consisting of one foot of drainage gravel, a geotextile, an 80 mil textured HDPE geomembrane, a geotextile, a geonet leak detection layer, a geotextile, an 80 mil textured HDPE geomembrane, and three feet of compacted clay.

After the various bins are filled with waste, a composite cover system will be constructed. The cover will include (from the top) two feet of vegetated soil with armament, a geotextile, one foot of graded gravel, three feet of riprap (biotic barrier), a geotextile, one foot of sand, a geotextile, an 80 mil HDPE geomembrane, a geosynthetic clay membrane, and two feet of compacted clay.

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Three leachate flux scenarios are addressed in this document. Scenario 1 uses a leachate flux resulting from a capped and lined WMF, representing a post-closure time period. Scenario 2 uses a leachate flux from an uncapped, but lined WMF prior to closure. The leachate flux for these scenarios are estimated using a computer model. Scenario 3 is a worst case scenario, using a leachate flux equal to an assumed RFETS recharge rate of 1 inch per year.

2.0 METHODOLOGY

A simple dilution calculation is used to obtain potential concentrations of groundwater exiting at seeps or entering surface water. In order to estimate the contamination concentrations of groundwater at locations where it intercepts surface water, (at seeps or the drainages) the following methodology was used:

1. Estimate leachate concentrations;
2. Estimate flux of leachate though the base of the WMF;
3. Estimate mass of leachate constituents in leachate exiting WMF;
4. Estimate concentrations of leachate constituents after mixing in groundwater below WMF.

In order to complete this analysis, the following assumptions were made:

- instantaneous mixing of leachate in groundwater below WMF
- annual flux out of WMF base is at equilibrium conditions (it does not change with time)
- groundwater concentrations beneath WMF do not include existing contamination
- retardation is ignored
- no thorough flow of groundwater beneath the WMF
- contamination from the WMF leachate does not "build up" over time

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- concentrations are estimated for a time period after the WMF has been capped.

3.0 ESTIMATION OF LEACHATE CONCENTRATIONS

In order to estimate the concentrations of contaminants at seep locations near the WMF, it is necessary to estimate the probable leachate composition. To accomplish this, the commonly used soil/water partitioning equation (EPA, 1994) was used to estimate maximum concentrations for organic constituents and the leachate composition from Siders (1996) was used for metals and radionuclides.

The soil/water partitioning equation is a more simplified approach than numerical transport modeling. Based on the unknowns regarding the analysis parameters (amount of waste in place, contaminant concentrations in the waste, etc.) a more simplified approach is more appropriate.

The soil/water partitioning equation describes the partitioning of a contaminant between solid, liquid, and gaseous phases under equilibrium conditions. The soil/water partitioning equation is:

$$C_w = C_s/[K_d + (\theta_w + \theta_a H')/\rho_b]$$

where:

C_w is the soil water concentration (mg/l)
C_s is the waste soil contaminant concentration (mg/kg)
K_d is the distribution coefficient (ml/kg)
θ_w is the water filled porosity of the waste soils (assumed to be 1.0)
θ_a is the air-filled porosity of the waste soils (assumed to be 0.0)
H' is the Henry's Law constant
ρ_b is the representative bulk density of the waste soils (assumed to be 1.5 g/cm^3)

Leachate concentrations for volatile and semi-volatile organic compounds (VOC/SVOCs) contaminants were estimated by Roberts (1996) with greater than 15% detection frequency. These VOC/SVOC leachate concentrations were used in this analysis for the initial leachate concentrations and composition

for VOC/SVOCs. Roberts calculated K_d values for the VOC/SVOCs using site-specific data. Roberts (1996) estimation of VOC/SVOC leachate composition and concentrations are presented in Table 1.

A similar approach (using the soil/water partitioning equation) was initially planned for estimating the leachate composition and concentrations for metals and radionuclides. Examination of K_d values for metals and radionuclides (used in the soil/water partitioning equation) revealed virtually no site specific values and that literature values ranged over several orders of magnitude. This variability makes it much more difficult to derive K_ds for metals than VOC/SVOCs. EPA (1994) indicates that the K_ds for metals (and metallic radionuclides) are affected by several factors, including numerous geochemical processes and parameters, variability in the field, and differences in experimental methods. These factors result in variabilities of up to seven orders of magnitude.

Because no meaningful literature or site-specific values for metal K_ds could be obtained, the leachate composition derived by Siders (1996) was used. Siders calculated a probable leachate compositions for metals, radionuclides, and inorganic parameters based on estimated volumes of waste to be stored in the WMF and available data for leachates, pore water, and groundwater from wastes and waste areas. Siders (1996) estimated metals and radionuclides leachate composition and concentrations are also presented in Table 1.

Roberts (1996) and Siders (1996) are contained in Appendix A as supporting documentation.

4.0 ESTIMATION OF LEACHATE FLUX

In order to estimate the amount of contaminants that could potentially reach surface water from the WMF, it was necessary to estimate the flux of fluid through the base of the WMF. This was accomplished using the results of two Hydrologic Evaluation of Landfill Performance (HELP) models and an assumed value of leachate flux. The HELP numerical code was developed for the EPA by the

U.S. Army Corps of Engineers. HELP is used to obtain rapid and economical estimation of water flux in and out of landfills. Both site-specific and literature values were used in the preparation of this model, which was used to evaluate the effectiveness of the proposed WMF cap/liner system design. The model was run for 100 years.

The HELP model for the WMF consisted of 17 layers over a 10 acre site, representing the engineered liner and cap system. The layers are:

Layer 1 - angular pea gravel

Layer 2 - vegetative layer with gravel

Layer 3 - general backfill

Layer 4 - sand/gravel

Layer 5 - bioexclusion layer (cobbles)

Layer 6 - sand/gravel

Layer 7 - geomembrane and geosynthetic clay liner

Layer 8 - clay liner

Layer 9 - general backfill

Layer 10 - compacted waste

Layer 11 - drainage network

Layer 12 - concrete slab with drainage pipes

Layer 13 - gravel

Layer 14 - leachate collection membrane

Layer 15 - geocomposite

Layer 16 - leak detection membrane

Layer 17 - barrier soil liner (clay).

To evaluate a range of possibilities regarding leachate fluxes, three scenarios were examined. Two scenarios using HELP were examined. Scenario 1 includes both cap and liner systems (simulating post-closure), while Scenario 2 includes only the liner system with no cap(simulating pre-closure). Another scenario (Scenario 3) was also considered in which the leachate flux through the base of the WMF is equal to an assumed recharge rate at RFETS (1 inch/year). Scenario 3 would represent a worst-case scenario because in order for this scenario to take place, the cap/liner system would either have experienced complete failure or would have never been installed. It should be noted that the assumed recharge rate is probably greater than the actual value at Rocky Flats.

From the HELP model scenarios, the average annual leakage through the base of layer 17 (the bottom clay liner) is 0.084 ft^3 (2.38 liters) for Scenario 1 (cap and liner) and 0.205 ft^3 (5.81 liters) for Scenario 2 (liner). These fluxes are probably greater than what would actually result from the WMF, due to the differences in the areas for the HELP models (10 acres) and the proposed design (4.13 acres). This is a conservative result because it would introduce more leachate into the groundwater. This results are only valid for the various inputs used in the model, including industry standard parameters, literature values, and the proposed design of the WMF. Any changes in the model parameter values could change the results of the model. Of course, the model is only a predictor of ideal conditions. Actual design and construction of the WMF will affect performance. It is assumed that the amount of leachate exiting the

WMF is continuous and at equilibrium (it will not change with time). The HELP model output is contained in Appendix B.

Using the assumed value of site recharge (1 inch/year) and the same area used in the HELP model (10 acres) results in 36,300 ft^3 (1.03 million liters) of leachate exiting the WMF annually. Again, this scenario represents a worst-case scenario which could only result from either no cap/liner installation or complete failure of the cap/liner system.

5.0 ESTIMATION OF MASS/ACTIVITY OF LEACHATE CONSTITUENTS

Using the flux exiting the WMF estimated in section 4.0, the mass (or activities for the radionuclides) of the leachate constituents were calculated. This was accomplished by multiplying the amount of the annual flux for each scenario (2.38, 5.81, and 1.03 million liters for scenarios 1, 2, and 3, respectively) by the concentration of the constituents comprising the leachate. The results of this calculation are presented in Table 2. These results represents the mass/activities of contaminants available for mixing in groundwater below the WMF.

6.0 ESTIMATION OF GROUNDWATER VOLUME BELOW WMF

To calculate the resulting concentrations of the mass/activity of leachate constituents, it is necessary to estimate the volume of groundwater beneath the WMF. To obtain this volume, the average saturated thickness was estimated, based on water levels wells screened in the upper hydrostratigraphic unit (UHSU). These data are available in EG&G (1995a). Since the UHSU is comprised of both alluvial materials and weathered bedrock, the estimated saturated thickness included the thickness of the weathered bedrock. The thickness of the weathered bedrock was obtained from EG&G (1995b). Using a

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saturated thickness of approximately 35 feet, a porosity of 0.3, and an assumed area of 10 acres, there is approximately 130 million liters of groundwater beneath the WMF available for mixing.

7.0 ESTIMATION OF GROUNDWATER CONCENTRATIONS BENEATH WMF FROM LEACHATE

Using the volume of groundwater beneath the WMF (estimated in section 6.0) and the mass/activity of the leachate constituents (estimated in section 5.0), the concentration of the groundwater from leachate constituents is calculated for each scenario. This is accomplished by dividing the volume of groundwater by the mass/activity of the constituents. This assumes instantaneous mixing of the leachate and the groundwater beneath the WMF and instantaneous appearance at surface water points and seeps. This is a conservative assumption, since no retardation and decay of the contaminants is considered. Concentrations of the leachate constituents which already exist (either naturally or through anthropogenic agencies) in the groundwater are not considered.

This estimation, however, does not consider the addition of contaminants over time. Table 3 presents the potential concentrations of groundwater beneath the WMF from leachate for each scenario. These concentrations represent a potential value for groundwater exiting at seeps and entering surface water for the given scenarios.

8.0 CONCLUSIONS AND RECOMMENDATIONS

These estimates represent potential concentrations for groundwater contamination from leachate. Assuming that this concentration reaches the surface water and seeps, it also represents a potential concentration that could appear at these locations. Resulting groundwater concentrations for the three scenarios were compared to draft RFCA (RFCA, 1996) action levels for surface water as a mean of evaluating the impact of the WMF. Table 4 lists the applicable RFCA surface water action levels for stream segment 5 (the section of Walnut Creek near the WMF).

Any modifications to the existing HELP model and/or changes in the design of the WMF could result in changes to the concentrations obtained in this analysis. Actual construction of the WMF could also result in differences between the predicted concentrations and observed concentrations in the future.

8.1 Scenario 1 (Cap and Liner)

The predicted concentrations, when compared with applicable surface water action levels listed in the draft RFCA, are much less than those levels requiring action. Because the estimated concentrations are very low, it appears that the design of the cap/liner system (as used in the HELP model) is sufficient to protect surface water and seeps from contamination.

It should be noted that changing the saturated thickness from 35 feet to 5 feet (thickness of the alluvial part of the UHSU) will lessen the resulting volume by less than an order of magnitude. Thus, reduction in the saturated thickness will only increase the resulting concentrations by an order of magnitude. These values would still be well below the actions levels specified by RFCA.

8.2 Scenario 2 (Liner)

Comparison of the resulting concentrations for Scenario 2 with RFCA surface water action levels reveals that for most leachate constituents, the concentrations are less than the action levels. Because the estimated concentrations are very low, it appears that during the active life of the facility, while waste is being loaded into the WMF modules, the liner system is sufficient to protect surface water and seeps from contamination.

Changing the saturated thickness from 35 feet to 5 feet (the thickness of the alluvial part of the UHSU) will lessen the resulting volume by less than an order of magnitude, thus increasing the groundwater concentrations by an order of magnitude. This action would not increase groundwater concentration above RFCA action levels for surface water.

8.3 Scenario 3 (Flux equals Recharge)

Comparison of the resulting concentrations for Scenario 3 with RFCA surface water action levels reveals that for most leachate constituents, the concentrations are less than the action levels. Only for certain VOC/SVOCs (carbon tetrachloride, 1,1 dichloroethane, 1,2 dichloroethene, methylene chloride, tetrachloroethylene, and trichloroethene) are groundwater concentrations greater than RFCA action levels for surface water. It should be noted that this scenario is the worst-case scenario. This scenario is not likely to take place because a liner would restrict leachate percolation into the UHSU. This scenario would either represent a complete failure of the cap/liner system or no cap/liner.

It should be noted that changing the saturated thickness from 35 feet to 5 feet (thickness of the alluvial part of the UHSU) will lessen the resulting volume by less than an order of magnitude, thus increasing the groundwater concentrations by an order of magnitude. This modification would lead to a greater number of leachate constituents exceeding the draft RFCA surface water action levels. In addition to the VOC/SVOCs mentioned previously, bis (2-ethylhexyl) phthalate exceeds the draft RFCA surface water action levels, as do some metals (manganese, mercury, and silver) and radionuclides (gross alpha, gross beta, U-233/234, and U-238).

8.4 Recommendations

It is recommended that a transport model, using the fluxes obtained from the HELP model and the leachate concentrations from Roberts (1996) and Siders (1996). A numerical model could incorporate retardation and decay, as well as account for mass transfer from the groundwater system to the surface water and seeps. It may be possible to utilize the ASAP groundwater flow model, once it is calibrated. The ASAP modeling effort is anticipated to be calibrated by the end of August 1996.

It is also recommended that a three-dimensional scientific visualization be constructed of the area where the WMF is to be constructed. RMRS Environmental Restoration has the capability to perform this task,

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which would show the relationships of geology and hydrogeology with the WMF. A three-dimensional model would be invaluable for integrating data and interpretations and would be useful for both technical and non-technical personnel.

9.0 REFERENCES

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Rocky Flats Cleanup Agreement (RFCA) (Public Comment Draft), March 14, 1996.

Siders, M., 1996, Analysis of inorganic constituents and probable leachate composition from waste stored in the new waste cell at the Rocky Flats Environmental Technology Site, Golden, Colorado, Rocky Mountain Remediation Services, March 29, 1996.

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TABLES

Table 1: Estimated Leachate Concentrations

Constituent	Leachate Concentrations	Units
Volatile Organic Compounds		
Acetone	150000	µg/L
Carbon Tetrachloride	2100	µg/L
Chloroform	3000	µg/L
1,1 Dichloroethane	3100	µg/L
1,1 Dichloroethene	2800	µg/L
1,2 Dichloroethene	16000	µg/L
Diethyl Phthalate	12000	µg/L
Di-n-Butyl Phthalate	3600	µg/L
Bis (2-Ethylhexyl) Phthalate	140	µg/L
Methylene Chloride	19000	µg/L
Tetrachloroethylene	2000	µg/L
1,1,1-Trichloroethane	2500	µg/L
Trichloroethene	2500	µg/L
Metals		
Aluminum	547	µg/L
Antimony	22	µg/L
Arsenic	48	µg/L
Barium	133	µg/L
Beryllium	1.8	µg/L
Cadmium	8.5	µg/L
Calcium	111230	µg/L
Cesium	146	µg/L
Chromium	173	µg/L
Cobalt	37	µg/L
Copper	59	µg/L
Iron	970	µg/L
Lead	27	µg/L
Lithium	528	µg/L
Magnesium	17910	µg/L
Manganese	550	µg/L
Mercury	0.46	µg/L
Molybdenum	302	µg/L
Nickel	90	µg/L
Potassium	165300	µg/L
Selenium	5.5	µg/L

Table 1 (cont.)
Estimated Leachate Concentrations

Constituent	Leachate Concentrations	Units
Silver	10	µg/L
Sodium	783800	µg/L
Strontium	1640	µg/L
Thallium	8	µg/L
Tin	84	µg/L
Vanadium	17	µg/L
Zinc	60	µg/L
Radionuclides		
Americium-241	0.11	pCi/L
Cesium-134	ID	pCi/L
Cesium-137	0.33	pCi/L
Gross Alpha	375	pCi/L
Gross Beta	230	pCi/L
Plutonium-239/240	0.12	pCi/L
Radium 226	1.4	pCi/L
Radium-228	3.2	pCi/L
Tritium (total)	1310	pCi/L
Uranium-233/234	147	pCi/L
Uranium-235	6.1	pCi/L
Uranium-238	142	pCi/L

Notes:

ID = Insufficient Data
µg/L = micrograms per liter
pCi/L = picocuries per liter

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Table 2: Estimated Mass/Activity of Leachate Constituents Exiting WMF

Constituent	Scenario 1	Scenario 2	Scenario 3	Units
Volatile Organic Compounds				
Acetone	357000	871500	1.54E+11	µg
Carbon Tetrachloride	4998	12201	2.16E+09	µg
Chloroform	7140	17430	3.09E+09	µg
1,1 Dichloroethane	7378	18011	3.19E+09	µg
1,1 Dichloroethene	6664	16268	2.88E+09	µg
1,2 Dichloroethene	38080	92960	1.65E+10	µg
Diethyl Phthalate	28560	69720	1.24E+10	µg
Di-n-Butyl Phthalate	8568	20916	3.70E+09	µg
Bis (2-Ethylhexyl) Phthalate	333.2	813.4	1.44E+08	µg
Methylene Chloride	45220	110390	1.96E+10	µg
Tetrachloroethylene	4760	11620	2.06E+09	µg
1,1,1-Trichloroethane	5950	14525	2.57E+09	µg
Trichloroethene	5950	14525	2.57E+09	µg
Metals				
Aluminum	1301.86	3178.07	5.60E+08	µg
Antimony	52.36	127.82	2.26E+07	µg
Arsenic	114.24	278.88	4.94E+07	µg
Barium	316.54	772.73	1.37E+08	µg
Beryllium	4.284	10.458	1.85E+06	µg
Cadmium	20.23	49.39	8.75E+06	µg
Calcium	264727.4	646246.3	1.15E+11	µg
Cesium	347.48	848.26	1.50E+08	µg
Chromium	411.74	1005.13	1.78E+08	µg
Cobalt	88.06	214.97	3.81E+07	µg
Copper	140.42	342.79	6.05E+07	µg
Iron	2308.6	5635.7	19.95E+08	µg
Lead	64.26	156.87	2.78E+07	µg
Lithium	1256.64	3067.68	5.45E+08	µg
Magnesium	42625.8	104057.1	1.84E+10	µg
Manganese	1309	3195.5	5.65E+08	µg
Mercury	1.0948	2.6726	4.73E+05	µg
Molybdenum	718.76	1754.62	3.11E+08	µg
Nickel	214.2	522.9	9.25E+07	µg
Potassium	393414	960393	1.70E+11	µg
Selenium	13.09	31.955	5.56E+06	µg

Table 2 (cont.)
Estimated Mass/Activity of Leachate Constituents Exiting WMF

Constituent	Scenario 1	Scenario 2	Scenario 3	Units
Silver	23.8	58.1	1.03E+07	µg
Sodium	1865444	4553878	8.05E+11	µg
Strontium	3903.2	9528.4	1.69E+09	µg
Thallium	19.04	46.48	8.20E+06	µg
Tin	199.92	488.04	8.65E+07	µg
Vanadium	40.46	98.77	1.75E+07	µg
Zinc	142.8	348.6	6.15E+07	µg
Radionuclides				
Americium-241	0.2618	.6391	1.13E+05	pCi
Cesium-134	ID	ID	ID	pCi
Cesium-137	0.7854	1.9173	3.40E+05	pCi
Gross Alpha	892.5	2178.75	3.86E+08	pCi
Gross Beta	547.4	1336.3	2.37E+08	pCi
Plutonium-239/240	0.2856	.6972	1.24E+05	pCi
Radium 226	3.332	8.134	1.44E+06	pCi
Radium-228	7.616	18.592	3.29E+06	pCi
Tritium (total)	3117.8	7611.1	1.35E+09	pCi
Uranium-233/234	349.86	854.07	1.51E+08	pCi
Uranium-235	14.518	35.441	6.25E+06	pCi
Uranium-238	337.96	825.02	1.46E+08	pCi

Notes:

ID = Insufficient Data
Mass/Activity calculated from leachate concentrations in Table 1.
µg = micrograms (mass)
pCi = picocuries (activity)
Scenario 1 leachate flux = 2.38 liters.
Scenario 2 leachate flux = 5.81 liters.
Scenario 3 leachate flux = 1.03 million liters.

Table 3: Estimated Groundwater Concentrations Beneath WMF From Leachate

Constituent	Scenario 1	Scenario 2	Scenario 3	Units
Volatile Organic Compounds				
Acetone	2.76E-03	6.73E-03	1190	µg/L
Carbon Tetrachloride	3.86E-05	9.42E-05	16.65	µg/L
Chloroform	5.51E-05	1.35E-04	23.8	µg/L
1,1 Dichloroethane	5.70E-05	1.39E-04	24.6	µg/L
1,1 Dichloroethene	5.14E-05	1.26E-04	22.2	µg/L
1,2 Dichloroethene	2.94E-04	7.18E-04	127	µg/L
Diethyl Phthalate	2.20E-04	5.38E-04	95	µg/L
Di-n-Butyl Phthalate	6.61E-05	1.61E-04	28.55	µg/L
Bis (2-Ethylhexyl) Phthalate	2.57E-06	6.28E-06	1.11	µg/L
Methylene Chloride	3.49E-04	8.52E-04	151	µg/L
Tetrachloroethylene	3.67E-05	8.97E-05	15.85	µg/L
1,1,1-Trichloroethane	4.59E-05	1.12E-04	19.85	µg/L
Trichloroethene	4.59E-05	1.12E-04	11	µg/L
Metals				
Aluminum	1.01E-05	2.45E-05	4.34	µg/L
Antimony	4.04E-07	9.87E-07	0.175	µg/L
Arsenic	8.82E-07	2.15E-06	0.381	µg/L
Barium	2.44E-06	5.97E-06	1.06	µg/L
Beryllium	3.31E-08	8.07E-08	0.0143	µg/L
Cadmium	1.56E-07	3.81E-07	0.0675	µg/L
Calcium	2.04E-03	4.99E-03	885	µg/L
Cesium	2.68E-06	6.55E-06	1.16	µg/L
Chromium	3.18E-06	7.76E-06	1.375	µg/L
Cobalt	6.80E-07	1.66E-06	0.294	µg/L
Copper	1.08E-06	2.65E-06	0.469	µg/L
Iron	1.78E-05	4.35E-05	7.7	µg/L
Lead	4.96E-07	1.21E-06	0.215	µg/L
Lithium	9.70E-06	2.37E-05	4.19	µg/L
Magnesium	3.29E-04	8.03E-04	142	µg/L
Manganese	1.01E-05	2.47E-05	4.37	µg/L
Mercury	8.45E-09	2.06E-08	0.0037	µg/L
Molybdenum	5.55E-06	1.35E-05	2.395	µg/L
Nickel	1.65E-06	4.04E-06	0.72	µg/L
Potassium	3.04E-03	7.41E-03	1310	µg/L
Selenium	1.01E-07	2.47E-07	0.0437	µg/L
Silver	1.84E-07	4.49E-07	0.0795	µg/L

Table 3 (cont.)
Estimated Groundwater Concentrations Beneath WMF From Leachate

Constituent	Scenario 1	Scenario 2	Scenario 3	Units
Sodium	1.44E-02	3.52E-02	6200	µg/L
Strontium	3.01E-05	7.36E-05	13	µg/L
Thallium	1.47E-07	3.59E-07	0.0635	µg/L
Tin	1.54E-06	3.77E-06	0.665	µg/L
Vanadium	3.12E-07	7.63E-07	0.135	µg/L
Zinc	1.10E-06	2.69E-06	0.476	µg/L
Radionuclides				
Americium-241	2.02E-09	4.93E-09	0.0009	pCi/L
Cesium-134	ID	ID	ID	pCi/L
Cesium-137	6.06E-09	1.48E-08	.0026	pCi/L
Gross Alpha	6.89E-06	1.68E-05	2.98	pCi/L
Gross Beta	4.23E-06	1.03E-05	1.83	pCi/L
Plutonium-239/240	2.20E-09	5.38E-09	0.001	pCi/L
Radium 226	2.57E-08	6.28E-08	0.011 1	pCi/L
Radium-228	5.88E-08	1.44E-07	0.0254	pCi/L
Tritium (total)	2.41E-05	5.88E-05	10.4	pCi/L
Uranium-233/234	2.70E-06	6.59E-06	1.17	pCi/L
Uranium-235	1.12E-07	2.74E-07	0.0484	pCi/L
Uranium-238	2.61E-06	6.37E-06	1.13	pCi/L

Notes:

ID = Insufficient Data

Concentrations calculated from mass/activities in Table 3 and estimated groundwater volume of 130 million liters.

µg/L = micrograms per liter

pCi/L = picocuries per liter

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Table 4: DRAFT RFCA Surface Water Action Levels for Stream Segment 5 (Walnut Creek)

Constituent	Concentration	Units
Volatile Organic Compounds		
Acetone	365000	µg/L
Carbon Tetrachloride	5	µg/L
Chloroform	100	µg/L
1,1 Dichloroethane	1010	µg/L
1,1 Dichloroethene	7	µg/L
1,2 Dichloroethene	70	µg/L
Diethyl Phthalate	29200	µg/L
Di-n-Butyl Phthalate	3650	µg/L
Bis (2-Ethylhexyl) Phthalate	6	µg/L
Methylene Chloride	5	µg/L
Tetrachloroethylene	5	µg/L
1,1,1-Trichloroethane	200	µg/L
Trichloroethene	5	µg/L
Metals		
Aluminum	8700	µg/L
Antimony	1400	µg/L
Arsenic	50	µg/L
Barium	1000	µg/L
Beryllium	4	µg/L
Cadmium	1.5	µg/L
Calcium	NAL	µg/L
Cesium	NAL	µg/L
Chromium	50	µg/L
Cobalt	NAL	µg/L
Copper	16	µg/L
Iron	300	µg/L
Lead	6500	µg/L
Lithium	NAL	µg/L
Magnesium	NAL	µg/L
Manganese	50	µg/L
Mercury	0.01	µg/L
Molybdenum	1000	µg/L
Nickel	123	µg/L
Potassium	NAL	µg/L
Selenium	10	µg/L
Silver	0.6	µg/L
Sodium	NAL	µg/L

Table 4 (cont.)
DRAFT RFCA Surface Water Action Levels for Stream Segment 5
(Walnut Creek)

Constituent	Concentrations	Units
Strontium	NAL	µg/L
Thallium	NAL	µg/L
Tin	NAL	µg/L
Vanadium	NAL	µg/L
Zinc	141	µg/L
Radionuclides		
Americium-241	0.15	pCi/L
Cesium-134	NAL	pCi/L
Cesium-137	NAL	pCi/L
Gross Alpha	10	pCi/L
Gross Beta	11	pCi/L
Plutonium-239/240	0.15	pCi/L
Radium 226	5	pCi/L
Radium-228	5	pCi/L
Tritium (total)	500	pCi/L
Uranium-233/234	10	pCi/L
Uranium-235	10	pCi/L
Uranium-238	10	pCi/L

Notes:

µg/L = micrograms per liter
pCi/L = picocuries per liter
NAL = No listed Action Level

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APPENDIX A - SUPPORTING DOCUMENTATION FOR LEACHATE CONCENTRATIONS

CALCULATION OF PROBABLE MAXIMUM LEACHATE CONCENTRATIONS

To assist in the design of the leachate treatment system for the Waste Management Facility, the following analysis was performed to determine the probable maximum leachate concentrations for the major organic contaminants found at the Rocky Flats Environmental Technology Site (RFETS). For this analysis, the commonly used soil/water partitioning equation was used to determine the contaminant concentrations in interstitial water in waste soils within the Waste Cell.

Although a more in-depth approach to estimating the leachate concentrations was considered (1D vertical transport modeling), the goals of the analysis (determination of maximum expected concentrations), and the ambiguity of the analysis parameters (amount of waste in place, contaminant concentrations in waste, etc.) indicated a simplified approach would be more appropriate. Because of the simplifying assumptions that would be adopted for 1D vertical transport modeling, the results from transport modeling should be very similar to those presented here.

COMPOUNDS CONSIDERED IN ANALYSIS

To determine which volatile organic compounds (VOC) and semivolatile organic compounds (SVOC) to use in this analysis, the detection frequency for all VOC/SVOC compounds of concern at RFETS was computed. Only those compounds tested for in at least 100 samples, and with a detection frequency of at least 5% were included in the leachate concentration calculations. The compounds and their detection frequency are listed in Table 1.

TABLE 1: Compounds Used in Analysis

COMPOUNDS WITH A DETECTION FREQUENCY OF AT LEAST 5%					
COMPOUND	CAS ID	Non-detects	Detects	Total	% Detects
ACETONE	67-64-1	2713	463	3176	15
CARBON TETRACHLORIDE	56-23-5	4576	1060	5636	19
CHLOROFORM	67-66-3	4477	1177	5654	21
1,1 DICHLOROETHANE	75-34-3	5345	341	5686	6
1,1-DICHLOROETHENE	75-35-4	5215	463	5678	8
1,2-DICHLOROETHENE	540-59-0	2875	338	3213	11
DIETHYL PHTHALATE	84-66-2	552	63	615	10
DI-n-BUTYL PHTHALATE	84-74-2	569	45	614	7
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	470	143	613	23
METHYLENE CHLORIDE	75-09-2	4607	1038	5645	18
TETRACHLOROETHENE	127-18-4	4054	1620	5674	29
1,1,1-TRICHLOROETHANE	71-55-6	5150	516	5666	9
TRICHLOROETHENE	79-01-6	4025	1653	5678	29

DETERMINATION OF LEACHATE CONCENTRATIONS

For this analysis the VOC/SVOC contaminated soils in the waste cell were considered to be directly exposed to rain and snow fall. Leachate concentrations were calculated assuming the soils at the base of the waste soil pile were saturated. This assumption is conservative and will provide maximum leachate concentrations. Drainage from unsaturated soils would result in somewhat lower concentrations.

The saturated-soil, contaminant water concentrations were calculated using the soil-groundwater partitioning equation, as presented in EPA (1994). This equation describes the partitioning of a contaminant between solid, liquid, and gaseous phases assuming equilibrium conditions. It is assumed that the concentrations of the interstitial water in the soil waste is representative of the maximum concentrations of any leachate that would be collected from the waste cell facility. Dilution from other waters collecting in the waste cell are not considered in these calculations. The soil/water partitioning equation is defined as:

$$C_w = C_s / \ [Kd + (\theta_w + \theta_a H') / \rho_b]$$

where:

- C_w is the soil water concentration
- C_s is the contaminant concentration in the waste soils
- Kd is the soil-water partitioning coefficient
- θ_w is the water-filled porosity of the waste soils
- θ_a is the air-filled porosity of the waste soils
- H' is the Henry's Law constant
- ρ_b is the representative bulk density of the waste soils

The contaminant concentrations in the waste soils were assumed to be equal to the values defined by the Universal Treatment Standards (UTS) (Table 2). These values were selected because soils placed in the waste cell will be required to meet the UTS criteria. In many cases, the concentrations of contaminants in the soils placed in the cell will be significantly lower than those defined by the UTS. This is because of the efficiency of the soil treatment technology and/or low initial soil concentrations.

Because waste soils will be coming from various locations within RFETS, values representative of sitewide conditions at RFETS were used for several of the parameters during the calculations. The partitioning coefficients (Kd), which are chemical specific, were computed using the appropriate chemical specific parameters, and representative RFETS sitewide values for environmental parameters. The water filled porosity (θ_w) and soil bulk density (ρ_b) were assumed as 0.40 and 1.5 gm/cm^3 respectively. Since the soils were considered saturated, the Henry's Law constant and air filled porosity values were not used in the calculations.

Table 2 presents the computed maximum soil water (leachate) concentrations. In addition, the partitioning coefficients (Kd) and UTS soil concentration data used in the calculations are also listed. For comparison purposes the maximum soil concentration observed to date for each compound at RFETS is also listed. Contaminant concentrations greater than those historically observed may be encountered during full scale excavation of contaminant source areas.

TABLE 2: Computed Leachate Concentrations

COMPOUND	Kd	UTS Soil Concen.	Maximum RFETS Soil Concen.	Water Concen.
	(ml/g)	(mg/kg)	(mg/kg)	(mg/L)
ACETONE	0.80	160	5100	150
CARBON TETRACHLORIDE	2.5	6	25000	2.1
CHLOROFORM	1.8	6	63	3.0
1,1 DICHLOROETHANE	1.7	6	0.049	3.1
1,1 DICHLOROETHENE	1.9	6	2	2.8
1,2 DICHLOROETHENE	1.6	30	1.2	16
DIETHYL PHTHALATE	2.1	28	3.1	12
DI-n-BUTYL PHTHALATE	7.5	28	43	3.6
BIS(2-ETHYLHEXYL) PHTHALATE	198	28	190	0.14
METHYLENE CHLORIDE	1.3	30	2400	19
TETRACHLOROETHYLENE	2.7	6	13000	2.0
1,1,1-TRICHLOROETHANE	2.2	6	240	2.5
TRICHLOROETHENE	2.2	6	16	2.5

REFERENCES

EPA, 1994, Soil Screening Guidance (Draft), EPA/540/R-94/101.

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ANALYSIS OF INORGANIC CONSTITUENTS AND PROBABLE LEACHATE COMPOSITION FROM WASTE STORED IN THE NEW WASTE CELL AT THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE, GOLDEN, COLORADO

March 29, 1996

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Rocky Mountain Remediation Services

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1.0 INTRODUCTION

The composition and volume of wastes to be placed in the proposed Waste Cell at Rocky Flats Environmental Technology Site (RFETS) were evaluated as part of the preparatory analysis for design and construction of the Cell. This report presents an assessment of the inorganic constituents in the waste, as well as estimations of the probable composition of leachate that may emanate from wastes stored in the Cell.

Wastes to be disposed of in the Cell include a variety of materials from a number of Operable Units (OUs) at RFETS. The estimated proportions, by volume, of waste to be placed in the cell are as follows:

OU4 vadose-zone soils	24.1%
OU4 pondcrete	14.5%
OU2 903 Pad and Lip	14.5%
OU4 asphalt liners	14.2%
OU4 subgrade & subsoils	14.2%
OU4 sludge	7.2%
OU9 tanks 14 & 16	4.0%
OU2 mound area	1.8%
OU2 trenches T-5 to T-11	1.2%
OU2 trench T-1	1.2%
OU4 debris	0.8%
OU9 tanks 9 & 10	0.6%
OU2 trench T-3	0.3%
OU2 trench T-4	0.3%
OU10 tank 40	0.2%
IDM wastes	0.2%
OU1 IHSS 119.1	0.1%
Misc. hot spots	0.1%

Chemical analyses of solid materials and groundwater from these areas, in addition to analytical data for leachates derived from Operable Unit 4 (OU4) pondcrete and sludges, were compiled and evaluated for this assessment. Data used in this analysis were retrieved from the Rocky Flats Environmental Database System (RFEDS) and from treatability reports for OU4 pondcrete and sludges. Only data for inorganic constituents are evaluated here; data for organic compounds were evaluated as a separate task.

Analytical data for subsurface soils (i.e., borehole data) and groundwater were obtained from RFEDS. These data were compiled as SAS7 data sets, prepared following standard data-cleanup protocols, and statistically summarized. Locations for which borehole and groundwater data were available are listed in Tables 1 and 2, respectively.

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Table 1.
Sampling Locations with Data Available for Subsurface Soils

Metals		Radionuclides		'"Water-Quality"	
02695	13091	02695	13091	02695	13091
02795	21793	02795	21793	02795	21793
02895	40293	02895	40293	02895	40293
02995	40393	02995	40393	02995	40393
04795	40593	04795	40593	*	40593
04895	40793	04895	40793	*	40793
04995	40993	04995	40993	*	40993
05095	41293	05095	41293	*	41293
06591	41593	06591	41593	06591	41593
06691	41793	06691	41793	06691	41793
06791	42193	06791	42193	06791	42193
06891	42493	06891	42493	06891	42493
06991	42593	06991	42593	06991	42593
07091	43193	07091	43193	07091	43193
07191	43393	07191	43393	07191	43393
07291	43693	07291	43693	07291	43693
07391	43793	07391	43793	07391	43793
07891	44093	07891	44093	07891	44093
07991	44393	07991	44393	07991	44393
08091	B217589	08091	B217589	08091	B217589
08191	BH2287	08191	BH2287	08191	BH2287
08291	BH2387	08291	BH2387	08291	BH2387
08391	BH2487	08391	BH2487	08391	BH2487
08491	BH3587	08491	BH3587	08491	BH3587
08591	BH3687	08591	BH3687	08591	BH3687
08691	BH3787	08691	BH3787	08691	BH3787
08791	BH3987	08791	BH3987	08791	BH3987
08891	BH4087	08891	BH4087	08891	BH4087
08991	BH4287	08991	BH4287	08991	BH4287
09091	BH4387	09091	BH4387	09091	BH4387
09191	BH4687	09191	BH4687	09191	BH4687
09391	BH4887	09391	BH4887	09391	BH4887
09591	BH4987	09591	BH4987	09591	BH4987
09891	BH5087	09891	BH5087	09891	BH5087
09991	BH5187	09991	BH5187	09991	BH5187
10191	BH5287	10191	BH5287	10191	BH5287
10291	BH5387	10291	BH5387	10291	BH5387
10491	BH5487	10491	BH5487	10491	BH5487
10591	BH5587	10591	BH5587	10591	BH5587

Asterisk (*) indicates that data were not available for this location.

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Table 2.
Sampling Locations with Data Available for Groundwater Samples

Metals		Radionuclides		Water-Quality
Dissolved	Total	Dissolved	Total	Unfiltered *
*	*	*	*	02695
*	*	*	02795	02795
•	02895	*	*	02895
*	*	*	02995	02995
*	*	*	*	04795
*	*	*	*	04895
*	*	•	*	04995
06591	06591	06591	06591	06591
06691	06691	06691	06691	06691
06791	06791	06791	06791	06791
06891	06891	06891	06891	06891
06991	06991	06991	06991	06991
*	*	*	*	*
07191	07191	07191	07191	07191
07291	*	07291	07291	07291
07391	07391	07391	07391	07391
07891	07891	07891	07891	07891
07991	07991	07991	07991	07991
*	*	08091	08091	08091
*	*	*	*	08391
*	*	*	*	08591
08891	08891	08891	08891	08891
09091	09091	09091	09091	09091
13091	13091	13091	13091	13091
B217589	*	B217589	B217589	B217589

Asterisk (*) indicates that data were not available for this location.

* Samples collected for analysis of anions and water-quality paramters are not filtered; however, anions are assumed to exist in the dissolved state.

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Data for OU4 vadose-zone waters were obtained from tables in the *OU4 Proposed IM/IRA EA Decision Document*, dated February 10, 1995 (EG&G, 1995a). Data for OU4 pondcrete and sludges were available in *Treatability Study Report and Process Formulation Report for Pondcrete* (EG&G, 1995b) and *Treatability Study Report and Process Formulation Report for Pond Sludge and Clarifier* (EG&G, 1995c). Unfortunately, the data presented in these treatability studies do not include major-ion compositions of the leachates; only data for selected radionuclides and trace metals, nitrate, and pH are given. Without major-ion data, standard geochemical modeling cannot be performed for the pondcrete and sludge leachates.

2.0 DATA ANALYSIS

Standard data-treatment protocols for RFEDS data call for the exclusion of QC data from the real-sample data, removal of rejected data (validation code = "R"), and the standardization of units and analyte names. Computation of summary statistics used a simple replacement value of one-half the result for nondetects. One-half the result was used instead of one-half the detection limit, in order to minimize the problems associated with high-value detection limits (i.e., the contract-required reporting limits [CRDL]) reported in the detection-limit field for some records.

Because distributional testing was not performed, these summary statistics should be considered only a general approximations of the true mean. In addition, the user should be cognizant of the detection rate for each analyte; as the detection rate decreases, the calculated mean value is generally less representative of the true population mean (i.e., the mean becomes more strongly influenced by the nondetect replacement values). Subsurface-soil data for background and waste populations were compared using analysis of variance (ANOVA) testing (Wilcoxon Rank Sum). Electronic data were not available to conduct ANOVA testing for pondcrete and sludge samples. Results of the ANOVA testing, as well as a discussion of their meaning, are given in the following sections.

2.1 Subsurface Soil

Data for subsurface soils were available for borehole locations in the 903 Pad and Lip Area, OU2 Mound Area, OU2 Trench T-1, OU2 Trench T-3, OU2 Trench T-4, OU2 Trenches T-5 through T-11, OU9 Tanks 9 & 10, OU10 Tank 40, and OU4 (see Table 1). The largest volume of subsurface soils to be placed in the Cell are the vadose-zone soils of OU4. These subsurface soils comprise an estimated 24.1%, by volume, of all wastes destined for the Cell.

Overall detection rates were calculated for each analyte in the subsurface-soil medium. Quality parameters, such as pH, were also evaluated for these soils. In general, the subsurface soils exhibit a neutral to alkaline condition; pH ranges from 6.23 to 11.0, with a mean value of 8.1. Most metals and radionuclides are less leachable under neutral to alkaline conditions than under a lower pH (i.e., more acidic), so a mean pH of 8.1 is favorable for decreasing the mobility of most constituents of concern. However, the mobility of anionic species, such as nitrate, is not greatly dependent on pH.

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To put the inorganic composition of the waste soils in context, data for soils destined for the Cell were compared with data for background subsurface soils. Background data were obtained on diskette from the *Background Geochemical Characterization Report* (DOE, 1993); only data for the upper hydrostratigraphic unit (UHSU) were used. Summary statistics and detection rates for inorganic analytes in both groups (i.e., waste and background) are shown in Tables 3a and 3b. However, the numbers shown here for the waste soils do not include the data for OU4 pondcrete and sludges, which are estimated to comprise 21.7 percent (by volume) of all waste destined for the Cell. Pondcrete and sludges are addressed separately in Sections 2.4 and 2.5 of this report.

The comparison of waste soils and background soils provides a sort of "reality check" for the general nature of the waste. As shown in the right-hand column of Table 4, the results of nonparametric ANOVA (Wilcoxon Rank Sum) indicate whether or not the two groups (i.e., waste soils and background soils) show statistically significant differences in composition. Taken at the 95-percent confidence level, a p-value of <0.05 indicates a significant difference. Of course, the results of any statistical analysis must be subjected to the scrutiny of professional judgment. A good point in case is the insignificant p-value obtained for tritium. Clearly, some of the waste soils contain substantially higher levels of tritium than do the background soils; however, the huge variance in tritium activities seen for waste soils produces huge uncertainties (i.e., the assumption of equal variances is violated), and, consequently poor power of discernment for the statistical tests. In such cases, an alternative statistical test, such as the quantile test, would have more power than the Wilcoxon test to detect differences between the two populations.

Concentrations of nitrate/nitrite in waste materials are obviously higher than those in background soils, but a significant p-value is not seen, due to the statistical violations discussed in the previous paragraph. The large variances seen for nitrate/nitrite concentrations and tritium activities invalidate the negative ANOVA results for these analytes. The mean and standard deviation for these two analytes, clearly indicate that some of the waste soils contain levels of nitrate/nitrite and tritium that are well above those seen for background soils. Overall, based on results of the ANOVA testing, the waste soils contain significantly higher levels of arsenic, calcium, americium-241, cesium-137, gross alpha, plutonium-239+240, tritium, uranium-233+234, uranium-235, and uranium-238.

2.2 OU4 Vadose-Zone Water

Pore water from the vadose zone in OU4 was collected in a series of lysimeters installed as part of the Phase-1 vadose-zone monitoring in OU4. Data for OU4 pore waters were obtained from tables in the *OU4 Proposed IM/IRA EA Decision Document*, dated February 10, 1995 (EG&G, 1995a), and are compiled here as Tables 5 and 6.

As discussed in the OU4 Decision Document, analyses of pore-water samples and soil materials from the same location were used to derive an estimated, chemical-specific partition coefficient, K_d, for selected trace metals, radionuclides, and nitrate. These K_d values, along with values obtained from the literature were presented in the Treatability Reports for pondcrete and sludges (EG&G, 1995b and 1995c).

Table 3a.
Summary of Data for Subsurface Soils: Waste Boreholes

Analyte	N	% Detects	Min	Max	Mean	Std. Dev.	Units
Aluminum	354	100.0	931	39100	9940	4907	MG/KG
Antimony	333	4.8	1.6	22.4	5.2	2.5	MG/KG
Arsenic	354	92.7	0.3	30.8	5.8	4.9	MG/KG
Barium	354	86.2	16.8	4150	120	332	MG/KG
Beryllium	353	45.9	0.055	22.9	0.71	1.23	MG/KG
Cadmium	320	39.4	0.145	547	5.5	41.3	MG/KG
Calcium	354	99.7	500	232000	22900	41010	MG/KG
Cesium	247	69.2	225	116.5	19.0	27.6	MG/KG
Chromium	354	99.2	1.0	304	14.6	24.4	MG/KG
Cobalt	354	66.4	0.6	78.1	6.6	6.0	MG/KG
Copper	354	91.2	1.8	132	12.3	9.8	MG/KG
Iron	354	100.0	1010	50800	12710	7225	MG/KG
Lead	354	100.0	1.2	278	13.4	28.4	MG/KG
Lithium	243	84.0	0.115	50.8	7.5	6.8	MG/KG
Magnesium	354	94.9	231	6300	2276	979	MG/KG
Manganese	354	100.0	1.3	3140	247	391	MG/KG
Mercury	354	26.8	0.023	6.00	0.088	0.328	MG/KG
Molybdenum	239	21.3	0.415	19.0	2.0	2.5	MG/KG
Nickel	354	84.5	2.15	173	14.7	15.4	MG/KG
Potassium	354	78.5	100	12600	1325	1074	MG/KG
Selenium	354	4.5	0.08	3.4	0.34	0.34	MG/KG
Silicon	216	98.2	1.35	14000	920	1535	MG/KG
Silver	351	10.5	0.16	96.5	1.4	6.3	MG/KG
Sodium	354	57.1	0.8	5990	419	791	MG/KG
Strontium	354	85.0	6.9	220	45.4	39.5	MG/KG
Thallium	353	16.4	0.095	1.00	0.46	0.37	MG/KG
Tin	242	28.1	1.55	91.1	18.0	12.3	MG/KG
Vanadium	354	97.7	5.0	82.2	26.7	12.8	MG/KG
Zinc	354	99.7	2.0	437	41.8	42.6	MG/KG
Ammonia	148	32.4	0.155	8.6	0.56	1.15	MG/KG
Chromium IV	12	16.7	0.265	0.86	0.40	0.22	MG/KG
Cyanide	275	12.7	0.07	43	0.98	2.94	MG/KG
Nitrate/Nitrite	208	80.3	0.0	6100	119	529	MG/KG
Oil & Grease	55	23.6	0.85	508	15.3	76.2	MG/KG
Petroleum Hydrocarbon	35	97.1	2.93	394	134	114	MG/KG
Sulfide	304	9.9	1.0	200	42.6	49.9	MG/KG
TOC	154	98.7	31.2	19200	982	2083	MG/KG
pH	276	100.0	6.23	11.0	8.1	0.5	PH
Americium-241	319	81.5	-0.06	25.0	0.277	1.696	PCi/G
Cesium-134	44	100	0.005	0.15	0.078	0.036	PCi/G
Cesium-137	318	90.9	-0.8	4.7	0.11	0.39	PCi/G
Gross alpha	305	100.0	-7.9	380	26	32.4	PCi/G
Gross beta	346	100.0	2.54	56.7	22.9	7.4	PCi/G
Plutonium-238	13	100	-0.002	0.205	0.036	0.062	PCi/G
Plutonium-239+240	333	88.0	-0.11	94	1.13	7.09	PCi/G
Radium-226	152	94.7	0.23	1.9	0.67	0.26	PCi/G
Radium-228	155	100.0	0.50	3.00	1.460	0.51	PCi/G
Strontium-89+90	315	75.2	-0.50	1.10	1.76	0.24	PCi/G
Strontium-90	6	100.0	-0.21	1.08	0.39	0.55	PCi/G
Tritium	336	74.4	-570	62000	1537	5764	PCi/G
Uranium-233+234	342	100.0	0.045	192	1.75	10.51	PCi/G
Uranium-235	237	90.7	-0.005	11.5	0.118	0.749	PCi/G
Uranium-238	352	100.0	0.23	113	1.44	6.21	PCi/G

Summary statistics calculated for RFEDS data compiled for this assessment, assuming a normal distribution.

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Table 3b.
Summary of Data for Subsurface Soils: Background Boreholes

Analyte	N	% Detects	Min	Max	Mean	Std. Dev.	Units
Aluminum	98	99.0	279	102000	12710	11330	MG/KG
Antimony	66	15.2	0.95	23.5	4.5	3.7	MG/KG
Arsenic	99	70.7	0.27	41.8	3.6	4.4	MG/KG
Barium	99	88.9	12.9	777	96.1	96.6	MG/KG
Beryllium	99	81.8	0.45	23.5	4.7	4.8	MG/KG
Cadmium	81	7.4	0.08	1.5	0.6	0.3	MG/KG
Calcium	99	99.0	580	157000	7053	16180	MG/KG
Cesium	95	1.1	81.8	1415	130.0	135	MG/KG
Chromium	99	84.8	2.1	176	18.8	24.7	MG/KG
Cobalt	99	22.2	1.9	51.4	6.4	7.1	MG/KG
Copper	99	95.0	2.2	123	12.6	12.8	MG/KG
Iron	99	100.0	1300	132000	14530	13260	MG/KG
Lead	99	99.0	2	39.8	10.8	7.1	MG/KG
Lithium	99	61.6	1.4	83.2	10	8.5	MG/KG
Magnesium	99	96.0	356	32500	2853	3246	MG/KG
Manganese	99	100.0	37	3330	218	342	MG/KG
Mercury	86	25.6	0.025	2.95	0.19	0.34	MG/KG
Molybdenum	99	50.5	1	67.6	10.9	8.6	MG/KG
Nickel	96	85.4	4.3	193	19.8	20.6	MG/KG
Potassium	98	52.0	186	18700	1404	2064	MG/KG
Selenium	82	2.4	0.11	6.8	0.9	1.2	MG/KG
Silver	83	39.8	0.3	40.9	5.6	9.5	MG/KG
Silicon	*	*	*	*	*	*	
Sodium	99	17.2	63	3680	304	422	MG/KG
Strontium	99	36.4	10.2	242	52	48.3	MG/KG
Thallium	75	4.0	0.1	2.45	0.5	0.5	MG/KG
Tin	92	27.2	10.1	441	62.5	112	MG/KG
Vanadium	99	98.0	4.2	283	31.5	28.5	MG/KG
Zinc	98	92.9	0.5	486	36.3	51.4	MG/KG
Ammonia	*	*	*	*	*	*	MG/KG
Chromium IV	*	*	*	*	*	*	MG/KG
Cyanide	*	*	*	*	*	*	MG/KG
Nitrate/Nitrite	98	39.8	0.5	7.1	1.3	1.1	MG/KG
Oil & Grease	*	*	*	*	*	*	MG/KG
Petroleum Hydrocarbon	*	*	*	*	*	*	MG/KG
Sulfide	89	16.8	1.0	43000	485	4558	MG/KG
TOC	*	*	*	*	*	*	MG/KG
pH	97	100.0	6.1	9.1	8.0	0.7	PH
Americium-241	28	"100"	-0.015	0.01	-0.002	0.007	PCi/G
Cesium-134	*	*	*	*	*	*	PCi/G
Cesium-137	99	"100"	0	0.2	0.012	0.041	PCi/G
Gross alpha	99	"100"	5	48	24.9	9.3	PCi/G
Gross beta	99	"100"	6	44	24.7	6.1	PCi/G
Plutonium-238	*	*	*	*	*	*	PCi/G
Plutonium-239+240	99	"100"	-0.01	0.03	0.004	0.007	PCi/G
Radium-226	83	"100"	0.5	1.3	0.75	0.23	PCi/G
Radium-228	83	"100"	0.50	2.20	1.40	0.32	PCi/G
Strontium-89+90	99	"100"	-0.60	1.20	0.03	0.36	PCi/G
Strontium-90	*	*	*	*	*	*	PCi/G
Tritium	99	"100"	-150	440	142	127	PCi/G
Uranium-233+234	99	"100"	0.2	8.9	0.78	0.93	PCi/G
Uranium-235	99	"100"	0	0.2	0.02	0.05	PCi/G
Uranium-238	99	"100"	0.2	3.2	0.73	0.38	PCi/G

Summary statistics calculated for RFEDS data compiled for this assessment, assuming a normal distribution.
Asterisk (*) indicates that data are not available. The "100" indicates that no records were qualified as nondetects.

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Table 4.
Comparison of Concentrations of Inorganic Constituents in Waste-Cell Subsurface Soils vs. Background Subsurface Soils

ANALYTE	DETECTIONS		HIGHER	MEAN CONCENTRATIONS		MEAN + 2 SD		UNITS	Wilcoxon
	Waste Cell	UHSU Bkgd	% DETECT	Waste Cell	UHSU Bkgd	Waste Cell	UHSU Bkgd		p-values
Aluminum	100.0	99.0	Cell	9940	12710	19754	35380	MG/KG	0.0155 @
Antimony	4.8	15.2	Back	*	*	*	*	MG/KG	*
Arsenic	92.7	70.7	Cell	5.8	3.6	15.6	12.4	MG/KG	0.0001 @
Barium	86.2	88.9	Back	120	96.1	784	290	MG/KG	0.4236
Beryllium	45.9	81.8	Back	0.7	4.7	3.2	14.3	MG/KG	0.0001 @
Cadium	39.4	7.4	Cell	5.5	*	88.1	*	MG/KG	*
Calcium	99.7	99.0	Cell	22900	7052	104910	39410	MG/KG	0.0001 @
Cesium	69.2	1.1	Cell	19.0	*	74.2	*	MG/KG	*
Chromium	99.2	84.8	Cell	14.6	18.8	63.6	68.2	MG/KG	0.0040 @
Cobalt	66.4	22.2	Cell	6.6	6.4	18.6	20.6	MG/KG	0.1184
Copper	91.2	95.0	Back	12.2	12.6	32.0	38.2	MG/KG	0.9263
Iron	100.0	100.0	*	12710	14530	27160	41046	MG/KG	0.0651
Lead	100.0	99.0	Cell	13.4	10.8	70.2	25.0	MG/KG	0.3489
Lithium	84.0	61.6	Cell	7.5	10.0	21.1	27.0	MG/KG	0.0010 @
Magnesium	94.9	96.0	Back	2276	2853	4234	9345	MG/KG	0.1410
Manganese	100.0	100.0	*	247	218	1028	902	MG/KG	0.6382
Mercury	26.8	25.6	Cell	0.09	0.19	0.75	0.87	MG/KG	0.0001 @
Molybdenum	21.3	50.5	Back	2.0	10.9	7.0	28.1	MG/KG	0.0001 @
Nickel	84.5	85.4	Back	14.7	19.8	45.5	61.0	MG/KG	0.0001 @
Potassium	78.5	52.0	Cell	1325	1404	3473	5532	MG/KG	0.8680
Selenium	4.5	2.4	Cell	*	*	*	*	MG/KG	*
Silicon	98.2	39.8	Cell	920	ND	3990	ND	MG/KG	NA
Silver	10.5	17.2	Back	*	*	*	*	MG/KG	*
Sodium	57.1	36.4	Cell	419	304	2000	1148	MG/KG	0.5814
Strontium	85.0	36.4	Cell	45.4	52.0	124	149	MG/KG	0.5690
Thallium	16.4	4.0	Cell	*	*	*	*	MG/KG	*
Tin	28.1	27.7	Cell	18.0	62.5	42.6	286	MG/KG	0.9318
Vanadium	97.7	98.0	Back	26.7	31.5	52.3	88.5	MG/KG	0.0533
Zinc	99.7	92.9	Cell	41.8	36.3	127	139	MG/KG	0.0713
Americium-241	81.5	"100"	NA	0.277	0.00	3.67	0.01	PCi/G	0.0001 @
Cesium-134	100	"100"	NA	0.078	ND	0.15	ND	PCi/G	NA
Cesium-137	90.9	"100"	NA	0.11	0.01	0.89	0.09	PCi/G	0.0001 @
Gross alpha	100	"100"	NA	26.0	24.9	90.8	43.5	PCi/G	0.0481 @
Gross beta	100	"100"	NA	22.9	24.7	37.7	36.8	PCi/G	0.0046 @
Plutonium-238	100	"100"	NA	0.036	ND	0.16	ND	PCi/G	NA
Plutonium-239+240	88.0	"100"	NA	1.13	0.00	15.3	0.02	PCi/G	0.0001 @
Radium-226	94.7	"100"	NA	0.67	0.74	1.19	1.21	PCi/G	0.0037 @
Radium-228	100	"100"	NA	1.46	1.40	2.47	2.04	PCi/G	0.6431
Strontium-89+90	75.2	"100"	NA	0.18	0.03	0.66	0.75	PCi/G	0.0001 @
Tritium	74.4	"100"	NA	1537	142	13065	396	PCi/L	0.1770
Uranium-233+234	100	"100"	NA	1.75	0.78	22.8	2.6	PCi/G	0.0005 @
Uranium-235	90.7	"100"	NA	0.12	0.02	1.62	0.11	PCi/G	0.0001 @
Uranium-238	100	"100"	NA	1.44	0.73	13.9	1.5	PCi/G	0.0001 @
Ammonia	32.4	ND	NA	0.56	ND	2.9	ND	MG/KG	NA
Chromium-VI	16.7	ND	NA	0.4	ND	0.83	ND	MG/KG	NA
Cyanide	12.7	ND	NA	0.98	ND	6.86	ND	MG/KG	NA
Nitrate/Nitrite	80.3	39.8	Cell	119	1.2	1177	3.4	MG/KG	0.4491
Oil and Grease	23.6	ND	NA	15.3	ND	168	ND	MG/KG	NA
Petro. Hydrocarb	97.1	ND	NA	134	ND	362	ND	MG/KG	NA
Sulfide	9.9	16.8	Back	*	*	*	*	MG/KG	*
TOC	98.7	ND	NA	982	ND	5148	ND	MG/KG	NA
pH	100	100	*	8.1	8.0	9.2	9.4	MG/KG	0.5194

NA = Not Applicable; ND = No Data; * = < 20% Detects, Mean Not Calculated; "100" means 100% detection is assumed (per DOE Order 5400.1).

Nonparametric ANOVA testing was performed using the Wilcoxon Rank Sum test; please see text for discussion and qualification of these results.

An @ indicates that the Wilcoxon test is significant (P-value < 0.05).

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Table 5.
Pore-Water Data for pH and Specific Conductivity

Lysimeter Location	pH		Specific Conductivity (uS)	
	Range	Mean	Range	Mean
40293	10.8-12.6	11.7	2.06-5.01	3.54
40393	10.8-12.9	11.6	1.62-2.58	1.94
40593	7.9-9.1	8.5	1.78-1.88	1.83
40793	9.8-10.9	10.2	0.52-1.18	0.81
40993	6.8-10.3	9.0	8.14-19.9	16.18
40993	6.9-10.9	9.5	NA	19.99
41293	9.0-11.0	10.1	1.11-2.68	2.24
41593	6.2-9.0	6.8	1.24-19.9	15.04
41793	7.8-12.2	9.8	1.06-7.61	2.27
42493	NA	7.6	NA	2.04
42493	7.0-7.8	7.3	1.43-2.64	2.22
42893	7.0-7.8	7.3	0.77-2.47	1.93
43193	7.4-7.9	7.7	2.76-4.55	3.25
43193	6.5-7.3	7.0	8.55-11.22	9.72
43693	7.0-7.8	7.4	4.36-19.9	18.19
43793	7.1-9.7	8.2	1.15-2.90	2.11
43793	8.1-11.4	10.8	2.18-3.84	3.02
44093	6.9-9.6	8.0	0.51-1.29	0.90
44093	8.0-8.5	8.2	2.57-3.20	2.91
44393	7.3-9.8	8.5	0.50-1.35	1.03
44393	9.9-11.5	10.4	0.86-2.50	1.09

Summary data from OU4 IM/IRA EA Decision Document, Draft February 10, 1995.

NA = Not applicable.

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Table 6.
Summary of Pore-Water Data for OU4 Lysimeters

Analyte	N	% Detects	Min	Max	Mean	Units
Aluminum	67	37.3	25	10700	984	UG/L
Antimony	66	56.1	0	ND	ND	UG/L
Arsenic	66	90.1	0	120	8.4	UG/L
Barium	67	86.6	0	1470	122	UG/L
Beryllium	66	56.1	0	ND	ND	UG/L
Cadmium	68	14.7	3	54	14	UG/L
Calcium	66	95.4	0	3490000	110200	UG/L
Cesium	27	11.1	39	75	59	UG/L
Chromium	66	60.1	0	10200	255	UG/L
Cobalt	67	58.2	0	2100	60.2	UG/L
Copper	68	14.7	6	900	107	UG/L
Iron	69	63.8	28	37400	1800	UG/L
Lead	70	47.1	1	1110	48.2	UG/L
Lithium	27	66.7	24	6170	984	UG/L
Magnesium	65	87.7	0	236000	20120	UG/L
Manganese	69	73.9	1	13100	925	UG/L
Mercury	70	0.0	ND	ND	ND	UG/L
Molybdenum	26	53.8	26	3660	547	UG/L
Nickel	66	68.2	0	6460	160	UG/L
Potassium	67	91.0	0	11400000	308700	UG/L
Selenium	66	74.2	0	19	1.4	UG/L
Silicon	26	96.2	11300	288000	71320	UG/L
Silver	69	24.6	4	21	10.3	UG/L
Sodium	66	98.5	0	24000000	905400	UG/L
Strontium	26	96.2	190	20100	2613	UG/L
Thallium	67	56.7	0	89	2.3	UG/L
Tin	27	0.0	ND	ND	ND	UG/L
Vanadium	66	71.2	0	730	24.8	UG/L
Zinc	69	75.4	6	1270	104	UG/L
Nitrate/Nitrite	77	97.4	4	17600000	1064020	UG/L
Sulfide	13	46.2	1	43000	17900	UG/L
Cyanide	18	11.1	0	1000	500	UG/L
Americium-241	1	0.0	ND	ND	ND	PCi/L
Gross alpha	15	66.7	4	6300	706	PCi/L
Gross beta	15	100.0	4	5400	433	PCi/L
Plutonium-239+240	1	100.0	0	0.013	0.013	PCi/L
Radium-226	9	100.0	0	6	1.804	PCi/L
Radium-228	2	100.0	3	5	4.150	PCi/L
Strontium-89+90	1	100.0	1	1	0.60	PCi/L
Total Radiocesium	1	0.0	ND	ND	ND	PCi/L
Tritium	14	35.7	620	5600	2384	PCi/L
Uranium-233+234	14	100.0	1	3400	274	PCi/L
Uranium-235	14	85.7	0	120	11.48	PCi/L
Uranium-238	15	100.0	0	3700	264.5	PCi/L

Summary data from OU4 IM/IRA EA Decision Document, Draft February 10, 1995. ND = not defined.

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The formula used to calculate K_d values from lysimeter data was as follows:

$$K_d = \frac{\text{Concentration in solid phase (i.e., subsurface soil)}}{\text{Concentration in the liquid phase (i.e., pore water)}}$$

These derived K_d values were then refined through model calibration (EG&G, 1995b). In addition, the K_d values from literature sources were also reviewed for comparison to these calculated K_d values (see Tables 7a and 7b).

In addition to using K_d values to determine what concentration in soils will lead to exceedances of groundwater standards, the geochemical modeling of vadose-zone water (i.e., pore water) would be helpful in providing a picture of rock/water interaction under varying Eh-pH conditions. Unfortunately, analyses of major anions (e.g., bicarbonate, chloride, sulfate, etc.) are not reported in the Decision Document, so geochemical modeling cannot be performed separately for vadose-zone waters.

2.3 OU4 Pondcrete

Treatability studies, conducted in support of pondcrete disposal at RFETS, evaluated the leachability of pondcrete. Pondcrete samples were subjected to the toxicity characteristic leaching procedure (TCLP), and the subsequent leachate analyzed for organic and inorganic constituents. These treatability studies evaluated both treated and untreated pondcrete, and both the "triwall" pondcrete and the "metals" pondcrete, which are so-called based on the type of storage container (EG&G, 1995b). Treatment of pondcrete involved the addition of lime, concrete, and fly ash to stabilize the pondcrete material.

Waste acceptance criteria (WAC) were used to determine whether or not leachate derived from treated and untreated pondcrete would meet disposal standards. The liquid-phase WAC is defined as "...the chemical-specific leachate concentration generated from the waste material in an engineered disposal facility which will ensure an acceptable groundwater concentration at the point of compliance (POC) within a required protective time frame" (EG&G, 1995b). The WAC for selected metals and radionuclides for the 1-inch-per-year infiltration rate (assumed as typical for RFETS) were given in tables in the Pondcrete Treatability Report (EG&G, 1995b), and are as follows:

Radionuclides	Waste Criteria	Metals & Nitrate	Waste Criteria
Americium-241	74.5 pCi/L	Arsenic	142 □g/L
Cesium-134	12,800 pCi/L	Beryllium	14.2 □g/L
Cesium-137	737 pCi/L	Cadmium	51.8 □g/L
Plutonium-239+240	4.43 pCi/L	Chromium	881 □g/L
Radium-226	415 pCi/L	Sodium	14,900 □g/L
Uranium-233+234	254 pCi/L	Nitrate	166,000 □g/L
Uranium-235	10.2 pCi/L		
Uranium-238	177 pCi/L		

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Table 7a.
Kd Values (L/kg) for Selected Analytes

Analyte	Calibr'd Kd Vadose Zone	Calibr'd Kd Sat'd Zone	Literature Kd Value	Literature Kd Value	Kd Calculated from Lysimeter	RFETS Vadose	RFETS Sat'd Zone
Americium-241	100	10	8.2 - 300000	700	NA	100	10
Arsenic	2	0.5	*	200	NA	*	*
Beryllium	5	1	250	650	NA	*	*
Cadmium	5	1	2.7 - 625	6.5	597	*	*
Cesium-134	1	0.1	40 - 3968	1000	NA	*	*
Cesium-137	1	0.1	40 - 3968	1000	NA	1	0.1
Chromium	35	1.5	1.7 - 1729	850	NA	*	*
Nitrate	0.01	0.01	*	*	0.127	*	*
Plutonium-239+240	100	20	27 - 36000	4500	NA	100	20
Radium-226	690	106	57 - 21000	450	690	690	106
Sodium	10	1.5	*	100	NA	*	*
Uranium-233+234	17	2	.03 - 2200	450	19.8	17	2
Uranium-235	17	2	.03 - 2200	450	NA	17	2
Uranium-238	17	2	.03 - 2200	450	14.5	17	2

Tables from "Treatability Study Report and Process Formulation Report for Pondcrete," June 1995.
Asterisk (*) indicates data not available in the specific reference. NA = not applicable or not available.

Table 7b.
Kd Values (L/kg) Used at Other DOE Facilities for Selected Radionuclides

Analyte	Oak Ridge	Savannah River	Hanford	INEL Sat'd Zone	INEL Vadose	Fernald Sat'd Zone	Fernald Vadose
Americium-241	40	150	100	NA	NA	10	100
Cesium-137	3000	100	1	20	20	1370	1810
Plutonium-239+240	40	100	100	200	2000	100	1700
Radium-226	3000	500	10	5	50	106	696
Uranium-233+234	40	50	0	100	1000	1.78	3.1
Uranium-235	40	50	0	100	1000	1.78	3.1
Uranium-238	40	50	0	100	1000	1.78	3.1

Tables from "Treatability Study Report and Process Formulation Report for Pondcrete," June 1995.
Asterisk (*) indicates data not available in the specific reference. NA = not applicable or not available.

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Results of the leachate analyses showed a strong dependence between pH and constituent concentrations in the leachate. In general, a moderately alkaline condition (pH = 9 to 11) significantly reduced the concentrations of dissolved trace metals and radionuclides in the leachate (see Figure 1). Nitrate and sodium concentrations were unaffected by variations in pH.

Based on the results of the treatability study, it was determined that pondcrete subjected to "...the treatment process will meet all applicable waste-acceptance criteria..." given stated assumptions (EG&G, 1995b). Only sodium in the treated pondcrete was seen to exceed the waste acceptance criteria (WAC). In contrast, untreated pondcrete leached excessive amounts (i.e., > WAC) of plutonium-239+240, americium-241, uranium-238, beryllium, and cadmium, under a 1-inch-per-year infiltration rate, which is the current best estimate for the infiltration rate at RFETS. Assuming that pondcrete materials are treated prior to placement in the Cell, the possible composition of leachate derived from the stored pondcrete should meet WAC for the scenario of 1-inch-per-year infiltration rate. The mean leachate compositions for pondcrete samples are summarized in Table 8.

The mean concentrations/activities of leachate analytes for **"triwall" pondcrete** are for those samples treated with lime, fly ash, and cement. The mean values for leachate analytes for **"metals" pondcrete** are for those samples treated with lime, fly ash, and cement. For additional details, the reader should refer to the Pondcrete Treatability Report (EG&G, 1995b).

2.4 OU4 Sludges

Sludge samples from the Solar Evaporation Ponds and from the Building 788 clarifier were subjected to TCLP testing, and the subsequent leachate analyzed for organic and inorganic constituents. The leachate was analyzed for selected hazardous constituents, which included arsenic, barium, cadmium, chromium, lead, nickel, sodium, nitrate, and selected radionuclides. These treatability studies evaluated both treated and untreated sludges. Treatment of the sludges involved the addition of lime, concrete, and fly ash to stabilize the sludge materials. Leachability of constituents of concern was determined for both the treated and untreated materials.

As with the pondcrete, results of the leachate analyses for sludges showed a strong dependence between pH and constituent concentrations in the leachate. In general, a moderately alkaline condition (pH = 9 to 11) significantly reduced the concentrations of trace metals and radionuclides in the leachate (see Figure 1).

Based on the results of the treatability study, it was determined that treated sludges will meet all WAC, given the stated assumptions (EG&G, 1995c). Only sodium in the treated sludges was seen to exceed the WAC. In contrast, untreated sludge materials leached excessive amounts (i.e., > WAC) of plutonium-239+240, uranium isotopes, arsenic, beryllium, cadmium, nitrate, and sodium under a scenario of a 1-inch-per-year infiltration rate. Values of WAC are shown in Section 2.3 above. The mean leachate compositions for various sludge materials are listed below and summarized in Table 8.

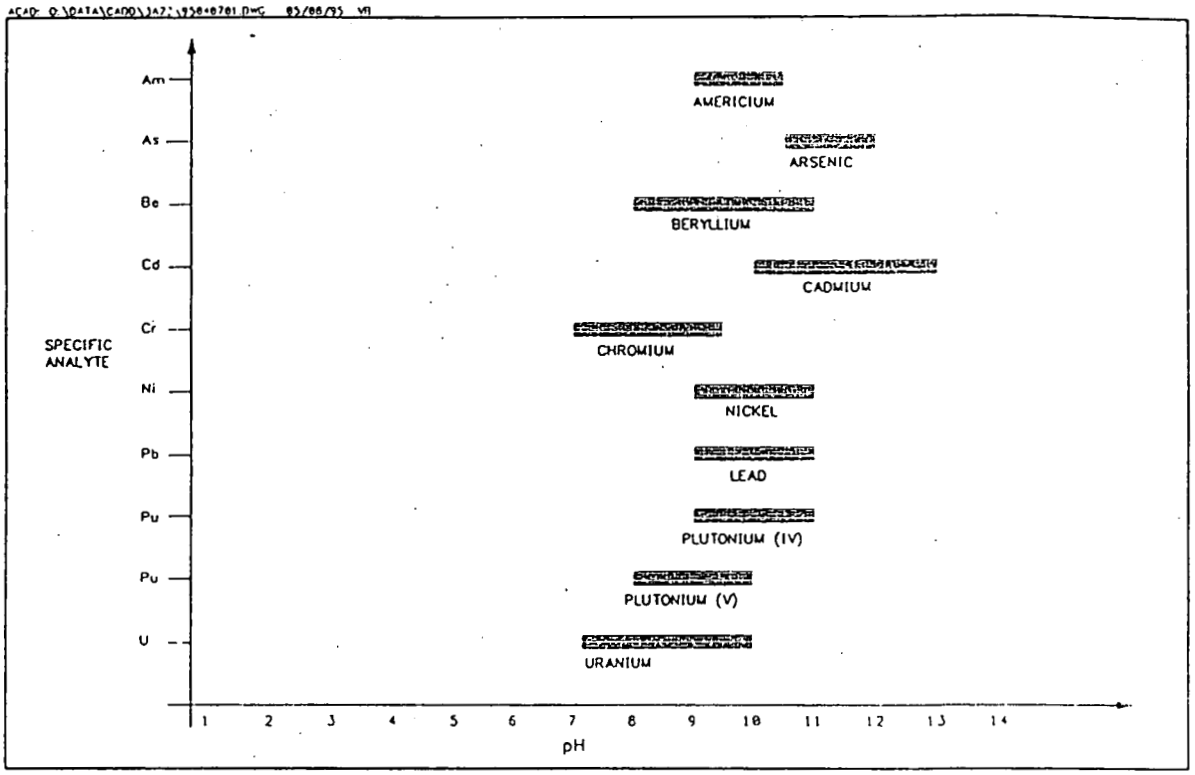

Figure 1. Optimum pH Values for Precipitation of Various Metal Hydroxides. (Figure from *Pondcrete Treatability Study Report and Process Formulation Report*, Revision 0, June 1995).

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Table 8.
Average Leachate (TCLP) Compositions for Treated Pondcrete and Sludges

Analyte	Phase II "Triwall" Pondcrete	Phase I "Metals" Pondcrete	Phase II Pond 207A/B Sludges	Phase II Pond 207C Sludges	Phase II Clarifier Sludges	Phase II Pond 207C & Clarifier Sludges	Units
Americium-241	<0.35	<0.15	<0.24	1	<0.33	<0.3	PCI/L
Cesium-134	<5.5	•	<5.3	<5.5	<5	<5.7	PCI/L
Cesium-137	<5.7	•	<5.8	<6.5	<5.3	<6	PCI/L
Plutonium-238	<0.11	<0.05	<0.095	<0.05	<0.095	<0.1	PCI/L
Plutonium239+240	<0.07	0.034	<0.05	<0.05	<0.054	<0.1	PCI/L
Radium-226	1.4	0.75	0.28	0.52	0.63	0.54	PCI/L
Uranium-233+234	0.044	<0.4	0.06	0.15	0.05	0.08	PCI/L
Uranium-235	<0.038	<0.36	0.08	<0.064	<0.05	<0.07	PCI/L
Uranium-238	0.042	<0.45	0.06	0.16	<0.06	0.08	PCI/L
Arsenic	<100	<100	<100	550	<100	140	UG/L
Beryllium	<0.5	<0.5	<0.5	<3.0	<0.55	<0.8	UG/L
Cadmium	<5.0	<5.0	<5.0	<5.0	5	<5	UG/L
Chromium	198	150	125	150	160	170	UG/L
Lead	<50	<50	<50	<50	<50	<50	UG/L
Nickel	<20	<20	<20	27	<20	<20	UG/L
Sodium	413000	555000	208000	3070000	383000	2397000	UG/L
Nitrate/Nitrite	110700	125000	12900	1320000	84300	1417000	UG/L
pH	11.4	11.1	11.3	11.8	11.1	11.8	PH
Reference	Table 3-11 EG&G, 1995b	Table 3-19 EG&G, 1995b	Table 3-14 EG&G, 1995c	Table 3-27 EG&G, 1995c	Table 3-37 EG&G, 1995c	Table 3-39 EG&G, 1995c	

NOTE: If reported detection rate was > 50%, then a replacement value of one-half the detection limit was used for calculation of summary statistics.

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Assuming that the sludges are treated prior to placement in the Cell, the possible composition of leachate derived from the stored sludges should meet WAC for the scenario of a 1-inch-per-year infiltration rate. The mean concentrations/activities reported for leachate analytes for **Ponds 207 A and B sludges, Pond 207 C sludges,** and **clarifier sludges** are for those samples treated with lime, fly ash, and cement (Phase II). For additional details, the reader should refer to the Pondcrete Treatability Report (EG&G, 1995c).

2.5 Groundwater

An evaluation of the groundwater chemistry in areas of contaminated subsurface soils destined for the Cell may also provide insights as to the likely composition of waste leachates. Locations for which both subsurface-soil and groundwater data were available are listed in Table 2. Summary statistics were calculated for these groundwater data (Table 9), and a series of modeling runs were conducted using mean concentrations and varying Eh conditions. Discussion of geochemical modeling and the results of modeling are given below in Section 3.0.

3.0 GEOCHEMICAL MODELING

Geochemical modeling takes into account solution chemistry, temperature, pH, and Eh to determine speciation and solubilities of various components. These four variables are the main factors influencing the solubility and behavior of inorganic constituents. Geochemical modeling is based on thermodynamic data and does not take into account various kinetic factors that may influence water/rock interactions; professional judgment should always be applied when evaluating model output.

Model input includes concentration data, pH, Eh, temperature, and specification of either the Debye-Huckel or Davies equation for determining individual ion-activity coefficients. By using actual concentration data, but varying selected parameters such as Eh, the general effects of such changes on constituent behavior can be assessed. This allows the user to evaluate and define optimum conditions for a given situation.

Using WATEQF (Plummer *et al.*, 1976), a limited modeling analysis was performed for groundwater related to the wastes destined for the proposed waste cell (see Table 9), in addition to modeling of an estimated leachate solution (see Table 10). Groundwater models were run for three Eh conditions (-0.2, 0.0, and 0.5 volts), whereas the estimated leachate solution was run for only two Eh conditions (0.0 and 0.5 volts).

Model output includes a listing of the distribution of aqueous species for each constituent, as well as the calculated saturation indices (SI) for a variety of phases. The SI is defined as the log of the ratio of the ion-activity product (IAP) to the solubility product (K_{sp}) for a given phase. The SI value for each phase indicates the likelihood that the phase will precipitate from, or dissolve into, the groundwater. If the SI value is approximately zero (i.e., +/- 0.5), then the phase is in equilibrium with the solution; if the SI value is less than zero (i.e., < 0.5), then the phase is likely to dissolve; if the SI value is greater than zero (i.e., > 0.5), then the phase is likely to precipitate. Modeling results are discussed below.

Table 9.

Summary of Groundwater Data for Areas with Contaminated Subsurface Soils

Analyte (dissolved)	N	% Detects	Min	Max	Mean	Std. Dev.	Units
Aluminum	97	12.4	5.5	269	22.1	34.9	UG/L
Antimony	103	3.9	5.5	51.5	13.1	7.1	UG/L
Arsenic	102	14.7	0.35	9	1.5	1.8	UG/L
Barium	105	99.1	43.3	675	195	114	UG/L
Beryllium	104	2.9	0.11	1.5	0.51	0.19	UG/L
Cadmium	104	4.8	0.9	21.7	1.6	2.1	UG/L
Calcium	100	100.0	33500	678000	160450	147770	UG/L
Cesium	84	1.2	6.5	309	70.1	101	UG/L
Chromium	105	1.0	1	4.8	1.8	0.6	UG/L
Cobalt	105	14.3	1	6.9	2.7	1.4	UG/L
Copper	104	22.1	1	17.6	2.2	1.9	UG/L
Iron	97	20.6	2	342	18.6	43.6	UG/L
Lead	103	5.8	0.35	13.8	0.8	1.3	UG/L
Lithium	100	55.0	1	42.4	12.3	9.5	UG/L
Magnesium	100	100.0	4120	105000	20060	23790	UG/L
Manganese	100	69.0	0.5	1850	228	420	UG/L
Mercury	105	1.0	0.05	0.23	0.099	0.017	UG/L
Molybdenum	96	10.4	1.5	34.1	6.7	5.5	UG/L
Nickel	103	17.5	1.5	86.1	9.3	14.6	UG/L
Potassium	100	91.0	242	11100	3098	2312	UG/L
Selenium	105	19.1	0.5	12	1.4	1.4	UG/L
Silicon	32	100.0	3630	9780	6632	1393	UG/L
Silver	105	1.0	1	25.1	1.8	2.4	UG/L
Sodium	100	100.0	4840	497000	46630	92500	UG/L
Strontium	100	100.0	240	3110	749	749	UG/L
Thallium	105	1.9	0.45	18.9	1.5	2.2	UG/L
Tin	100	17.0	3.6	74.6	14.2	12.5	UG/L
Vanadium	105	19.1	1	93	4.7	9.8	UG/L
Zinc	99	28.3	0.6	65.3	6.1	8.9	UG/L
Bicarb as CaCO3	127	100.0	65000	690000	264800	79440	UG/L
Chloride	130	97.7	500	3010000	170040	439190	UG/L
Fluoride	130	99.2	100	1410	505	240	UG/L
Nitrate/Nitrite	128	94.5	10	444000	9400	39400	UG/L
Orthophosphate	91	45.1	1.9	247	23	44	UG/L
Silica	64	100.0	8000	20965	15830	2894	UG/L
Sulfate	132	96.2	10000	250000	40744	36240	UG/L
TDS	127	100.0	210000	3800000	672095	775800	UG/L
TSS	127	96.1	2000	43000000	1553800	5121800	UG/L
pH	10	100.0	6.8	10.5	7.9	1.0	PH
Americium-241	6	83.3	0.006	0.435	0.108	0.169	PCi/L
Cesium-134	6	100.0	-0.63	0.71	-0.2	0.48	PCi/L
Cesium-137	8	87.5	-0.37	0.37	0.07	0.24	PCi/L
Gross alpha	99	88.9	0.32	67.1	10.4	11	PCi/L
Gross beta	95	90.5	-1.4	56.4	9.5	10.3	PCi/L
Plutonium-239+240	8	87.5	-0.001	1.999	0.403	0.01	PCi/L
Radium-226	45	95.6	0	2.82	0.87	0.67	PCi/L
Tritium (total)	110	53.6	-109	1067	154	163	PCi/L
Uranium-233+234	95	100.0	0.32	24.4	5.63	5.49	PCi/L
Uranium-235	95	76.8	-0.085	1.5	0.27	0.34	PCi/L
Uranium-238	95	100.0	0.24	75.7	7.68	12.01	PCi/L

Summary statistics calculated for RFEDS data compiled for this evaluation. ND = no data.
Locations for which data were evaluated are given in Table 2 of this report.

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Table 10.

Summary of Data and Estimated Leachate Composition for Waste-Cell Wastes

	52.5%		25.8%		14.5%		7.2%		Estimated	
	OU4 Pore Water - 52.5% Waste-site GW				OU4 Pondcrete		OU4 Sludges		Leachate	
Analyte	BKGD	Mean	BKGD	Mean	BKGD	Mean	BKGD	Mean	Composition	Units
Aluminum		984		22.1	X	114	X	114	547	UG/L
Antimony	X	25		13.1	X	25	X	25	22	UG/L
Arsenic		8.4		1.5	X	27		550	48	UG/L
Barium		122		195	X	84	X	84	133	UG/L
Beryllium	X	2.2		0.51	X	2.2	X	2.2	1.8	UG/L
Cadmium		14		1.6	X	2.4		5	8.5	UG/L
Calcium		110200		160450	X	55205	X	55205	111230	UG/L
Cesium		59		70.1	X	446	X	446	146	UG/L
Chromium		255		1.8		180		170	173	UG/L
Cobalt		60.2		2.7	X	20.5	X	20.5	37	UG/L
Copper		107		2.2	X	10.8	X	10.8	59	UG/L
Iron		1800		18.6	X	94	X	94	970	UG/L
Lead		48.2		0.8	X	8.6	X	8.6	27	UG/L
Lithium		984		12.3	X	38.7	X	38.7	528	UG/L
Magnesium		20120		20060	X	10026	X	10026	17910	UG/L
Manganese		925		228	X	32.7	X	32.7	550	UG/L
Mercury	X	0.59		0.099	X	0.59	X	0.59	0.46	UG/L
Molybdenum		547		6.7	X	61.2	X	61.2	302	UG/L
Nickel		160		9.3	X	15.5		15.5	90	UG/L
Potassium		308700		3098	X	11270	X	11270	165300	UG/L
Selenium		1.4		1.4	X	20.5	X	20.5	5.5	UG/L
Silicon		71320		6632	X	62.8	X	62.8	39170	UG/L
Silver		10.3		1.8	X	31900	X	31900	62.8	UG/L
Sodium		905400		46630		555000		3000000	783800	UG/L
Strontium		2613		749	X	352	X	352	1640	UG/L
Thallium		2.3		1.5	X	29.6	X	29.6	8	UG/L
Tin	X	108		14.2	X	108	X	108	84	UG/L
Vanadium		24.8		4.7	X	12.4	X	12.4	17	UG/L
Zinc		104		6.1	X	14.3	X	14.3	60	UG/L
Bicarb as CaCO3	X	223810		264800	X	223810	X	223810	234400	UG/L
Chloride	X	12832		170040	X	12832	X	12832	53400	UG/L
Fluoride	X	690		505	X	690	X	690	640	UG/L
Nitrate/Nitrite		1064020		9400		125000		1000000	651200	UG/L
Orthophosphate	X	13		23	X	13	X	13	16	UG/L
Silica	X	14300		15830	X	14300	X	14300	14700	UG/L
Sulfate	X	86230		40744	X	86230	X	86230	74500	UG/L
TDS	X	354151		672095	X	354151	X	354151	736200	UG/L
pH		8.8		7.9		11.2		11.5	9.1	UG/L
Americium-241	X	0.011		0.108	X	0.011		1	0.11	PCi/L
Cesium-134	X		X		X		X		ID	PCi/L
Cesium-137	X	0.42		0.07	X	0.42	X	0.42	0.33	PCi/L
Gross alpha		706		10.4	X	8.4	X	8.4	375	PCi/L
Gross beta		433		9.5	X	4.9	X	4.9	230	PCi/L
Plutonium-239+240		0.013		0.403		0.034	X	0.011	0.12	PCi/L
Radium-226		1.804		0.87		1.4		0.5	1.4	PCi/L
Radium-228		4.15	X	2.12	X	2.12	X	2.12	3.2	PCi/L
Tritium (total)		2384		154	X	102	X	102	1310	PCi/L
Uranium-233+234		274		5.63	X	6.91	X	6.91	147	PCi/L
Uranium-235		11.48		0.27	X	0.195	X	0.195	6.1	PCi/L
Uranium-238		264.5		7.68	X	4.83	X	4.83	142	PCi/L

X indicates that the background value was used for that analyte; ID indicates insufficient data provided in reference source.

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3.1 Modeling of Groundwater Chemistry

Using the mean concentrations of constituents, models were run for three redox conditions: Eh = -0.2 volts (reducing), Eh = 0.2 volts (mildly oxidizing), and Eh = 0.5 volts (oxidizing). The dominant aqueous species, as well as phases that may control solubility, were then reviewed for each of the three redox conditions (see Figure 2).

At the low Eh value of -0.2 volts, representative of environments isolated from the atmosphere, the solution is oversaturated with respect to Ag_2Se; native silver; copper sulfide - Cu_2S; chromite - $FeCr_2O_4$; PbSe; ferroselite - $FeSe_2$; illite, smectite, and kaolinite clays; ZnSe; native selenium; FeSe; and uranium species - U_4O_9, uraninite (UO_2), and coffinite ($USiO_4$); in addition to various iron oxides, calcite, and quartz.

Unconfined groundwater in the shallow subsurface probably exhibits Eh values in the range of 0.0 to 0.2 volts. At an Eh of 0.2 volts, the solubility of uranium species increases markedly. The solution is still oversaturated with respect to iron oxides and oxyhydroxides, clays, calcite, native silver and silver selenide, and quartz. Molybdenum, vanadium, selenium, arsenic, and uranium have oxyanion complexes or negatively charged carbonate complexes as the dominant aqueous species.

To represent an environment in contact with the atmosphere (e.g., surface water or leachates from wastes stored aboveground), an Eh = 0.5 volts was used. Again, iron, aluminum, and manganese oxides and oxyhydroxides are predicted to precipitate, along with calcite and quartz, and various clay minerals. Actually, the solution appears to be at or near equilibrium with calcite, quartz, barite, pyrolusite, manganese phosphate, and hydroxyapatite. The groundwater remains undersaturated with respect to uranium-bearing phases, such as uranium carbonates. Anionic complexes for molybdenum, uranium, vanadium, chromium, arsenic, and selenium are the dominant species for these constituents in solution.

3.2 Modeling of Estimated Leachate Solution

An estimated leachate composition was derived by assembling data for vadose-zone water, groundwater, and TCLP leachates from treated pondcrete and sludges. The concentration data were then weighted for the relative proportion of a waste type. As shown in Table 10, the mean concentration multiplied by the relative proportion, which is based on the estimated volume of waste, was used to generate an estimate of leachate. If data for specific analytes were unavailable, then the mean concentration for background groundwater was used for that proportion. The mean pH of 9.1, an oxidizing Eh of 0.5 volts, and a temperature of 12°C were used for one model and a more reducing Eh of 0.0 volts was used for the second model (all other parameters unchanged).

The proportions of each waste type used for the estimated leachate composition were 52.5% OU4 vadose-zone water, 25.8% waste-site groundwater, 14.5% treated-pondcrete leachate, and 7.2% treated-sludge leachate (see Table 10). The estimated values shown here should be considered rough, preliminary estimates of constituent concentrations. As noted below, changes in physicochemical conditions can change the leachate composition.

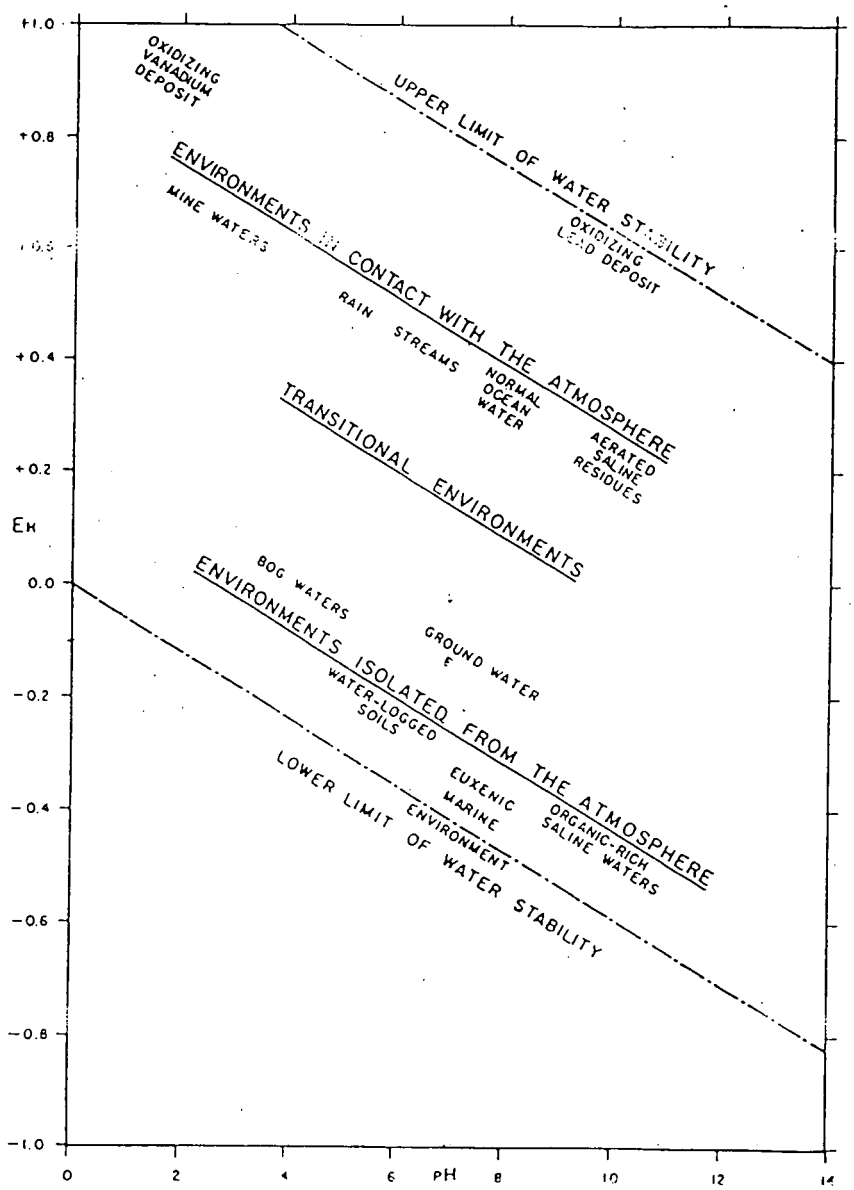

Figure 2. Generalized Eh-pH diagram showing conditions of natural environments. (From Garrels and Christ, 1965).

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The hypothetical leachate solution produced model outputs with a reasonable 9.0% charge-balance error, and a distribution of aqueous species that indicates an abundance of nitrate and sodium as free ions. The dominant species in solution, in order of decreasing molality (for the Eh=0.0 case) are listed in Appendix A tables. (Molality is defined as moles of solute per 1000 grams of water; for dilute solutions at normal temperatures, molality is essentially equal to molarity. Molarity is moles of solute per 1000 grams of solution).

For the case the model run with an oxidizing Eh of 0.5 volts, the speciation indicates the importance of uranium-carbonate complexes. In the presence of carbonate, the solubility of uranium is greatly increased (compare Figures 3a and 3b), and the amount of dissolved uranium is much higher than it would be in carbonate-free water (Drever, 1988). In addition, oxyanions of chromium, molybdenum, arsenic, vanadium, and selenium are predicted to be the dominant aqueous species for these constituents. These species are important from a migration perspective because anions are generally more mobile than cations. The mobility of anions is related to the presence of abundant cation-exchange sites on clays and iron oxides, but fewer anion-exchange sites in the substrate. Thus, anionic species such as nitrate, chloride, sulfate, and oxyanions of metals, are generally less retarded as the solution migrates in the subsurface.

Output from the model run with an Eh of 0.0 volts also shows the importance of oxyanion complexes for molybdenum, chromium, selenium, vanadium, and arsenic. In general, the activities of anionic complexes of chromium, selenium are higher in the case of Eh = 0.0 volts, whereas the activities of major-ion species are largely unchanged. In particular, the activities of $Cr(OH)_4^-$, Fe^{+2}, $FeOH^+$, SeO_3^{-2}, Cu^+, $CuCl_2^-$, CuCl, $HSeO_3^-$ are markedly greater under an Eh of 0.0 volts, as compared to an Eh of 0.5 volts.

4.0 SUMMARY AND CONCLUSIONS

Wastes derived from OU4 will constitute approximately 75 percent of the total waste mass in the Waste Cell, with pondcrete and sludge materials comprising 21.7% of the total waste volume, and OU4 vadose-zone soils comprising 24.1% of the total waste volume. Because OU4 contributes the bulk of waste for the Cell, this evaluation focussed on the existing data for OU4 materials. Based on these data, nitrate, sodium, gross alpha, gross beta, tritium, and uranium isotopes appear to be the most mobile constituents in the OU4 wastes.

For subsurface-soil wastes to be stored at the proposed Cell, constituent concentrations in the waste materials were statistically compared to those in background subsurface soils. This comparison highlights those constituents that may be released in concentrations higher than those of background groundwater. However, just because the solid wastes contain constituent concentrations higher than those of background soils, does not necessarily mean that waste leachates will contain proportionately higher levels of those constituents.

Based on the estimated volumes of waste destined for the Cell and the available data for leachates, pore water, and groundwater from the wastes and waste areas, a general leachate composition was calculated (see Table 10). Geochemical modeling of the leachate suggests that iron, aluminum, and manganese

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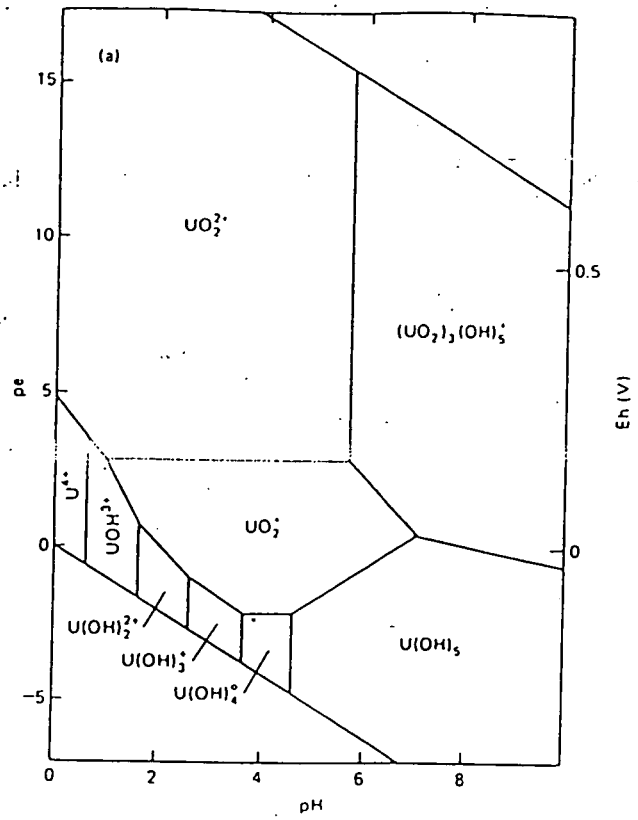

Figure 3a. Distribution of dissolved uranium species in a carbonate-free system at 25°C (Figure from Drever, 1988).

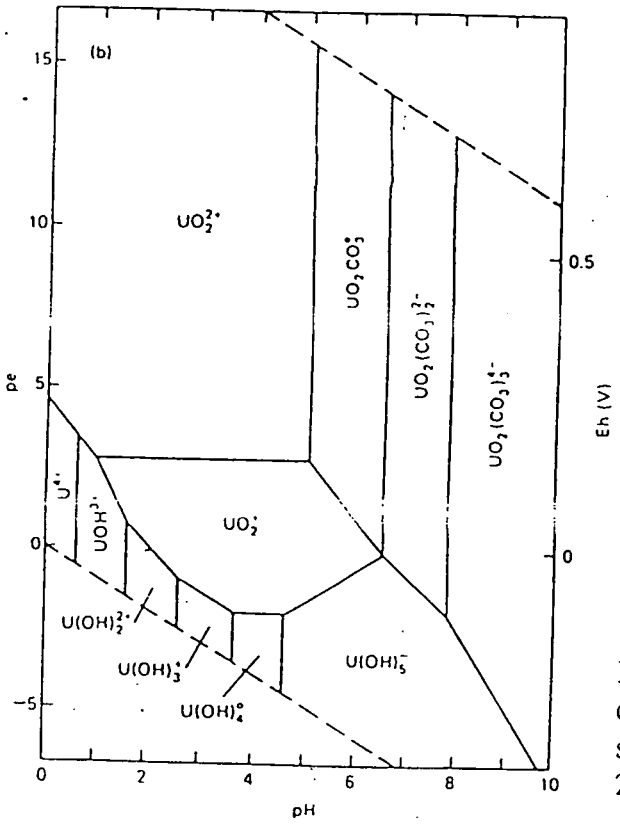

Figure 3b. Distribution of dissolved uranium species in a system containing carbonate, at 25°C. (Figure from Drever, 1988).

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oxides and oxyhydroxides, along with clay minerals, calcium carbonate, and compounds containing zinc, copper, barium, chromium, strontium will precipitate from the leachate. Silver, lead, and molybdenum appear to be at approximate equilibrium with the leachate, under the specified Eh-pH conditions. On the other hand, the leachate is undersaturated with respect to uranium, vanadium, arsenic, radium, and selenium phases, so these constituents would still tend to remain in solution. As long as uranium, vanadium, arsenic, and selenium exist as oxyanions, it is unlikely that they will be strongly retarded under the given Eh-pH conditions.

The solubility and behavior of iron is strongly influenced by Eh-pH conditions. The oxidized form of iron (ferric, Fe^{+3}) is much less soluble than the reduced form (ferrous, Fe^{+2}). Ferric oxyhydroxides, generalized as $Fe(OH)_3$, form suspended particulates. The importance of these ferric oxyhydroxide particulate is that their surfaces have a large capacity for the adsorption of trace metals (Hem, 1992). If Eh decreases and the iron is reduced, the adsorbed trace metals, in addition to the iron, will be released into solution. Where the solubility of trace elements is controlled by adsorption onto oxide surfaces, the dissolved concentrations of these elements will be highly sensitive to changes in Eh and pH. At RFETS, much of the plutonium and americium in near-surface waters may be adsorbed onto iron oxyhydroxide particulates, so Eh conditions may have significant impact on both trace metal and radionuclide mobility.

In general, most metals, including plutonium and americium, are less mobile in a neutral, oxidizing environment; however, those metals and radionuclides that tend to form oxyanions or other negatively charged aqueous species tend to remain mobile. Additionally, anions such as nitrate, chloride, and sulfate tend to be mobile under most naturally occurring Eh-pH conditions. Controlling the migration of anionic species probably presents the greatest challenge for wastes contaminated with numerous metals and radionuclides. Uranium tends to be immobilized under reducing conditions, but plutonium and americium are mobilized under these conditions. By modeling the leachate for a range of Eh-pH conditions, the optimum conditions for immobilization can be defined.

5.0 REFERENCES

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
NO3 -	2.88270E+03	4.66967E-02	NO3 -	2.88270E+03	4.66967E-02
NA +	7.80660E+02	3.41067E-02	NA +	7.80660E+02	3.41067E-02
K +	1.65027E+02	4.23906E-03	K +	1.65027E+02	4.23906E-03
HCO3 -	2.16955E+02	3.57133E-03	HCO3 -	2.16955E+02	3.57133E-03
CA 2+	1.00756E+02	2.52497E-03	CA 2+	1.00756E+02	2.52497E-03
CL -	5.33527E+01	1.51153E-03	CL -	5.33535E+01	1.51155E-03
MG 2+	1.64351E+01	6.78994E-04	MG 2+	1.64352E+01	6.78995E-04
SO4 2-	6.16884E+01	6.45010E-04	SO4 2-	6.16901E+01	6.45028E-04
CO3 2-	1.62828E+01	2.72536E-04	CO3 2-	1.62831E+01	2.72540E-04
H4SIO4	2.15717E+01	2.25426E-04	H4SIO4	2.15717E+01	2.25426E-04
CACO3	1.68300E+01	1.68893E-04	CACO3	1.68295E+01	1.68888E-04
LI +	5.27316E-01	7.63285E-05	LI +	5.27316E-01	7.63285E-05
CASO4	8.54916E+00	6.30733E-05	CASO4	8.54901E+00	6.30722E-05
NASO4 -	5.78539E+00	4.88102E-05	NASO4 -	5.78541E+00	4.88104E-05
NAHCO3	3.85061E+00	4.60479E-05	NAHCO3	3.85056E+00	4.60474E-05
NACO3 -	3.37192E+00	4.08052E-05	NACO3 -	3.37190E+00	4.08050E-05
F -	6.17843E-01	3.26644E-05	F -	6.17843E-01	3.26644E-05
MGCO3	2.71445E+00	3.23339E-05	MGCO3	2.71439E+00	3.23331E-05
CAHCO3 +	2.99946E+00	2.98001E-05	CAHCO3 +	2.99941E+00	2.97995E-05
H3SIO4 -	1.92131E+00	2.02907E-05	H3SIO4 -	1.92133E+00	2.02908E-05
SR 2+	1.63998E+00	1.87995E-05	SR 2+	1.63998E+00	1.87995E-05
AL(OH)4 -	1.71114E+00	1.80894E-05	AL(OH)4 -	1.71114E+00	1.80894E-05
FE(OH)4 -	1.79174E+00	1.45278E-05	FE(OH)4 -	1.89406E+00	1.53575E-05
MGSO4	1.80138E+00	1.50310E-05	MGSO4	1.80135E+00	1.50308E-05
MGHCO3 +	1.08704E+00	1.27956E-05	MGHCO3 +	1.08702E+00	1.27954E-05
MN 2+	4.99737E-01	9.13654E-06	MN 2+	4.99738E-01	9.13656E-06
KSO4 -	9.25961E-01	6.88091E-06	KSO4 -	9.25963E-01	6.88093E-06
H2CO3	3.98652E-01	6.45562E-06	H2CO3	3.98649E-01	6.45558E-06
OH -	9.33412E-02	5.51250E-06	OH -	9.33418E-02	5.51253E-06
MOO4 2-	5.03437E-01	3.16156E-06	MOO4 2-	5.03437E-01	3.16156E-06
AL(OH)5 2-	2.25688E-01	2.02907E-06	AL(OH)5 2-	2.25692E-01	2.02910E-06
FE(OH)3	2.09654E-01	1.97045E-06	FE(OH)3	2.21626E-01	2.08297E-06
UO2(CO3)3 4-	8.22000E-01	1.83451E-06	UO2(CO3)3 4-	8.22001E-01	1.83451E-06
CR(OH)3	1.46351E-01	1.42691E-06	CR(OH)3	2.99286E-12	2.91801E-17
CR(OH)4 -	1.55738E-01	1.30327E-06	CR(OH)4 -	3.18482E-12	2.66518E-17
CS +	1.46000E-01	1.10338E-06	CS +	1.46000E-01	1.10338E-06
BA 2+	1.32744E-01	9.70805E-07	BA 2+	1.32744E-01	9.70805E-07
CU(OH)2	8.52646E-02	8.77824E-07	CU(OH)2	8.80314E-02	9.06309E-07
NACL	4.94403E-02	8.49695E-07	NACL	4.94403E-02	8.49696E-07
FE 2+	4.59251E-02	8.25969E-07	FE 2+	7.07058E-11	1.27165E-15

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
MNHCO3 +	8.94985E-02	7.75245E-07	MNHCO3 +	8.94967E-02	7.75229E-07
ZN(CO3)2 2-	1.29407E-01	7.01076E-07	ZN(CO3)2 2-	1.29408E-01	7.01079E-07
HASO4 2-	8.85985E-02	6.35972E-07	HASO4 2-	8.85985E-02	6.35972E-07
MGF +	2.12824E-02	4.93562E-07	MGF +	2.12820E-02	4.93553E-07
CR(OH)2 +	5.23695E-02	6.11561E-07	CR(OH)2 +	1.07095E-12	1.25064E-17
NAF	1.80013E-02	4.30616E-07	NAF	1.80011E-02	4.30611E-07
HVO4 2-	3.62742E-02	3.14233E-07	HVO4 2-	3.62742E-02	3.14233E-07
NAOH	1.02805E-02	2.58165E-07	NAOH	1.02804E-02	2.58163E-07
CACL +	1.93137E-02	2.56828E-07	CACL +	1.93136E-02	2.56826E-07
MGOH +	1.04177E-02	2.53238E-07	MGOH +	1.04175E-02	2.53235E-07
CAF +	1.44848E-02	2.46262E-07	CAF +	1.44845E-02	2.46257E-07
AL(OH)3	1.89591E-02	2.44126E-07	AL(OH)3	1.89589E-02	2.44124E-07
CAOH +	8.53506E-03	1.50169E-07	CAOH +	8.53494E-03	1.50167E-07
ZNCO3	1.43310E-02	1.14797E-07	ZNCO3	1.43308E-02	1.14795E-07
KCL	8.04242E-03	1.08349E-07	KCL	8.04242E-03	1.08349E-07
FEOH +	7.21382E-03	9.94534E-08	FEOH +	1.11061E-11	1.53115E-16
LISO4 -	1.01144E-02	9.86315E-08	LISO4 -	1.01145E-02	9.86318E-08
ZN(OH)2	8.85994E-03	8.95326E-08	ZN(OH)2	8.85985E-03	8.95317E-08
HPO4 2-	7.22895E-03	7.56502E-08	HPO4 2-	7.23126E-03	7.56744E-08
PBCO3	2.00188E-02	7.52488E-08	PBCO3	2.00186E-02	7.52482E-08
MNOH +	4.59498E-03	6.41496E-08	MNOH +	4.59491E-03	6.41486E-08
SEO3 2-	8.03125E-03	6.35383E-08	SEO3 2-	3.96637E-09	3.13794E-14
AGCL	8.22030E-03	5.76091E-08	AGCL	8.22029E-03	5.76090E-08
PB(CO3)2 2-	1.75898E-02	5.39927E-08	PB(CO3)2 2-	1.75900E-02	5.39933E-08
CAPO4 -	6.54477E-03	4.86753E-08	CAPO4 -	6.54662E-03	4.86890E-08
MNSO4	6.98606E-03	4.64709E-08	MNSO4	6.98593E-03	4.64700E-08
AG +	2.72015E-03	2.53287E-08	AG +	2.72014E-03	2.53287E-08
MNCL +	2.25270E-03	2.50318E-08	MNCL +	2.25269E-03	2.50316E-08
H2VO4 -	2.43053E-03	2.08735E-08	H2VO4 -	2.43049E-03	2.08732E-08
UO2(CO3)2 2-	7.66996E-03	1.97511E-08	UO2(CO3)2 2-	7.66948E-03	1.97498E-08
CUCO3	2.24546E-03	1.82540E-08	CUCO3	2.31831E-03	1.88462E-08
MGPO4 -	2.14997E-03	1.81036E-08	MGPO4 -	2.15058E-03	1.81088E-08
H2SIO4 2-	1.68006E-03	1.79329E-08	H2SIO4 2-	1.68010E-03	1.79333E-08
CAHPO4	2.31770E-03	1.71097E-08	CAHPO4	2.31834E-03	1.71144E-08
FESO4	2.51164E-03	1.66069E-08	FESO4	3.86682E-12	2.55673E-17
KOH	8.66068E-04	1.55045E-08	KOH	8.66061E-04	1.55044E-08
CU +	9.59824E-04	1.51711E-08	CU +	1.44324E-12	2.28121E-17
ZN 2+	6.54952E-04	1.00618E-08	ZN 2+	6.54961E-04	1.00620E-08
AGCL2 -	1.70865E-03	9.59980E-09	AGCL2 -	1.70867E-03	9.59993E-09
CUCL2 -	9.97771E-04	7.45378E-09	CUCL2 -	1.50033E-12	1.12081E-17

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
MN(NO3)2	1.26224E-03	7.08480E-09	MN(NO3)2	1.26219E-03	7.08456E-09
CUCL	6.56438E-04	6.66003E-09	CUCL	9.87057E-13	1.00144E-17
CU(CO3)2 2-	1.19969E-03	6.56435E-09	CU(CO3)2 2-	1.23863E-03	6.77745E-09
HSEO3 -	8.18534E-04	6.42473E-09	HSEO3 -	4.04239E-10	3.17290E-15
MGHPO4	7.63872E-04	6.37822E-09	MGHPO4	7.64084E-04	6.37998E-09
FE(OH)2 +	4.32779E-04	4.83733E-09	FE(OH)2 +	4.57496E-04	5.11360E-09
ASO4 3-	6.58950E-04	4.76434E-09	ASO4 3-	6.58969E-04	4.76448E-09
H2ASO4 -	3.87543E-04	2.76194E-09	H2ASO4 -	3.87537E-04	2.76190E-09
ZNOH +	2.23975E-04	2.73057E-09	ZNOH +	2.23974E-04	2.73056E-09
NAHPO4 -	2.70604E-04	2.28462E-09	NAHPO4 -	2.70685E-04	2.28529E-09
ZNHCO3 +	2.60112E-04	2.06697E-09	ZNHCO3 +	2.60109E-04	2.06696E-09
BANO3 +	3.69232E-04	1.86050E-09	BANO3 +	3.69223E-04	1.86045E-09
CANO3 +	1.27154E-04	1.25107E-09	CANO3 +	1.27152E-04	1.25105E-09
PBOH +	2.28733E-04	1.02469E-09	PBOH +	2.28734E-04	1.02469E-09
H +	9.71697E-07	9.68242E-10	H +	9.71703E-07	9.68247E-10
MNF +	7.04473E-05	9.57017E-10	MNF +	7.04459E-05	9.56997E-10
H2PO4 -	5.56854E-05	5.76686E-10	H2PO4 -	5.57022E-05	5.76860E-10
ZNNO3 +	6.78005E-05	5.34599E-10	ZNNO3 +	6.77999E-05	5.34594E-10
LIOH	1.05336E-05	4.41823E-10	LIOH	1.05335E-05	4.41820E-10
ZN(OH)3 -	5.08938E-05	4.39155E-10	ZN(OH)3 -	5.08936E-05	4.39153E-10
CUOH +	3.30841E-05	4.12524E-10	CUOH +	3.41579E-05	4.25913E-10
PB(OH)2	9.75080E-05	4.06022E-10	PB(OH)2	9.75077E-05	4.06021E-10
AGNO3	6.82005E-05	4.03252E-10	AGNO3	6.81995E-05	4.03246E-10
SROH +	2.95709E-05	2.83878E-10	SROH +	2.95703E-05	2.83873E-10
ZNSO4	4.52244E-05	2.81365E-10	ZNSO4	4.52242E-05	2.81363E-10
KHPO4 -	3.76752E-05	2.80139E-10	KHPO4 -	3.76864E-05	2.80222E-10
FE(OH)3 -	2.65027E-05	2.49088E-10	FE(OH)3 -	4.08027E-14	3.83486E-19
ZNOHCL	2.69604E-05	2.29798E-10	ZNOHCL	2.69604E-05	2.29798E-10
FE(OH)2	1.56102E-05	1.74481E-10	FE(OH)2	2.40327E-14	2.68622E-19
HMOO4 -	2.22191E-05	1.38659E-10	HMOO4 -	2.22187E-05	1.38657E-10
AGSO4 -	2.64680E-05	1.30362E-10	AGSO4 -	2.64680E-05	1.30363E-10
CROH 2+	8.49900E-06	1.23712E-10	CROH 2+	1.73807E-16	2.52994E-21
PBHCO3 +	2.62107E-05	9.81533E-11	PBHCO3 +	2.62107E-05	9.81532E-11
PO4 3-	8.32633E-06	8.80591E-11	PO4 3-	8.32924E-06	8.80898E-11
CU(OH)3 -	9.35824E-06	8.20436E-11	CU(OH)3 -	9.66198E-06	8.47064E-11
PB 2+	1.56215E-05	7.57264E-11	PB 2+	1.56219E-05	7.57281E-11
VO4 3-	8.63026E-06	7.54171E-11	VO4 3-	8.63052E-06	7.54193E-11
CU 2+	3.76080E-06	5.94435E-11	CU 2+	3.88292E-06	6.13739E-11
FEHPO4	7.62012E-06	5.04134E-11	FEHPO4	1.17351E-14	7.76371E-20
CUHCO3 +	6.02892E-06	4.86141E-11	CUHCO3 +	6.22456E-06	5.01917E-11

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
AL(OH)2 +	2.79884E-06	4.60881E-11	AL(OH)2 +	2.79884E-06	4.60881E-11
AGOH	3.20726E-06	2.57971E-11	AGOH	3.20724E-06	2.57969E-11
HF	4.96279E-07	2.49157E-11	HF	4.96276E-07	2.49155E-11
CUCL3 2-	4.21272E-06	2.49040E-11	CUCL3 2-	6.33473E-15	3.74485E-20
PBNO3 +	6.34991E-06	2.36918E-11	PBNO3 +	6.34990E-06	2.36917E-11
HSO4 -	1.88935E-06	1.95498E-11	HSO4 -	1.88936E-06	1.95499E-11
AGCL3 2-	3.51977E-06	1.65026E-11	AGCL3 2-	3.51991E-06	1.65033E-11
CAH2PO4 +	1.84222E-06	1.34996E-11	CAH2PO4 +	1.84274E-06	1.35034E-11
UO2CO3	3.40896E-06	1.03746E-11	UO2CO3	3.40868E-06	1.03738E-11
ZNCL +	1.01104E-06	1.00712E-11	ZNCL +	1.01105E-06	1.00712E-11
BAOH +	1.42119E-06	9.24841E-12	BAOH +	1.42117E-06	9.24825E-12
PB(OH)3 -	1.85895E-06	7.23082E-12	PB(OH)3 -	1.85896E-06	7.23085E-12
MNCL2	8.46711E-07	6.75796E-12	MNCL2	8.46705E-07	6.75791E-12
PBSO4	1.70290E-06	5.64007E-12	PBSO4	1.70290E-06	5.64008E-12
MGH2PO4 +	5.72431E-07	4.74000E-12	MGH2PO4 +	5.72594E-07	4.74134E-12
CUNO3 +	4.85693E-07	3.88557E-12	CUNO3 +	5.01453E-07	4.01166E-12
V2O7 4-	6.63632E-07	3.11654E-12	V2O7 4-	6.63664E-07	3.11669E-12
U(OH)5 -	7.40917E-07	2.30352E-12	U(OH)5 -	1.57142E-24	4.88558E-30
ZNF +	1.48919E-07	1.77269E-12	ZNF +	1.48918E-07	1.77268E-12
ZN(SO4)2 2-	4.30731E-07	1.68010E-12	ZN(SO4)2 2-	4.30740E-07	1.68014E-12
AGF	1.97863E-07	1.56650E-12	AGF	1.97860E-07	1.56648E-12
CUSO4	2.32550E-07	1.46344E-12	CUSO4	2.40097E-07	1.51093E-12
PBCL +	3.52103E-07	1.45746E-12	PBCL +	3.52107E-07	1.45748E-12
HV2O7 3-	1.38701E-07	6.48312E-13	HV2O7 3-	1.38702E-07	6.48317E-13
HMNO2 -	3.18962E-08	3.64272E-13	HMNO2 -	3.18957E-08	3.64266E-13
H3VO4	2.08379E-08	1.77428E-13	H3VO4	2.08374E-08	1.77424E-13
H2V2O7 2-	3.58255E-08	1.66672E-13	H2V2O7 2-	3.58247E-08	1.66669E-13
ZN(OH)4 2-	2.10445E-08	1.58440E-13	ZN(OH)4 2-	2.10448E-08	1.58443E-13
H3ASO3	1.38531E-08	1.10480E-13	H3ASO3	2.93825E-26	2.34329E-31
FEH2PO4 +	1.64541E-08	1.08135E-13	FEH2PO4 +	2.53396E-17	1.66530E-22
UO2(HPO4)2 2-	4.70916E-08	1.02383E-13	UO2(HPO4)2 2-	4.71171E-08	1.02438E-13
AGCL4 3-	2.24702E-08	9.03934E-14	AGCL4 3-	2.24719E-08	9.04002E-14
FEOH 2+	5.39072E-09	7.43197E-14	FEOH 2+	5.69869E-09	7.85656E-14
H2ASO3 -	7.62412E-09	6.12939E-14	H2ASO3 -	1.61710E-26	1.30006E-31
CUCL +	5.48892E-09	5.56890E-14	CUCL +	5.66712E-09	5.74969E-14
H3V2O7 -	9.96006E-09	4.61223E-14	H3V2O7 -	9.95968E-09	4.61205E-14
AG(OH)2 -	5.65228E-09	4.00136E-14	AG(OH)2 -	5.65227E-09	4.00135E-14
PB(OH)4 2-	1.03328E-08	3.77082E-14	PB(OH)4 2-	1.03330E-08	3.77090E-14
CU(OH)4 2-	4.88153E-09	3.72645E-14	CU(OH)4 2-	5.04005E-09	3.84746E-14
ALOH 2+	1.46350E-09	3.34165E-14	ALOH 2+	1.46352E-09	3.34171E-14

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
CU2(OH)2 2+	4.60246E-09	2.86939E-14	CU2(OH)2 2+	4.90612E-09	3.05871E-14
PBHPO4	8.60234E-09	2.84990E-14	PBHPO4	8.60486E-09	2.85074E-14
MN(OH)3 -	2.97956E-09	2.82438E-14	MN(OH)3 -	2.97951E-09	2.82434E-14
CUHPO4	3.89586E-09	2.45294E-14	CUHPO4	4.02347E-09	2.53329E-14
FEH3SIO4 2+	3.32854E-09	2.21474E-14	FEH3SIO4 2+	3.51870E-09	2.34127E-14
RA 2+	4.60000E-09	2.04416E-14	RA 2+	4.60000E-09	2.04416E-14
PBF +	4.48706E-09	1.99244E-14	PBF +	4.48705E-09	1.99244E-14
PB(SO4)2 2-	7.78605E-09	1.95842E-14	PB(SO4)2 2-	7.78627E-09	1.95847E-14
V3O9 3-	5.78183E-09	1.95653E-14	V3O9 3-	5.78175E-09	1.95651E-14
CUF +	1.16114E-09	1.41289E-14	CUF +	1.19882E-09	1.45874E-14
UO2H3SIO4 +	3.83563E-09	1.05511E-14	UO2H3SIO4 +	3.83536E-09	1.05503E-14
ZNCL2	1.34653E-09	9.92381E-15	ZNCL2	1.34654E-09	9.92386E-15
UO2OH +	2.35062E-09	8.22547E-15	UO2OH +	2.35046E-09	8.22490E-15
CU2CL4 2-	1.97974E-09	7.39475E-15	CU2CL4 2-	4.47633E-27	1.67201E-32
UO2 + (5 VALEN	1.94987E-09	7.25286E-15	UO2 + (5 VALEN	2.83956E-18	1.05622E-23
CR 3+	3.38668E-10	6.54211E-15	CR 3+	6.92606E-21	1.33792E-25
ALF2 +	3.48883E-10	5.39293E-15	ALF2 +	3.48879E-10	5.39287E-15
MNCL3 -	7.40510E-10	4.61124E-15	MNCL3 -	7.40515E-10	4.61127E-15
CR3(OH)4 5+	6.77241E-10	3.03651E-15	CR3(OH)4 5+	5.79260E-42	2.59720E-47
PBCL2	8.19388E-10	2.95932E-15	PBCL2	8.19398E-10	2.95936E-15
ALF 2+	9.01809E-11	1.96997E-15	ALF 2+	9.01818E-11	1.96999E-15
H2SEO3	1.94371E-10	1.51371E-15	H2SEO3	9.59910E-17	7.47552E-22
FEF 2+	6.12781E-11	8.22344E-16	FEF 2+	6.47786E-11	8.69320E-16
ALF3	5.28175E-11	6.31731E-16	ALF3	5.28162E-11	6.31716E-16
HSE -	4.29605E-11	5.39593E-16	HSE -	2.02456E-70	2.54289E-75
MG4(OH)4 4+	8.72909E-11	5.30569E-16	MG4(OH)4 4+	8.72926E-11	5.30579E-16
CR2(OH)2 4+	5.97102E-11	4.34572E-16	CR2(OH)2 4+	2.49728E-32	1.81753E-37
H3ASO4	3.49089E-11	2.47022E-16	H3ASO4	3.49081E-11	2.47016E-16
ZN2OH 3+	3.37522E-11	2.29423E-16	ZN2OH 3+	3.37534E-11	2.29431E-16
HF2 -	3.65613E-12	1.74752E-16	HF2 -	3.65611E-12	1.74751E-16
U(OH)4	2.27988E-11	7.48207E-17	U(OH)4	4.83540E-29	1.58687E-34
HASO3 2-	7.57406E-12	6.13866E-17	HASO3 2-	1.60651E-29	1.30205E-34
UO2HPO4	2.10021E-11	5.76351E-17	UO2HPO4	2.10067E-11	5.76478E-17
FEF2 +	4.78282E-12	5.11907E-17	FEF2 +	5.05592E-12	5.41138E-17
V(OH)3	4.96009E-12	4.88607E-17	V(OH)3	1.05204E-29	1.03634E-34
H3PO4	4.36920E-12	4.47827E-17	H3PO4	4.37049E-12	4.47960E-17
UO2F +	9.30440E-12	3.23344E-17	UO2F +	9.30370E-12	3.23320E-17
CUCL2	3.43497E-12	2.56607E-17	CUCL2	3.54649E-12	2.64938E-17
VOOH +	1.91911E-12	2.29616E-17	VOOH +	2.79492E-21	3.34404E-26
UO2 2+	4.49144E-12	1.67067E-17	UO2 2+	4.49120E-12	1.67058E-17

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
AL 3+	4.36401E-13	1.62455E-17	AL 3+	4.36420E-13	1.62462E-17
ZNCL3 -	2.65592E-12	1.55332E-17	ZNCL3 -	2.65597E-12	1.55335E-17
PBH2PO4 +	3.69384E-12	1.21969E-17	PBH2PO4 +	3.69495E-12	1.22006E-17
CRCL 2+	1.00995E-12	1.16001E-17	CRCL 2+	2.06540E-23	2.37226E-28
CUH2PO4 +	1.63968E-12	1.02591E-17	CUH2PO4 +	1.69340E-12	1.05952E-17
PBF2	2.15644E-12	8.83357E-18	PBF2	2.15641E-12	8.83345E-18
H2MOO4	1.01877E-12	6.31843E-18	H2MOO4	1.01875E-12	6.31828E-18
UO2F2	1.59818E-12	5.21137E-18	UO2F2	1.59804E-12	5.21092E-18
PB2OH 3+	1.64721E-12	3.83509E-18	PB2OH 3+	1.64730E-12	3.83528E-18
PBCL3 -	1.02136E-12	3.27168E-18	PBCL3 -	1.02138E-12	3.27177E-18
ALF4 -	2.44013E-13	2.38010E-18	ALF4 -	2.44008E-13	2.38004E-18
ALSO4 +	2.21894E-13	1.81134E-18	ALSO4 +	2.21894E-13	1.81135E-18
FEF3	1.07771E-13	9.59273E-19	FEF3	1.13923E-13	1.01404E-18
UO2SO4	3.05405E-13	8.37929E-19	UO2SO4	3.05382E-13	8.37868E-19
VO2 +	3.46573E-14	4.19704E-19	VO2 +	3.46567E-14	4.19697E-19
H4VO4 +	4.57846E-14	3.86539E-19	H4VO4 +	4.57838E-14	3.86532E-19
VO 2+	2.35386E-14	3.53186E-19	VO 2+	3.42814E-23	5.14376E-28
SEO4 2-	4.27668E-14	3.00478E-19	SEO4 2-	9.95778E-03	6.99630E-08
HCL	6.61742E-15	1.82294E-19	HCL	6.61746E-15	1.82295E-19
FE 3+	5.68642E-15	1.02271E-19	FE 3+	6.01146E-15	1.08117E-19
FESO4 +	7.79888E-15	5.15659E-20	FESO4 +	8.24431E-15	5.45111E-20
UO2F3 -	1.38126E-14	4.24239E-20	UO2F3 -	1.38114E-14	4.24203E-20
PB3(OH)4 2+	2.61967E-14	3.81544E-20	PB3(OH)4 2+	2.61972E-14	3.81551E-20
AL(SO4)2 -	6.44660E-15	2.95524E-20	AL(SO4)2 -	6.44664E-15	2.95525E-20
ZN2(OH)6 2-	6.34278E-15	2.73655E-20	ZN2(OH)6 2-	6.34282E-15	2.73656E-20
UO2CL +	5.37984E-15	1.76888E-20	UO2CL +	5.37951E-15	1.76877E-20
UO2(SO4)2 2-	7.51406E-15	1.63310E-20	UO2(SO4)2 2-	7.51372E-15	1.63302E-20
ZNCL4 2-	3.20297E-15	1.55272E-20	ZNCL4 2-	3.20311E-15	1.55279E-20
V(OH)2 +	5.34910E-16	6.32412E-21	V(OH)2 +	1.13456E-33	1.34136E-38
ASO3 3-	6.15942E-16	5.03305E-21	ASO3 3-	1.30649E-33	1.06757E-38
PBCL4 2-	1.08860E-15	3.13286E-21	PBCL4 2-	1.08866E-15	3.13302E-21
H2F2	1.04498E-16	2.62316E-21	H2F2	1.04497E-16	2.62313E-21
PBF3 -	5.56643E-16	2.11624E-21	PBF3 -	5.56637E-16	2.11622E-21
H2SE	1.69995E-16	2.10860E-21	H2SE	8.01117E-76	9.93697E-81
CRCL2 +	1.87853E-16	1.53523E-21	CRCL2 +	3.84164E-27	3.13958E-32
ALF5 2-	1.53693E-16	1.26562E-21	ALF5 2-	1.53691E-16	1.26560E-21
FE(SO4)2 -	2.53604E-16	1.02723E-21	FE(SO4)2 -	2.68090E-16	1.08591E-21
FECL 2+	5.72297E-17	6.29599E-22	FECL 2+	6.04997E-17	6.65573E-22
MOO2 +	7.91494E-17	6.21376E-22	MOO2 +	1.15270E-25	9.04948E-31
SE 2-	4.37757E-17	5.56851E-22	SE 2-	2.06301E-76	2.62427E-81

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
CRO4 2-	5.82198E-17	5.04138E-22	CRO4 2-	3.85425E-01	3.33748E-06
VOSO4	7.44671E-17	4.58875E-22	VOSO4	1.08451E-25	6.68286E-31
U(OH)3 +	1.12456E-16	3.90770E-22	U(OH)3 +	2.38509E-34	8.28789E-40
FEHPO4 +	5.75863E-17	3.80965E-22	FEHPO4 +	6.08932E-17	4.02842E-22
VOF +	1.87099E-17	2.18672E-22	VOF +	2.72483E-26	3.18465E-31
(UO2)2(OH)2 2+	1.23239E-16	2.15623E-22	(UO2)2(OH)2 2+	1.23223E-16	2.15596E-22
CUCL3 -	1.83220E-17	1.08313E-22	CUCL3 -	1.89171E-17	1.11831E-22
SE2 2-	1.23844E-17	7.87683E-23	H2SEO4	2.34132E-17	1.62213E-22
V4O9 2-	2.20125E-17	6.35775E-23	V4O9 2-	9.90257E-53	2.86010E-58
(UO2)3(OH)5 +	4.93402E-17	5.53647E-23	(UO2)3(OH)5 +	4.93294E-17	5.53525E-23
H4ASO3 +	6.78183E-18	5.36565E-23	H4ASO3 +	1.43844E-35	1.13807E-40
UO2F4 2-	1.17273E-17	3.40414E-23	UO2F4 2-	1.17264E-17	3.40389E-23
H2SO4	1.80148E-18	1.84490E-23	H2SO4	1.80148E-18	1.84491E-23
FEH2PO4 2+	1.55319E-18	1.02075E-23	FEH2PO4 2+	1.64241E-18	1.07938E-23
FECL2 +	1.04324E-18	8.26679E-24	FECL2 +	1.10283E-18	8.73906E-24
FE2(OH)2 4+	7.97240E-19	5.49562E-24	FE2(OH)2 4+	8.90976E-19	6.14178E-24
UO2H2PO4 +	1.59390E-18	4.36206E-24	UO2H2PO4 +	1.59427E-18	4.36305E-24
AL2(OH)2 4+	8.36922E-20	9.55490E-25	AL2(OH)2 4+	8.36988E-20	9.55565E-25
V4O12 4-	2.74488E-19	6.96636E-25	V4O12 4-	2.74489E-19	6.96640E-25
HCRO4 -	7.71763E-20	6.62530E-25	HCRO4 -	5.10911E-04	4.38598E-09
VOF2	3.76326E-20	3.60202E-25	VOF2	5.48057E-29	5.24575E-34
ALF6 3-	2.16917E-20	1.54552E-25	ALF6 3-	2.16920E-20	1.54554E-25
HMOO3 +	9.59304E-21	6.64739E-26	HMOO3 +	9.59287E-21	6.64728E-26
PBF4 2-	1.38605E-20	4.91595E-26	PBF4 2-	1.38605E-20	4.91595E-26
VOH 2+	2.39841E-21	3.54532E-26	VOH 2+	5.08718E-39	7.51985E-44
HV6O17 3-	1.41562E-20	2.45724E-26	HV6O17 3-	1.41551E-20	2.45705E-26
FE3(OH)4 5+	2.16811E-21	9.24428E-27	FE3(OH)4 5+	2.56153E-21	1.09217E-26
HSEO4 -	5.65482E-22	3.94524E-27	HSEO4 -	1.31664E-10	9.18590E-16
CUCL4 2-	1.79979E-22	8.80287E-28	CUCL4 2-	1.85830E-22	9.08901E-28
FECL3	1.30862E-22	8.10327E-28	FECL3	1.38338E-22	8.56619E-28
U(OH)2 2+	9.41146E-23	3.47481E-28	U(OH)2 2+	1.99612E-40	7.36990E-46
VOF3 -	3.36711E-23	2.72881E-28	VOF3 -	4.90366E-32	3.97408E-37
H2V2O4 2+	6.56295E-24	3.92619E-29	V2(OH)2 4+	1.91254E-80	1.41356E-85
AL3(OH)4 5+	1.74939E-25	1.17948E-30	AL3(OH)4 5+	1.74960E-25	1.17962E-30
V 3+	4.92052E-26	9.70182E-31	V 3+	1.04370E-43	2.05788E-48
UO2(H2PO4)2	4.03178E-25	8.72750E-31	UO2(H2PO4)2	4.03386E-25	8.73201E-31
MN 3+	5.76598E-27	1.05418E-31	MN 3+	3.95923E-18	7.23853E-23
U(HPO4)4 4-	1.70461E-27	2.75287E-33	U(HPO4)4 4-	3.61994E-45	5.84605E-51
H2V6O17 2-	6.63413E-28	1.14955E-33	H2V6O17 2-	6.63340E-28	1.14942E-33
H2SEO4	1.00558E-28	6.96692E-34			

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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Appendix A
Aqueous Speciation of constituents in Estimated Waste-Cell Leachate

Eh = 0.0 Volts			Eh = 0.5 Volts		
SPECIES	PPM	MOLALITY	SPECIES	PPM	MOLALITY
MOO2 2+	6.78321E-29	5.32528E-34	MOO2 2+	6.78321E-29	5.32528E-34
VOH +	3.81920E-30	5.64552E-35	VOH +	1.17976E-56	1.74392E-61
UOH 3+	1.22294E-29	4.81632E-35	UOH 3+	2.59386E-47	1.02155E-52
H2CRO4	3.10199E-30	2.64020E-35	H2CRO4	2.05352E-14	1.74782E-19
U(HPO4)3 2-	1.10978E-29	2.11929E-35	U(HPO4)3 2-	2.35588E-47	4.49891E-53
V 2+	4.41282E-31	8.70079E-36	V 2+	1.36316E-57	2.68775E-62
PB(OH)6 2-	4.60697E-31	1.49633E-36	PB(OH)6 2-	2.17206E-13	7.05479E-19
U(HPO4)2	1.79503E-31	4.19304E-37	U(HPO4)2	3.80934E-49	8.89829E-55
SIF6 2-	5.59232E-32	3.95353E-37	SIF6 2-	5.59228E-32	3.95350E-37
UO2(H2PO4)3 -	2.60205E-32	4.65881E-38	UO2(H2PO4)3 -	2.60419E-32	4.66263E-38
UF2 2+	5.00518E-33	1.82130E-38	UF2 2+	1.06156E-50	3.86286E-56
UF3 +	3.63191E-33	1.23649E-38	UF3 +	7.70285E-51	2.62245E-56
UF4	3.38219E-33	1.08181E-38	UF4	7.17313E-51	2.29436E-56
UF 3+	8.16813E-34	3.19196E-39	UF 3+	1.73246E-51	6.77015E-57
UHPO4 2+	7.46342E-34	2.24437E-39	UHPO4 2+	1.58343E-51	4.76161E-57
U(SO4)2	8.23956E-36	1.92399E-41	U(SO4)2	1.74754E-53	4.08062E-59
UF5 -	4.42369E-36	1.33422E-41	UF5 -	9.38202E-54	2.82968E-59
USO4 2+	3.34529E-36	1.00574E-41	USO4 2+	7.09522E-54	2.13314E-59
U 4+	3.99321E-37	1.68502E-42	U 4+	8.47000E-55	3.57410E-60
UF6 2-	7.54603E-38	2.15311E-43	UF6 2-	1.60043E-55	4.56649E-61
UCL 3+	1.40145E-39	5.14708E-45	UCL 3+	2.97251E-57	1.09171E-62
CR2O7 2-	7.32216E-42	3.40505E-47	CR2O7 2-	3.20898E-10	1.49228E-15
MO 3+	4.09938E-44	4.29172E-49	MO 3+	1.26637E-70	1.32579E-75
V2(OH)2 4+	4.25093E-45	3.14185E-50	H2V2O4 2+	1.39201E-41	8.32752E-47
U 3+	2.42153E-47	1.02182E-52	U 3+	7.48016E-74	3.15641E-79
MNO4 2-	2.38971E-51	2.01812E-56	MNO4 2-	5.31177E-16	4.48581E-21
V10O28 6-	1.40982E-51	1.47906E-57	V10O28 6-	1.40980E-51	1.47904E-57
PB(OH)8 4-	1.58176E-52	4.62842E-58	PB(OH)8 4-	7.45809E-35	2.18233E-40
HV10O28 5-	1.83567E-55	1.92380E-61	HV10O28 5-	1.83553E-55	1.92365E-61
MNO4 -	7.03952E-62	5.94489E-67	MNO4 -	1.07437E-17	9.07307E-23
PB 4+	9.02677E-62	4.37578E-67	PB 4+	4.25617E-44	2.06320E-49
H2V10O28 4-	1.12304E-61	1.17571E-67	H2V10O28 4-	1.12289E-61	1.17556E-67

Ion speciation in leachate solution modeled using WATEQF (Plummer et al., 1976), using a mean pH of 9.1 and a temperature of 12 degrees C. See text for further discussion.

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APPENDIX B: HELP MODEL OUTPUT

1097

To
Wayne Belchel
RMRS T893B
Fx 7193

FAX MEMO
PAGES ____ DATE ____ FAX # ____
TO ____
FROM ____
CC ____
PH # ____ FAX # ____

From
Leon Collins - RMRS
X 6708
3/25/96

6 Pages

output filename Rain 100L.out

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	15.44	(2.909)	560443.0	100.00
RUNOFF	0.060	(0.0993)	2176.92	0.388
EVAPOTRANSPIRATION	14.299	(2.5270)	519043.47	92.613
LATERAL DRAINAGE COLLECTED FROM LAYER 6	1.08088	(0.64998)	39236.066	7.00090
PERCOLATION/LEAKAGE THROUGH FROM LAYER 8	0.00000	(0.00000)	0.135	0.00002
AVERAGE HEAD ACROSS TOP OF LAYER 8. Waste Layer is #10	0.001	(0.001)		
LATERAL DRAINAGE COLLECTED FROM LAYER 13 Concrete Slab	0.00000	(0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH FROM LAYER 14	0.00000	(0.00000)	0.155	0.00002
AVERAGE HEAD ACROSS TOP OF LAYER 14	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 15.	0.00000	(0.00000)	0.051	0.00001
PERCOLATION/LEAKAGE THROUGH FROM LAYER 17	0.00000	(0.00000)	0.084	0.00001

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INITIAL SOIL WATER CONTENT = 0.1591 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.370000005000E-01 CM/SEC

LAYER 10

TYPE 1 - VERTICAL PERCOLATION LAYER - compacted Waste
MATERIAL TEXTURE NUMBER 19

THICKNESS	=	204.00	INCHES
POROSITY	=	0.1680	VOL/VOL
FIELD CAPACITY	=	0.0730	VOL/VOL
WILTING POINT	=	0.0190	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0730	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 11

TYPE 1 - VERTICAL PERCOLATION LAYER - drainage Net.
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 12

TYPE 1 - VERTICAL PERCOLATION LAYER - Concrete slab with drain Pipes
MATERIAL TEXTURE NUMBER 43

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3600	VOL/VOL
FIELD CAPACITY	=	0.0358	VOL/VOL
WILTING POINT	=	0.0210	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0358	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.30900002000	CM/SEC

LAYER 13

TYPE 2 - LATERAL DRAINAGE LAYER - Gravel under Slab
MATERIAL TEXTURE NUMBER 43

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3600	VOL/VOL
FIELD CAPACITY	=	0.0358	VOL/VOL
WILTING POINT	=	0.0210	VOL/VOL

INITIAL SOIL WATER CONTENT	=	0.0358	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.30900002000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	235.0	FEET

LAYER 14

TYPE 4 - FLEXIBLE MEMBRANE LINER — Leachate Collection Membrane
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.08	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

LAYER 15

TYPE 2 - LATERAL DRAINAGE LAYER — Geocomposite
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	1.00	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	235.0	FEET

LAYER 16

TYPE 4 - FLEXIBLE MEMBRANE LINER — Leak detection Membrane
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.08	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

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LAYER 17

TYPE 3 - BARRIER SOIL LINER — Bottom Clay
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	36.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 1 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 235. FEET.

SCS RUNOFF CURVE NUMBER	=	64.60	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	10.000	ACRES — actually only 4½ acres per 100K yd³ cell
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.939	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.438	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.828	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	49.658	INCHES
TOTAL INITIAL WATER	=	49.658	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR — Above Grade

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
DENVER COLORADO

MAXIMUM LEAF AREA INDEX	=	1.80	
START OF GROWING SEASON (JULIAN DATE)	=	139	
END OF GROWING SEASON (JULIAN DATE)	=	254	
AVERAGE ANNUAL WIND SPEED	=	8.80	MPH — slow!
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	54.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	50.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	49.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	54.00	%

wet ∴ conservative for site.

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DENVER COLORADO

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ERAGE HEAD ACROSS TOP OF LAYER 17	0.000 (	0.000)		
CHANGE IN WATER STORAGE	0.000	(0.3851)	-13.57	-0.002

****

1102

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	2.49	90387.000
RUNOFF	0.392	14236.7549
DRAINAGE COLLECTED FROM LAYER 6	0.58248	21143.84180
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000001	0.01920
AVERAGE HEAD ACROSS LAYER 8	0.330	
DRAINAGE COLLECTED FROM LAYER 13	0.00000	0.00001
PERCOLATION/LEAKAGE THROUGH LAYER 14	0.000000	0.00377
AVERAGE HEAD ACROSS LAYER 14	0.000	
DRAINAGE COLLECTED FROM LAYER 15	0.00000	0.00345
PERCOLATION/LEAKAGE THROUGH LAYER 17	0.000000	0.00025
AVERAGE HEAD ACROSS LAYER 17	0.000	
SNOW WATER	1.55	56425.5508

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.2237
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0370

****

0.00025 ft^3/day

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******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**               HELP MODEL VERSION 3.01    (14 OCTOBER 1994)               **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**              FOR USEPA RISK REDUCTION ENGINEERING LABORATORY             **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\HELP3\RAIN100.D4
TEMPERATURE DATA FILE:        C:\HELP3\RAIN100.D7
SOLAR RADIATION DATA FILE:    C:\HELP3\RAIN100.D13
EVAPOTRANSPIRATION DATA:      C:\HELP3\RAIN100.D11
SOIL AND DESIGN DATA FILE:    C:\HELP3\RAIN18.D10
OUTPUT DATA FILE:             C:\HELP3\RAIN100N.OUT


TIME:  11:18      DATE:   4/ 7/1996


******************************************************************************

     TITLE:  interim cover (no cover)

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                       TYPE 1 - VERTICAL PERCOLATION LAYER
                           MATERIAL TEXTURE NUMBER   2
          THICKNESS                  =     12.00   INCHES
          POROSITY                   =      0.4370 VOL/VOL
          FIELD CAPACITY             =      0.0620 VOL/VOL
          WILTING POINT              =      0.0240 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.0495 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.579999993000E-02 CM/SEC
       NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  1.80
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
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LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.0620	VOL/VOL
WILTING POINT	=	0.0240	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0572	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.579999993000E-02	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

THICKNESS	=	1.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.0620	VOL/VOL
WILTING POINT	=	0.0240	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0981	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.579999993000E-02	CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	6.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4178	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 19

THICKNESS	=	204.00	INCHES
POROSITY	=	0.1680	VOL/VOL
FIELD CAPACITY	=	0.0730	VOL/VOL
WILTING POINT	=	0.0190	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0730	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02	CM/SEC

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0703	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC

LAYER 7

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 43

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3600	VOL/VOL
FIELD CAPACITY	=	0.0358	VOL/VOL
WILTING POINT	=	0.0210	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0522	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.30900002000	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 43

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3600	VOL/VOL
FIELD CAPACITY	=	0.0358	VOL/VOL
WILTING POINT	=	0.0210	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0358	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.30900002000	CM/SEC
SLOPE	=	3.00	PERCENT
DRAINAGE LENGTH	=	235.0	FEET

LAYER 9

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.08	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE

FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

LAYER 10

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 20

THICKNESS	=	1.00	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	10.0000000000	CM/SEC
SLOPE	=	1.00	PERCENT
DRAINAGE LENGTH	=	235.0	FEET

LAYER 11

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.08	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	2.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	4 - POOR	

LAYER 12

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	36.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

1107

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 2 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 235. FEET.

SCS RUNOFF CURVE NUMBER	=	73.10	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	10.000	ACRES
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.740	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.866	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.432	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	35.229	INCHES
TOTAL INITIAL WATER	=	35.229	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM DENVER COLORADO

MAXIMUM LEAF AREA INDEX	=	1.00	
START OF GROWING SEASON (JULIAN DATE)	=	137	
END OF GROWING SEASON (JULIAN DATE)	=	254	
AVERAGE ANNUAL WIND SPEED	=	8.80	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	54.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	50.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	49.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	54.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DENVER COLORADO

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.51	0.69	1.21	1.81	2.47	1.58
1.93	1.53	1.23	0.98	0.82	0.55

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR DENVER COLORADO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
29.50	33.60	38.00	47.40	57.20	67.00
73.30	71.40	62.60	51.90	38.70	32.60

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NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR DENVER COLORADO

STATION LATITUDE = 39.77 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.53	0.78	1.25	1.75	2.39	1.60
	2.01	1.48	1.32	0.92	0.80	0.61
STD. DEVIATIONS	0.37	0.44	0.66	0.98	1.21	0.94
	1.12	0.84	0.88	0.71	0.55	0.36
RUNOFF						
TOTALS	0.006	0.028	0.023	0.000	0.001	0.000
	0.000	0.000	0.000	0.000	0.000	0.004
STD. DEVIATIONS	0.020	0.076	0.066	0.000	0.005	0.001
	0.000	0.000	0.001	0.000	0.002	0.018
EVAPOTRANSPIRATION						
TOTALS	0.549	0.592	1.076	1.521	2.096	1.703
	2.215	1.372	1.217	0.763	0.717	0.613
STD. DEVIATIONS	0.262	0.338	0.465	0.688	0.913	0.826
	0.932	0.767	0.693	0.512	0.440	0.306
LATERAL DRAINAGE COLLECTED FROM LAYER 8						
TOTALS	0.0521	0.0451	0.0464	0.0415	0.0393	0.0353
	0.0414	0.0479	0.0530	0.0563	0.0548	0.0554
STD. DEVIATIONS	0.0224	0.0211	0.0243	0.0247	0.0263	0.0267
	0.0264	0.0254	0.0190	0.0187	0.0177	0.0198
PERCOLATION/LEAKAGE THROUGH LAYER 9						
TOTALS	0.0325	0.0284	0.0299	0.0272	0.0262	0.0232
	0.0265	0.0295	0.0325	0.0343	0.0335	0.0340
STD. DEVIATIONS	0.0102	0.0095	0.0110	0.0114	0.0126	0.0137
	0.0136	0.0133	0.0089	0.0085	0.0076	0.0085

LATERAL DRAINAGE COLLECTED FROM LAYER 10

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TOTALS	0.0325	0.0284	0.0299	0.0272	0.0262	0.0232
	0.0265	0.0295	0.0325	0.0343	0.0335	0.0340
STD. DEVIATIONS	0.0102	0.0095	0.0110	0.0114	0.0125	0.0137
	0.0136	0.0133	0.0089	0.0085	0.0076	0.0085

PERCOLATION/LEAKAGE THROUGH LAYER 12

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ACROSS LAYER 9

AVERAGES	0.0010	0.0010	0.0009	0.0009	0.0008	0.0008
	0.0008	0.0010	0.0011	0.0011	0.0011	0.0011
STD. DEVIATIONS	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
	0.0005	0.0005	0.0004	0.0003	0.0003	0.0004

DAILY AVERAGE HEAD ACROSS LAYER 12

AVERAGES	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005
STD. DEVIATIONS	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002
	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	15.44	(2.909)	560443.0	100.00
RUNOFF	0.062	(0.0998)	2251.85	0.402
EVAPOTRANSPIRATION	14.434	(2.5623)	523949.44	93.488
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.56843	(0.21235)	20634.100	3.68175
ERCOLATION/LEAKAGE THROUGH FROM LAYER 9	0.35784	(0.09918)	12989.652	2.31775
AVERAGE HEAD ACROSS TOP OF LAYER 9	0.001	(0.000)		

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LATERAL DRAINAGE COLLECTED FROM LAYER 10	0.35783	(0.09919)	12989.262	2.31768
ERCOLATION/LEAKAGE THROUGH FROM LAYER 12	0.00001	(0.00000)	[illegible]205	0.00004
AVERAGE HEAD ACROSS TOP OF LAYER 12	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.017	(0.7303)	618.08	0.110

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(111)

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	2.49	90387.000
RUNOFF	0.394	14310.1660
DRAINAGE COLLECTED FROM LAYER 8	0.00395	143.20885
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.001778	64.55125
AVERAGE HEAD ACROSS LAYER 9	0.002	
DRAINAGE COLLECTED FROM LAYER 10	0.00169	61.37564
PERCOLATION/LEAKAGE THROUGH LAYER 12	0.000000	0.00078
AVERAGE HEAD ACROSS LAYER 12	0.001	
SNOW WATER	1.55	56425.5508

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.1896
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0146

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FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	0.3697	0.0308
2	1.8921	0.1577
3	0.4370	0.4370
4	2.5620	0.4270
5	14.8920	0.0730
6	0.0160	0.0800
7	0.9514	0.0793
8	0.4296	0.0358
9	0.0000	0.0000
10	0.0104	0.0104
11	0.0000	0.0000
12	15.3720	0.4270
SNOW WATER	0.000	

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Appendix I

NEPA Values Analysis Backup Documentation

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Table I-1 Summary of Criteria Used to Evaluate Environmental Impacts[1]

Criteria	Included in Onsite vs Offsite Screen	Included in Siting Study	Included in Facility Design Screen	Included in Final Comparison	Included in OU 4 February DD
Human Health	§B7.1, Table 7.1		(A1, A2, A4, B1, F6)	NCP threshold: human health & regulatory requirements	§IV.10.1
Environment	§B7.2	§C2.4.1, §C2.4.3	Broken into the following criteria	NCP threshold: human health & regulatory requirements	Table IV.10-22
Ecological Risk	§B7.3.3	§C2.4.1			§IV.10.2
Air Quality	§B7.3.1, §B7.3.2, §B7.3.3		(F5)		§IV.10.3
Water Quality	§B7.3.1, §B7.3.2, §B7.3.3	§C2.4.1	(B1, B5, B10, B11, B12)		§IV.10.4, §IV.10.5
Soils & Sediments	§B7.3.1, §B7.3.2, §B7.3.3				
Commitment of Resources		§C2.4.2, §C2.4.4, §C2.4.6	(C8, E6)		§IV.10.6
Natural Phenomenon Mitigation/ Mitigation Measures		§C2.4.1	(B2, B3)		§IV.10.7
Transportation		§C2.4.2			§IV.10.8
Short-term vs. Long-term		§C2.4.1, §C2.4.2, §C2.4.3	(A5, A6, F7)	NCP primary balancing: long-term and short-term effectiveness, treatment	§IV.10.9
Cultural/archeological Resources					§IV.10.10
Cumulative Impacts		§C2.4.2	(C1, C9)		§IV.10.11
Direct/Indirect Effects[2]					Table IV.10-22

1) This table identifies the selection in this DD containing criteria used to evaluate the NEPA-values in the Onsite vs Offsite Evaluation (Appendix B) and the Remediation Waste Storage Facility Siting Study. For the Facility Design Screen, the criteria alpha-numeric designation is shown; these criteria are noted throughout the screen. For the Final Comparison, the related NCP criteria are listed. The Solar Ponds location was evaluated in the OU 4 February Proposed DD, and the sections where the criteria are discussed are also indicated. Additional criteria were also used in some of the studies (for example, cost); for a complete listing of the criteria used in each study, see the appropriate document section.

2) Direct effects which occur at the same time and place as an action and indirect effects which occur at a later time and greater distance are generally considered by medium in this criterion

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Table I-2 Summary of Results: Evaluation of Environmental Impacts Onsite vs. Offsite Waste Management

Criteria	Potential Impact Onsite	Potential Impact Offsite	Potential Impact for No Action
• **Schedule**	The concept of reducing overall risk to the public and the environment [from unremediated locations at RFETS] is more attractive than an extended waste removal process using offsite disposal. §B6.0	-	-
• **Human Health**	After the waste is placed in the cell, the risks associated with onsite and offsite disposal should not be significantly different. During construction, risk to the public will be minimal and worker risks can be tightly controlled. §B7.1	National statistics suggest five accidents would occur during transportation of the waste. The magnitude of risk to the public is difficult to quantify; however these exposures would be involuntary and uncontrolled. §B7.1 & Table 7-1	Presents the greatest human health risk to the community in the long-term, depending on future actions taken to prevent migration and future land uses. These risks are calculated for selected Buffer zone operable units to be low. Industrial Area risks have not been calculated, but are expected to be higher. §B7.1
• **Environmental**	Long-term waste management options onsite and offsite were deemed to be equally effective in containing contaminants because of similar design and similar regulatory requirements. §B7.2	-	-
- **Air Quality**	Vehicle exhausts and potential for spills exists. Fugitive dust during excavation and placement. §B7.3.3	Vehicle exhausts and potential for spills exists. Fugitive dust during excavation and placement. §B7.3.2	There could be local air quality impacts resulting from future events such as construction or erosion. §B7.3.1
- **Ecological**	Impacts would depend on the location of the RWSF. Impacts would be minimized if the selected location was previously developed. Impacts expected to be minimal. §B7.3.3	No direct impact expected. A spill could create impacts. §B7.3.2	Not significant. §B7.3.1
- **Soils & Sediments**	Minimal damage to topsoil, site selection and erosional controls would minimize impacts. Spills could impact surface soils. §B7.3.3	No direct impact expected. A spill could create impacts. §B7.3.2	Contamination could spread. §B7.3.1
- **Water Quality**	No impact on water quality is anticipated. A spill could create impacts, however this risk is lower than the offsite option due to close proximity of an onsite RWSF. §B7.3.3	No direct impact expected. A spill could create impacts. §B7.3.2	Groundwater plumes will continue to spread. §B7.3.1

This table shows which screening-criteria include evaluations of environmental impacts, summarizes the potential environmental impacts of the three alternatives screened, and references the document section where more information is available. See also Table 7-2 in Appendix B for summary of the study results.

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Table I-3 Summary of Results: Evaluation of Environmental Impacts Remediation Waste Storage Facility Siting Study[1]

Criteria	Potential Impacts for Onsite Locations	Specific to Proposed Location at Solar Ponds Area
Environment	• All sites have approximately the same geomorphic conditions with the degree of erosion occurring at a predictable rate. (§2.4.2 Public Protection) • A reliable, effective, and protective facility can be engineered at any of the sites being considered. (§2.4.1 CAMU)	none noted
Ecological Risk	• The presence of significant springs and seeps in certain Buffer Zone sites reduces their suitability because of potential impacts to sensitive habitats. (§2.4.2 Public Protection)	none noted
Ground Water Quality	• All the sites are located in recharge areas. (§2.4.2 Public Protection) • All of the sites have minimal groundwater flow. (§2.4.2 Public Protection) • Downward migration from the unconfined aquifer is thought to be nonexistent.. (§2.4.2 Public Protection) • Groundwater flow in fractured claystone bedrock is thought to be minimal. (§2.4.2 Public Protection) • The sites have seasonally shallow water tables that may require engineered barriers. (§2.4.2 Public Protection)	• Local variations in shallow bedrock lithology at the Solar Ponds area is caused by subcropping sandstones, but vertical flow to deeper sandstones and the Laramie/Fox Hills aquifer is minimal. (§2.4.2 Public Protection)

[1]This table summarized the results of the evaluations for the Onsite Remediation Waste Storage Facility Siting Study. References in the table indicate the section of the study where discussion of the criteria are found.

Table I-3 (continued)

Criteria	Potential Impacts for Onsite Locations	Specific to Proposed Location at Solar Ponds Area
Surface Water Quality	• Estimates of lateral groundwater travel times from the proposed sites to their nearest discharge pints are well below 1,000 years. (§2.4.2 Public Protection) • None of the sites are located in areas that will be impacted by surface water. The sites are not expected to have a significant impact on surface water. (§2.4.2 Public Protection)	none noted
Commitment of Resources	• Alluvial thicknesses greater than 40 feet are potentially economic for the gravel resource. Portions of the Buffer Zone have alluvial thicknesses of 40 feet or more. (§2.4.3 RFETS Special Issues) • Minimization of the land area upon which remediation wastes would remain in place is generally dependent on the design selected rather than location. (§2.4.3 RFETS Special Issues) • Jefferson County has stated a desire to maintain the Buffer Zone as undeveloped open space; sites in the Buffer Zone would impinge on this. (§2.4.6 Other Stakeholder Concerns)	• Solar Ponds area do not constitute an economical gravel resource. (§2.4.3 RFETS Special Issues) • The Solar Ponds site coincides with the Site Vision by locating the WMF within the larger footprint of the final cap cove. (§2.4.3 RFETS Special Issues & §2.4.4 Regulator Support) • Sites within the Industrial Area, including the Solar Ponds area, would be more readily acceptable. (§2.4.6 Other Stakeholder Concerns)
Natural Phenomenon Mitigation/ Mitigation Measures	• Geotechnical stability of foundation soils is not expected to be a problem at any of the sites. (§2.4.2 Public Protection) • The inferred bedrock faults are not considered to pose a seismic risk. (§2.4.2 Public Protection)	none noted

Table I-3 (continued)

Criteria	Potential Impacts for Onsite Locations	Specific to Proposed Location at Solar Ponds Area
Transportation	• Most of the waste targeted for the RWSF originates in the Industrial Area; haul distances would be shorter to sites inside the Industrial Area. (§2.4.3 RFETS Special Issues)	none noted
Short-term vs. Long-term	• The presence of significant clay fraction provides a relatively favorable environment for waste disposal, especially for strongly sorbed contaminants such as metals. (§2.4.2 Public Protection) • Several locations would require construction or upgrade of the onsite roads and site preparation, including building demolition, subsurface line removal, and rerouting access. (§2.4.3 RFETS Special Issues) • The timing of remedial activity implementation is more dependent on the WMF design and the permitting process than on the site selected. (§2.4.1 CAMU)	• Site preparation costs for the Solar Ponds area are at the upper end of the range for the various sites. (§2.4.3 RFETS Special Issues)
Cumulative Impacts	•Impacts from plutonium consolidation or residue stabilization activities are not a factor for siting the WMF. (§2.4.3 RFETS Special Issues)	•Solar Ponds would be an ideal candidate to support the Site Vision (i.e., Buffer Zone as open pace and Industrial Area as industrial/waste management) (§2.4.3 RFETS Special Issues)

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Table I-4 Summary of Results: Evaluation of Environmental Impacts Facility Design Screen

Attributes	Design										
	Above-grade Landfill	Concrete Lined Cell with Bulk Placement	Concrete Lined Cell with Cargo Containers	Hardened Concrete Vault	Silo Design	Slab on Grade	Metal Buildings	Entomb-ment	Pyramid Design	Waste Pile	No Action
Ground-water Protection	waste isolated from substrate and ground-water, run-off diverted to edges	provides reasonable assurances substrate and ground water protected, drainage around cap	see previous column; containers provide an additional barrier	drainage around cap	drainage around cap, includes a liner system	temporary facility, maintenance to avoid cracks	adequate for 30 years	numerous barriers	could require more maintenance to maintain protectiveness	adequate for 30 years	equivalent to better than landfill
Consistency	relatively larger footprint, supports Site Vision	relatively smaller footprint, supports Site Vision	relatively smaller footprint, supports Site Vision	footprint not as large as some options, some resource competition with Site Vision	small footprint, ties well to Site Vision	large footprint, short-term support to Site Vision	large footprint, short-term support to Site Vision	very large footprint, could negatively impact other Site activities	large footprint, timing could impact Site Vision	does not suport RFCA	consistent with Site Vision

The facility design screen compared designs independent of location. This screen addresses technical issues and is not a primary source of environmental evaluation. Potential impacts are inherent in some of the criteria. The potential impacts to the environment cluster around a few attributes:

- Some designs offer more protection to the groundwater; the presence or absence of a liner and leachate collection system being an important design feature.
- Designs that are consistent with the Site Vision tend to reduce commitment of land. Location of the facility would also effect the consistency.

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Table I-5 Summary of Results: Evaluation of Environmental Impacts Proposed Facility Design at Solar Ponds Location[1]

Criteria	Potential Impacts
Human Health §IV.10.1	Minimize existing risks due to long-term potential exposure to surficial soil, vadose zone soil, materials from D&D, and other remediation waste*(including all soils and materials noted in the list of wastes tentatively planned for placement in the RWSF)*. Short-term risks due to worker exposure to remediation waste that exceed PRGs during remediation. Potential adverse effects to workers as a result of encountering unknown utilities or uncharacterized areas of high contamination. Risks to workers associated with soil excavation, relocation, treatment processes and construction activities (e.g., increased fugitive dust generation, increased transportation requirements)
Environment Table IV.10-22	Temporary physical disruption of industrial area during construction; *approximately 10 acres for RWSF* affected by soil excavation, material staging, and construction activities Temporary physical disruption of borrow area used for clean fill material Increased local traffic requirements, increased dust generation during construction *and possibly during operation*, and increased potential for erosion due to changes in surface topography at *both the construction area* and borrow area Three small wetlands *may* require protection during construction, *depending on the details of the RWSF construction*. Wetlands banking *may be* considered as a mitigation measure *if the detailed design or in-field activities indicate impacts to the wetlands occur*. Mitigation measures may be required for the Prebles Meadow Jumping Mouse, which is being considered for listing as a federal endangered species. No floodplains will be affected
Ecological Risk §IV.10.2	*The area* has been characterized as a highly disturbed industrial area which can support only the most hardy species of plants and animals. The natural environment at and adjacent to *the RWSF site* has been significantly altered by construction and operation of the SEPs *(Solar Evaporation Ponds)* and other industrial facilities.... It is highly probable that these construction activities will interfere with any existing vegetation and animal use of the site.
Air Quality §IV.10.3	*Atmospheric dispersion calculations were prepared for the project proposed in the OU 4 Proposed IM/IRA-EA Decision Document. Those calculations demonstrate little risk due to exposure to site contaminants to remediation workers, on-site workers, or the public during construction. The original project included considerable excavation; the RWSF as currently envisioned will be constructed with less excavation and so should create less fugitive dust.* Potential increase in PM_{10} emissions at both *the construction area* and the borrow areas during construction
Ground Water Quality §IV.10.4	Potential effect on local hydrogeology by reducing percolation and changing topography in a potential recharge area *(Impacts specific to the design from the OU 4 DD have been omitted)*

[1]This table summarized the results of the evaluations at the Solar Ponds location. For further information, see indicated portion of Section IV.10 and Table IV.10-22 from the *OU 4 Proposed IM/IRA-EA Decision Document* (February, 1995). Some modifications from the OU 4 document are included in the RWSF; those modifications are noted by *italics*.

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Table I-5 (continued)

Criteria	Potential Impacts
Surface Water Quality §IV.10.5	No surface water bodies exist within *the construction area* Consolidation of soil contamination *in the RWSF* will minimize or eliminate precipitation run-off *potentially contaminated by remediation wastes* *(Impacts specific to the design from the OU 4 DD have been omitted)*
Commitment of Resources §IV.10.6	Clean fill from borrow areas, construction materials, and area underneath and adjacent to *the RWSF*
Natural Phenomenon Mitigation/ Mitigation Measures §IV.10.7	*The design proposed in the OU 4 DD and the final, capped form of the RWSF are similar. The OU 4 DD considered damage from excess snow loading, lightning strikes, tornado generated missile impacts, meteorite impacts, volcanism: these were found to be incredible or unlikely to cause damage. Glacial activity and reactivation of the alluvial fan would not effect the site within the timespan of 1,000 years used in the evaluation. Wind erosion and flooding would not damage the site. Earthquake analysis suggested the conditions under which a seismically induced slope failure could occur. Several faults are known to exist in the vicinity of Rocky Flats. None of the faults investigated to date have been found capable (movement within the last 1 million years displacing alluvial sediments). DOE will investigate the RWSF for capable faults before finalizing the design and proceeding to construction.*
Transportation §IV.10.8	Minor increase in traffic volume and patterns during construction activities; negligible impact on surrounding transportation infrastructure
Short-term vs. Long-term §IV.10.9	Short-term interruption of industrial area and borrow area required to minimize potential risks associated with exposure to site contamination Construction of *RWSF* will preclude unrestricted use of area underlying and adjacent to *the RWSF*
Cultural/ Archeological Resources §IV.10.10	No resources present
Cumulative Impacts §IV.10.11	Implementation of the preferred IM/IRA is consistent with the long-term mission of remediating the RFETS Implementing may interfere slightly with other activities in progress at the RFETS *(Impacts specific to the design from the OU 4 DD have been omitted)*
Direct/Indirect Effects Table IV.10-22	As described above Remediation of OU 4 sludges *and other remediation wastes to be placed in the RWSF* currently stored onsite will be expedited Short-term direct increase in remediation jobs; indirect job loss due to eliminating production functions at RFETS

Brief Description of the Use of a Corrective Action Management Unit

The RCRA Corrective Action Management Unit (CAMU) rule is a regulatory provision designed to provide flexibility in order to expedite and implement protective, reliable and cost-effective remedies for remediation waste. At the Rocky Flats Environmental Technology Site (RFETS), the use of a CAMU means more rapid cleanup for a larger volume of wastes in a safer manner than the conventional RCRA approach would have allowed. Instead of needing to treat each contaminated area on an individual basis, bulk remediation waste can be brought to one facility for centralized management while containerized material is brought to another centralized facility for shipment.

The bulk storage CAMU will be an above ground, concrete-lined cell located in the eastern portion of the Protected Area adjacent to the Solar Evaporation Ponds. This modular style structure will store up to 400,000 cubic yards of remediation waste from cleanup operations and deactivation, decontamination, and demolition (D&D). The remediation waste will have some treatment applied before storage and will be placed for easy monitoring and recovery. A longer term storage configuration, up to 20 years, will be provided to accommodate possible disruption in offsite treatment and disposal operations. The facility will also be designed to serve as a final disposal facility if that option were agreed to by the stakeholders at some future date.

The containerized storage CAMU will be an above ground, prefabricated metal building placed on a concrete slab and located in the southeastern portion of the Industrial Area. This facility would be used to store containers prior to shipment offsite for treatment and disposal. Because of the prohibitive cost of containers and the throughput capacity of the offsite treatment operations, storage in this CAMU should be for approximately six months or less. The type of remediation waste managed in this facility will be from localized hot spots and from D&D activities not amenable to bulk storage. A railroad staging area shared with other forms of RFETS waste, "as generated waste," will be used to load and ship the waste containers by railcar.

While both CAMU facilities may be necessary to achieve the targeted ten year cleanup goal, the bulk storage CAMU facility is much more dependent on the final action levels agreed to for cleanup objectives. As the cleanup levels become less restrictive, the volume of remediation waste requiring treatment decreases and the offsite treatment and disposal options becomes more cost effective. For the bulk storage facility, a volume of something less than about 40,000 cubic yards results in the costs for storage and disposal being about equal. Thus, with a cleanup level forecasted to generate less than 40,000 cubic yards of remediation waste, the bulk storage facility would no longer necessarily be the least cost option. The containerized storage CAMU facility would still be required in order to comply with RCRA storage requirements.

Because the cleanup levels have not yet been agreed to, planning for the bulk storage CAMU facility as a contingence remains viable. If more restrictive cleanup levels are required the bulk storage facility will be necessary to expedite cleanup. Seeking a CAMU designation for the bulk storage facility at this time provides the flexibility necessary for future decisions on the cleanup levels. The actual design and construction of the facility would not take place until after the resolution of the cleanup levels, if at all.

The timing in making the decision concerning the use of a CAMU designation is critical. The draft Hazardous Waste Identification Rule (HWIR) proposed the removal of the CAMU as a tool to expedite and enhance remedial actions. While the final HWIR may reverse that position, due April 1997, any CAMU approved prior to the final date will still be available as a remediation option. The range in potential cleanup level volumes for remediation waste requires as many viable options for remediation as possible. The bulk and containerized storage CAMU's represent two of the more promising options and, therefore, the designations from the State of Colorado should continue to be sought.

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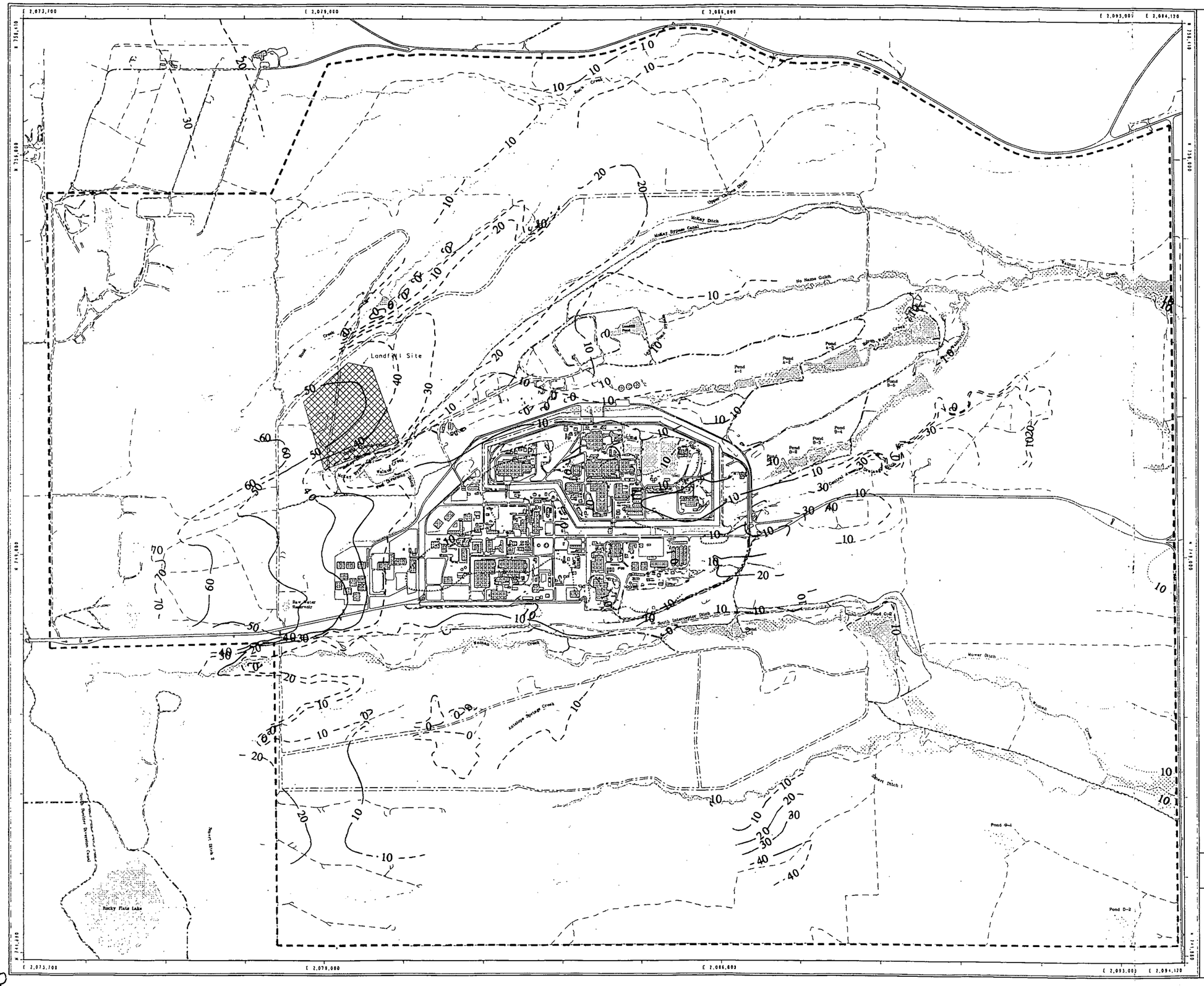

Figure 2
Hydrogeological Conditions

EXPLANATION

- Line of Equal Depth to Water (in feet)
- (dashed where inferred)
- Decreasing Line of Equal Depth to Water (in feet)
- (dashed where inferred)

Standard Map Features

- Buildings or other structures
- 100 year floodplain
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

600 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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Rocky Flats Environmental Technology Site

Prepared by:
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MAP ID: Draft

August 08, 1996

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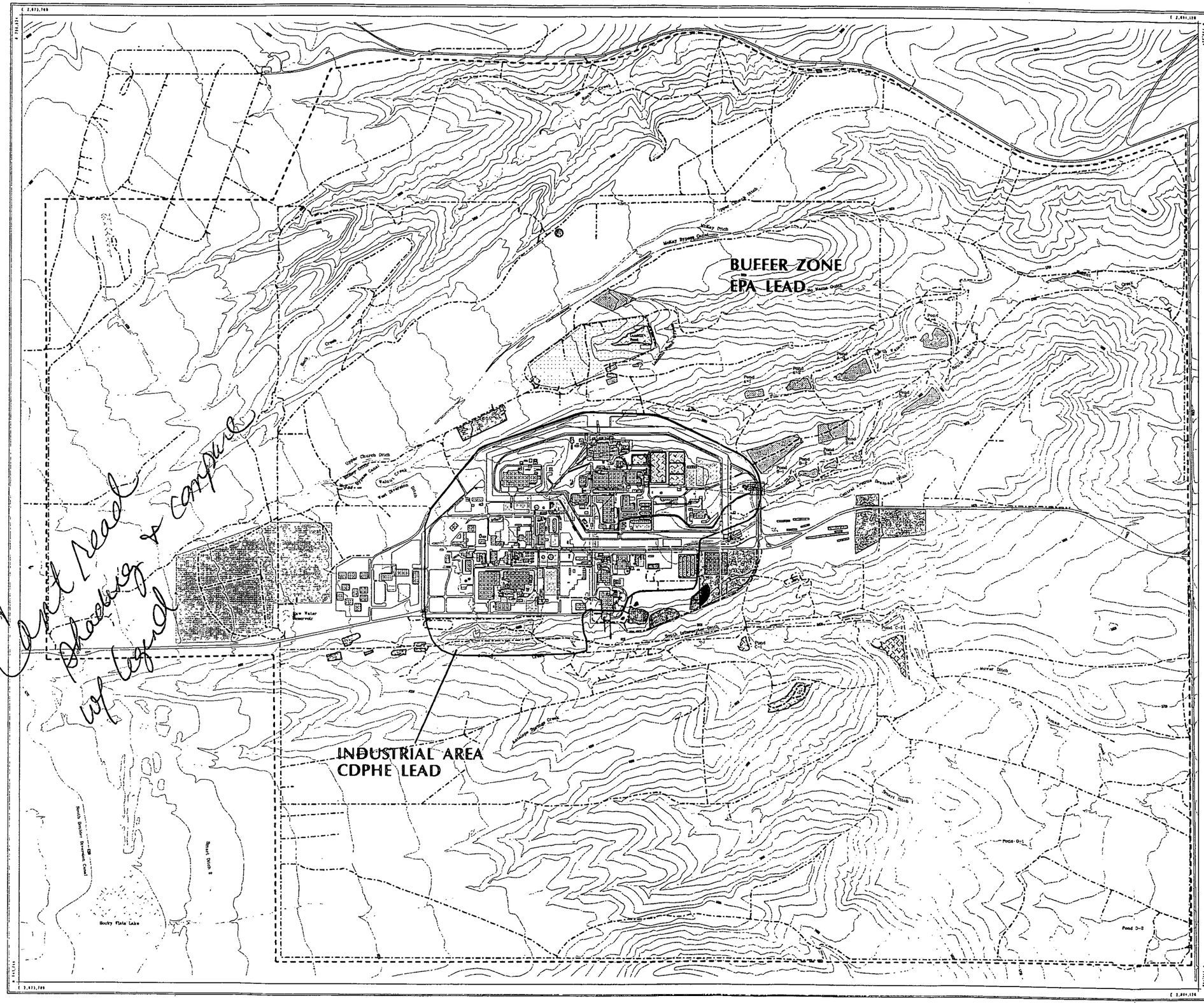

Figure 1-2
Proposed Consolidated Operable Units

Conceptual Strategy Purposes for Discussion Only

See paragraph 67 of RFCA

EXPLANATION

Note: OU3 not shown

- Industrial Area OU
- Buffer Zone OU
- Operable Unit 1
- Operable Unit 5
- Operable Unit 6
- Operable Unit 7
- Operable Unit 11 Closed through CAD/ROD Process
- Operable Unit 15 Closed through CAD/ROD Process
- Operable Unit 16 Closed through CAD/ROD Process
- Individual Hazardous Substance Sites (IHSS)

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)
Proposed Consolidated OU's data provided by Annette Primrose of RMRS/SA - 9-1996.

Scale = 1 : 19910
1 inch represents approximately 1659 feet

600 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: x8682 August 14, 1996

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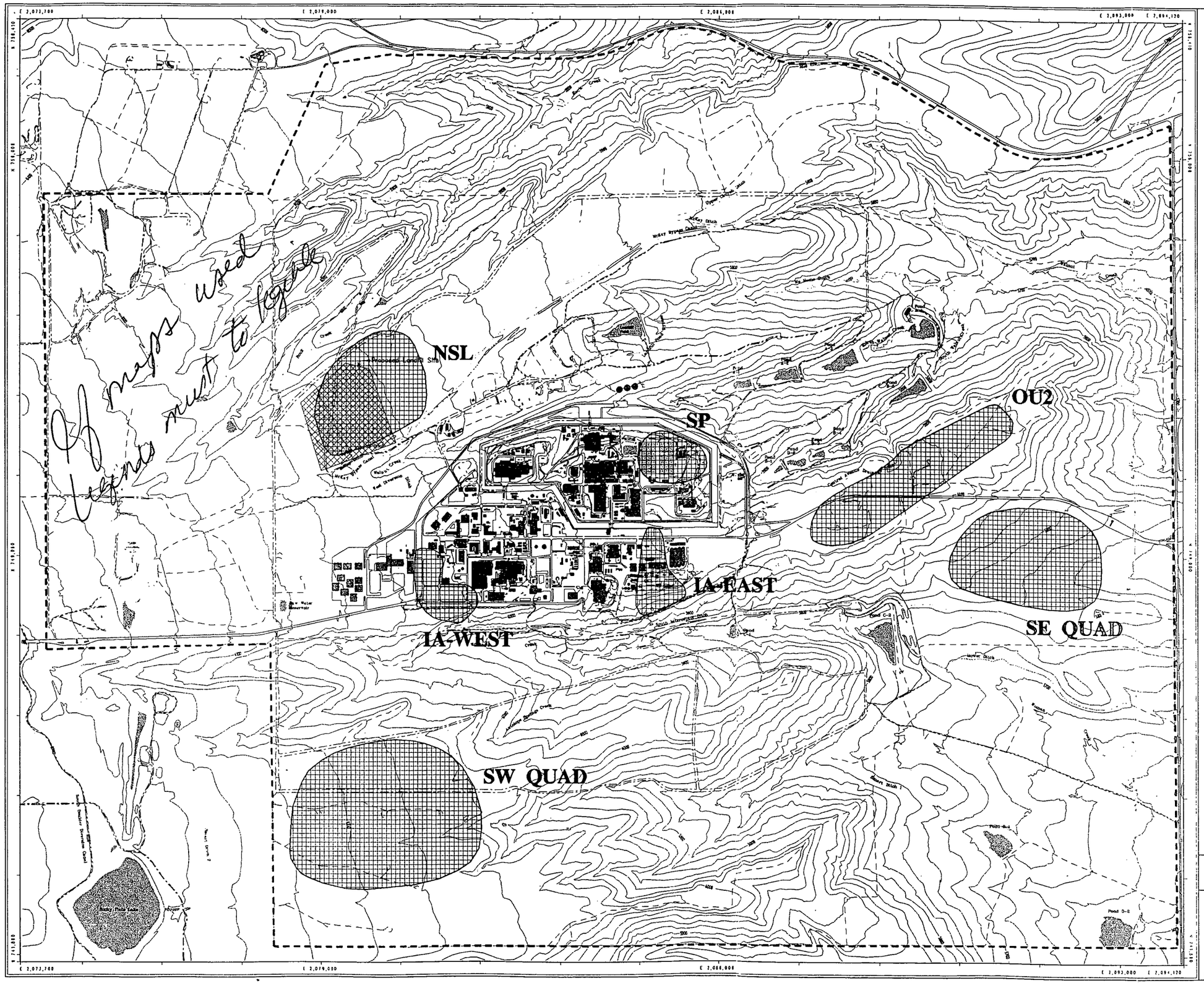

Figure 5-2
Location Map

EXPLANATION

RWSF Site

NSL - New Sanitary Landfill
ESF - East Spray Fields
SP - Solar Ponds plus IHSS 165 and 176

SW QUAD - Southwest Quadrant
SE QUAD - Southeast Quadrant
IA WEST - Industrial Area West
IA EAST - Industrial Area East

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

500 0 1000 2000ft

State Plane Coordinate Projection
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MAP ID: Draft

October 14, 1996

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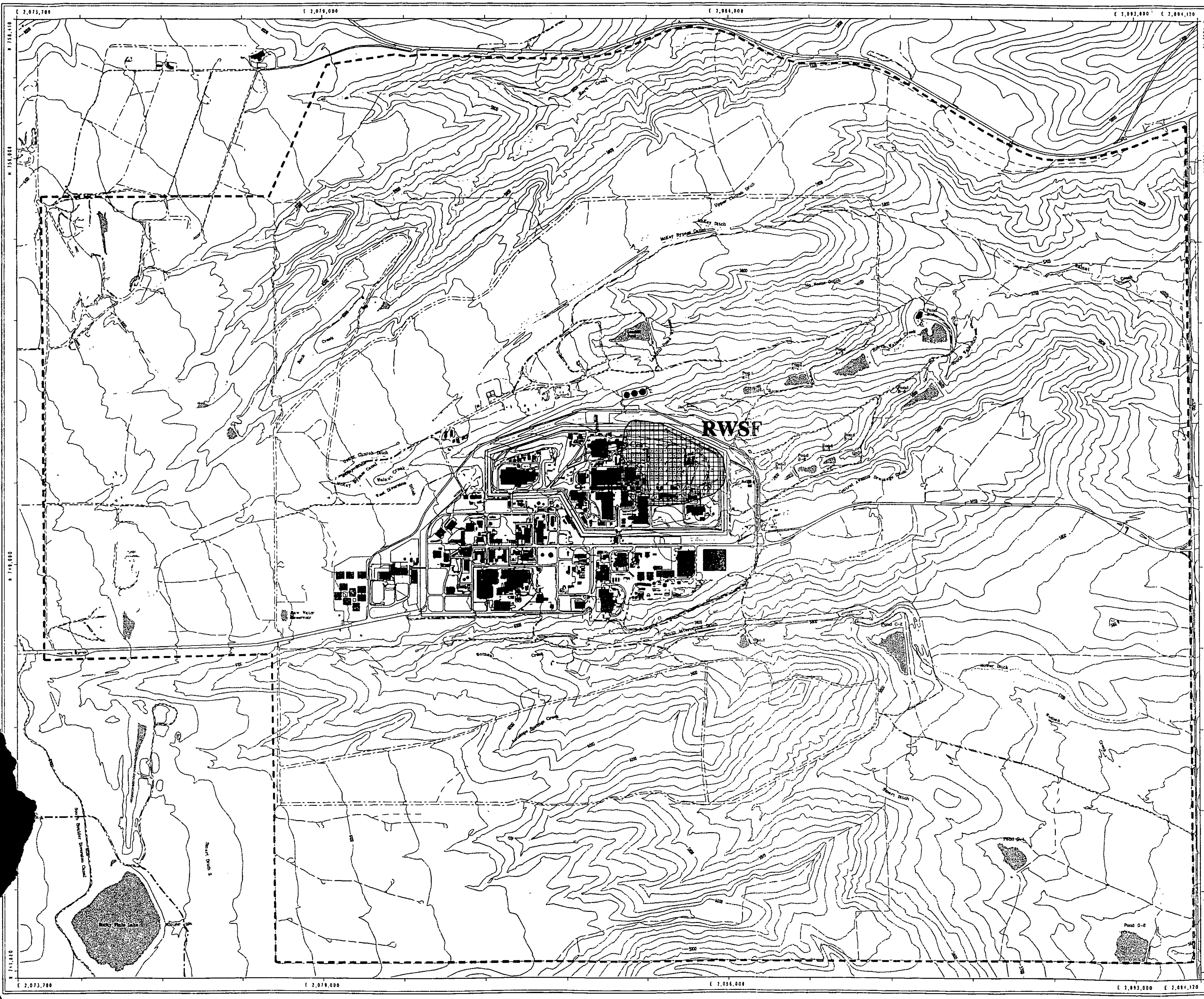

Selected figure 7-1
Site Location Map

EXPLANATION

RWSF Site

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' intervals)
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

500 0 1000 2000ft

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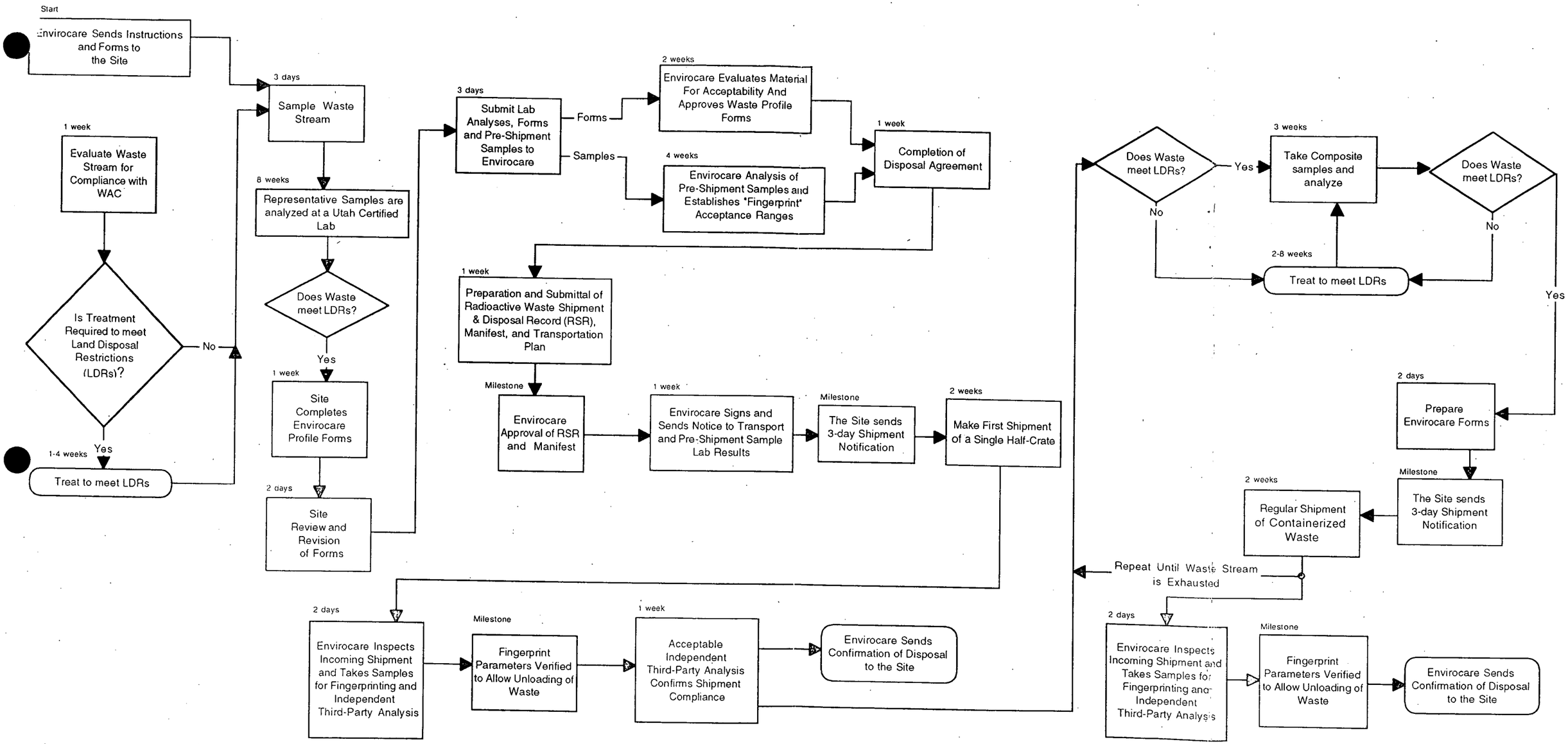

Estimated Time to Make First Shipment of Each Waste Stream: **32 - 48 Weeks**

Estimated Time to make Each Additional Shipment of Each Waste Stream: **9 - 25 Weeks**

Figure B-2

PROCESS FLOW DIAGRAM FOR OFFSITE WASTE DISPOSAL OPTION

856

Figure 3

Geological and Geotechnical Conditions

EXPLANATION

Fault line - dashed where inferred

Slope Categories

- Slope = 15% - 20%
- Slope = 20% - 30%
- Slope > 30%

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Contours (20' Intervals)
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

600 0 1000 2000ft

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Colorado Central Zone
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MAP ID: Draft

August 08, 1996

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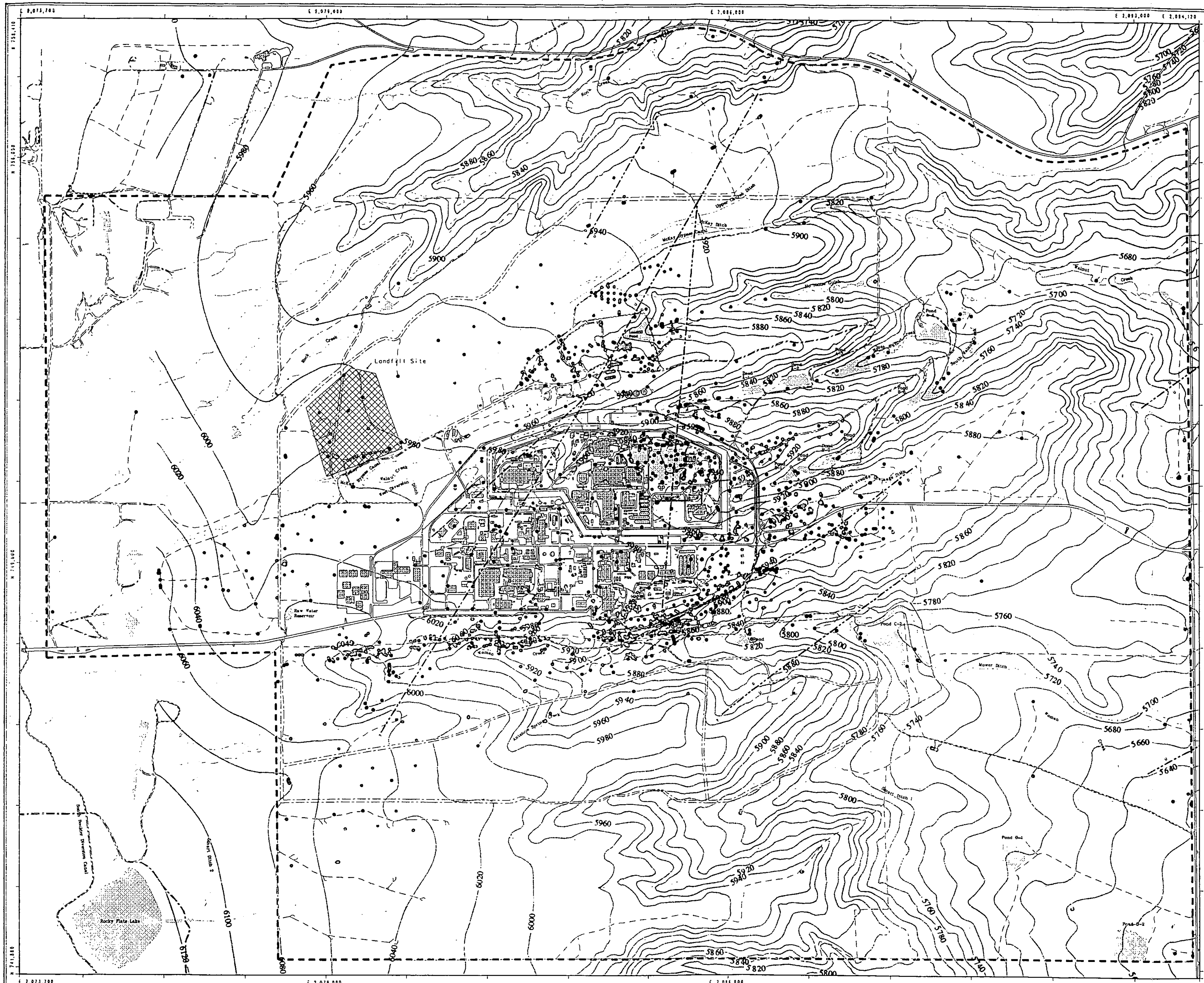

Figure 4
Structure Base of Alluvium

EXPLANATION

- Structure base of alluvium (top of bedrock elevation)
- Fault line - dashed where inferred
- Groundwater wells
- Boreholes

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

500 0 1000 2000ft

State Plane Coordinate Projection
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MAP ID: Draft

August 08, 1996

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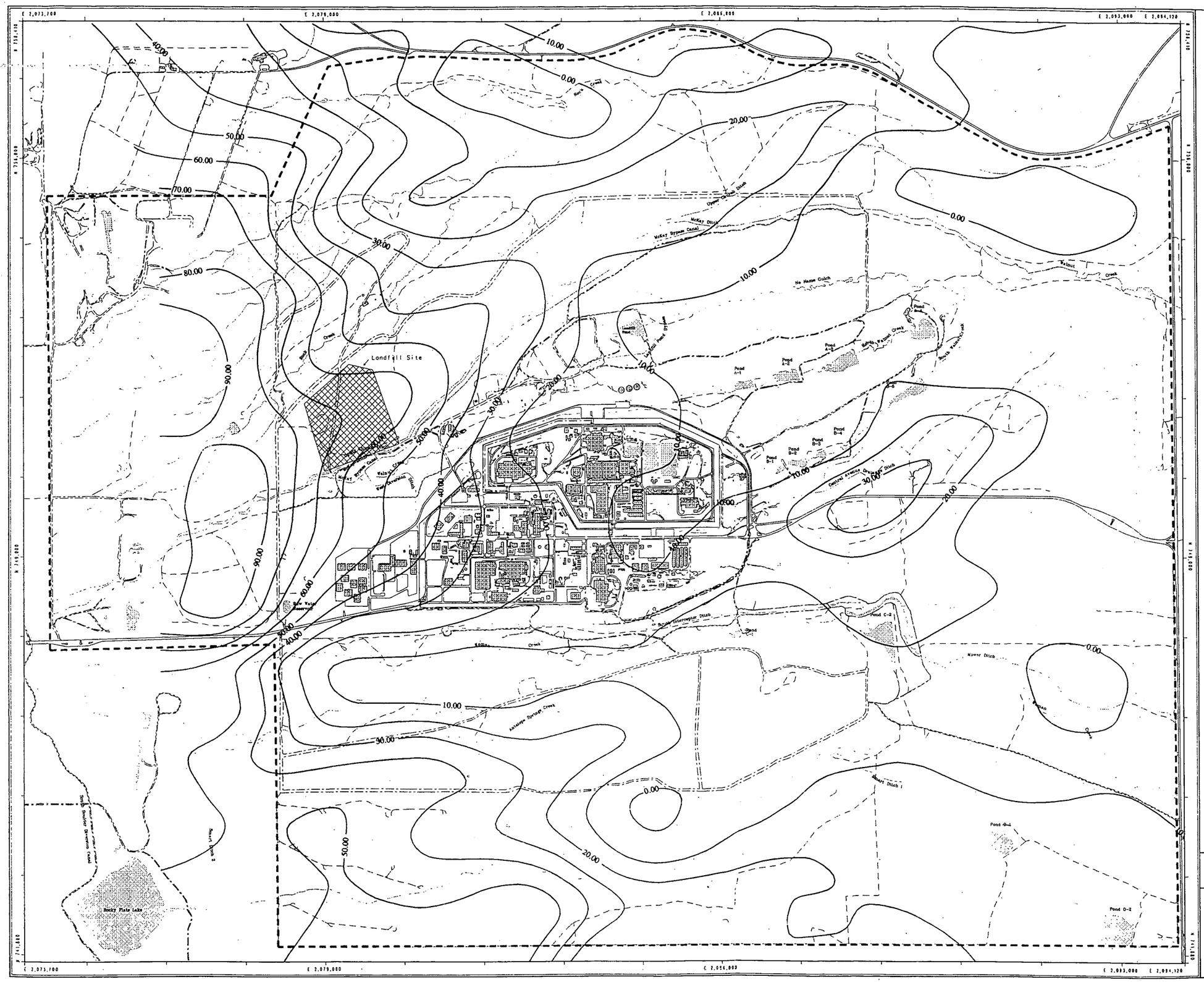

Figure 5
Thickness of Alluvium

EXPLANATION

Thickness of alluvium

Alluvium thickness greater than or equal to 40 Ft.

NOTE:
Potential economic thickness is 40 feet plus

Standard Map Features

Buildings or other structures

Lakes and ponds

Streams, ditches, or other drainage features

Fences

Rocky Flats boundary

Paved roads

Dirt Roads

Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: Draft

August 08, 1996

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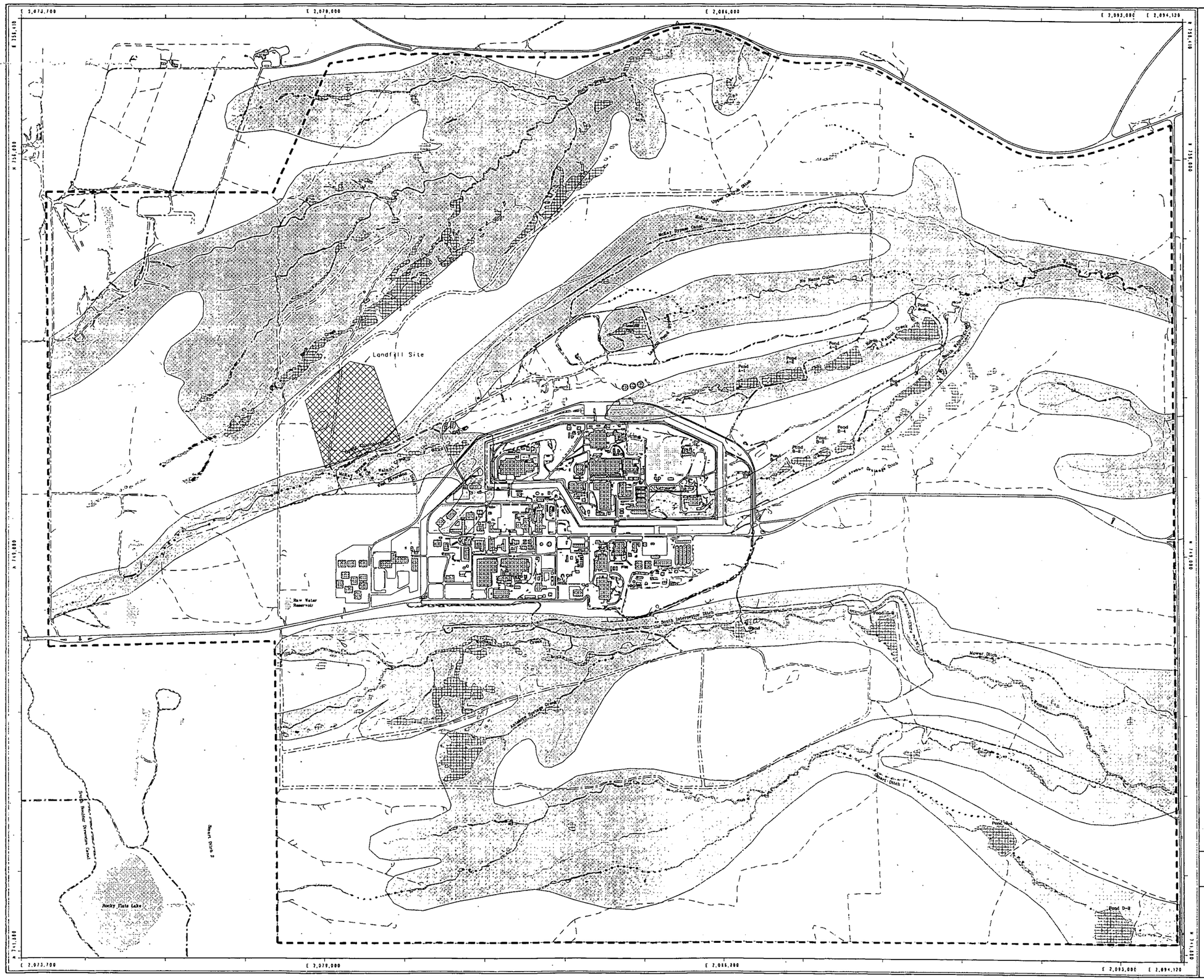

Figure 6

Ecology and NEPA Map

EXPLANATION

Wetland Features

- Wetlands
- Point Wetlands (< 10ft Diameter)
- Linear Wetlands (< 10ft wide)

Preble's Meadow Jumping Mouse

- Probable Range

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
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500 0 1000 2000ft

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Colorado Central Zone
Datum: NAD27

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August 08, 1996

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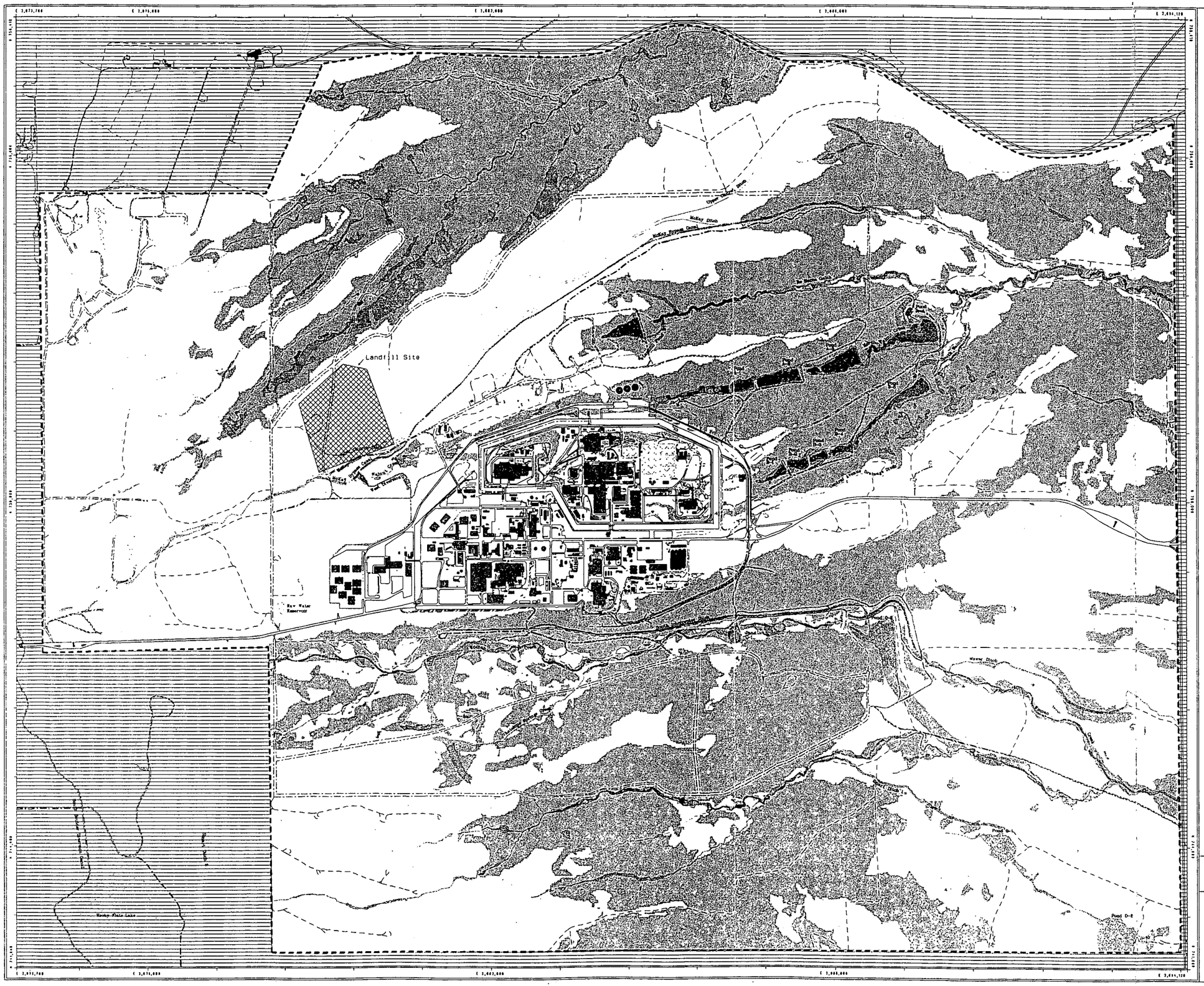

Figure 7
Adverse (for RWSF siting) Conditions Map

EXPLANATION

NOTE:
This map was created using the analytical capabilities of ARC/INFO. Three data layers (coverage's) were combined, representing physical restraining criteria, each given an equal weighting factor: wetlands, 100-year floodplain, and slopes greater than 15%. The surface was color coded based on the number of criteria present.
Point and line wetland features have a 50 foot buffer around them for better visibility.

WMF = Waste Management Facility

- Lands best suited for the placement of a Waste Management Facility, based on criteria stated above
- One criterion present
- Two criteria present
- Three criteria present (least suitable location)

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

Scale = 1 : 19640
1 inch represents approximately 1637 feet

500 0 1000 2000 FT

State Plane Coordinate Projection
Colorado Central Zone
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MAP ID: x7707

October 15, 1996

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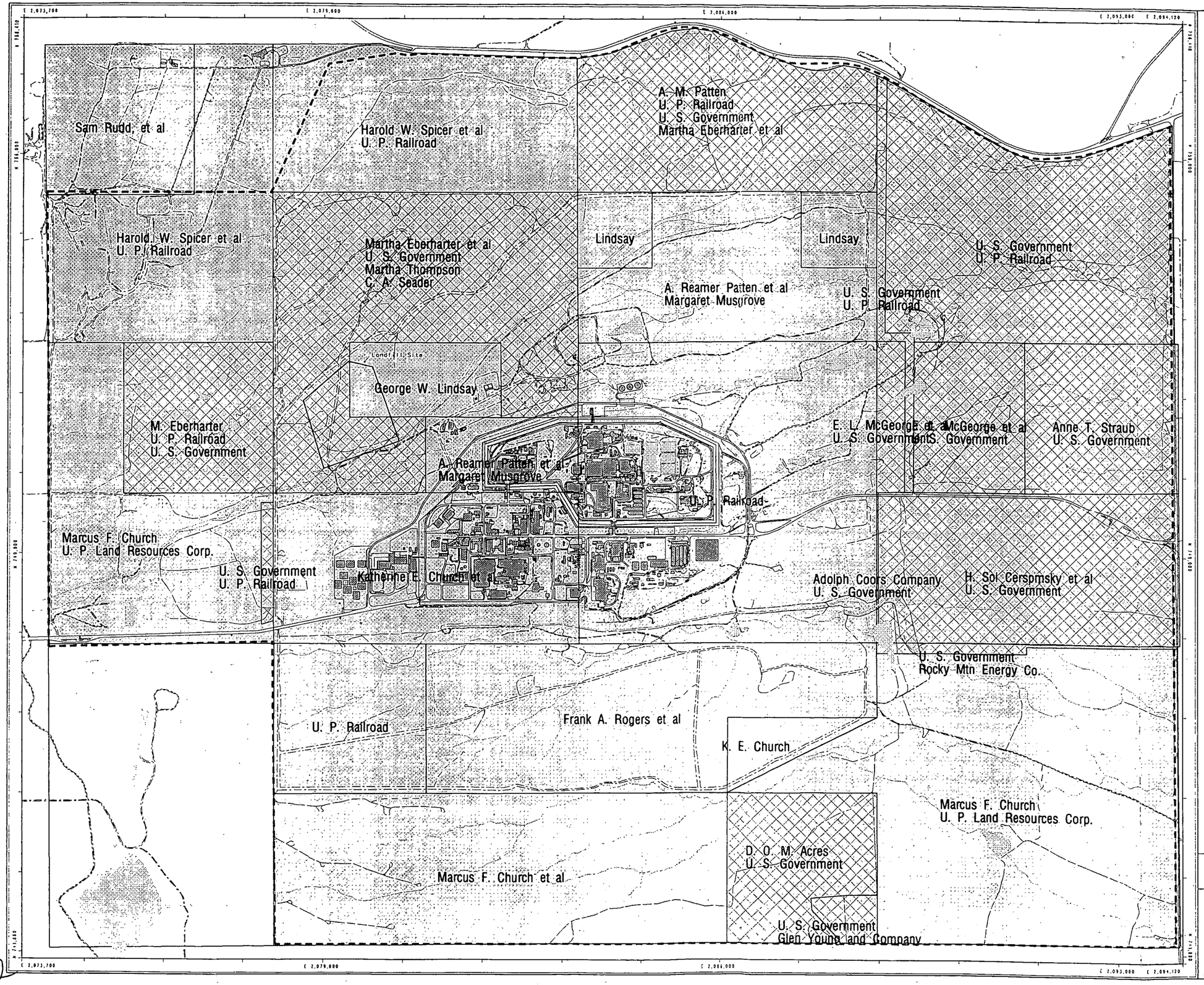

Figure 8
Mineral Ownership Map

EXPLANATION

- Private
- Government
- Both Government and Private

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt Roads
- Trails

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Engr., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - (date unknown)

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MAP ID: Draft

August 14, 1996

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